World Forests XVII

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The Evolution of Global Paper Industry 1800–2050

A Comparative Analysis

Springer

The Evolution of Global Paper Industry 1800–2050

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ISSN 1566-0427 ISSN 1566-0427 (electronic)
ISBN 978-94-007-5430-0 ISBN 978-94-007-5431-7 (eBook)
DOI 10.1007/978-94-007-5431-7
Springer Dordrecht Heidelberg New York London

Library of Congress Control Number: 2012955341

Printed on acid-free paper

Springer is part of Springer Science+Business Media (www.springer.com)

Preface

We began this book almost a decade ago, and now it is completed. First, we gratefully acknowledge the contributions of each individual writer to the scientific content of the book. Second, we thank the Academy of Finland, the Finnish Funding Agency for Technology and Innovation, Forestcluster Ltd, University of Jyväskylä, Aalto University, and numerous other organizations for financial and organizational support. Third, we express our gratitude to the host of research assistants helping us during the process. Aino, Miikka, Mikko, Esa, Lauri and others – thank you! Fourth, we received valuable comments from Peter Murmann, Matti Palo, Jyrki Kettunen, participants of three dedicated workshops, and our colleagues in numerous universities and countries. Fifth, our language editor, Virginia Mattila did magnificent work during the final stage of the process—as did Ville Korkiakangas at the publishing unit of the University of Jyväskylä in typesetting the volume. Finally, we would like to thank Springer *World Forests* series editors Matti Palo and Jussi Uusivuori, and especially Melanie van Overbeek, Ria Kanters, and Valeria Rinaudo from Springer.

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Chapter 1
Research on Evolution and the Global History of Pulp and Paper Industry: An Introduction

Juha-Antti Lamberg, Jari Ojala, Mirva Peltoniemi, and Timo Särkkä

1.1 Industry Life Cycle

This book presents a comprehensive analysis of the birth, growth, maturity, and finally the decline of the mechanized pulp and paper industry from its inception in the early nineteenth century Europe to its current situation and future prospects in developing markets in Southern America and other regions. The underlying assumption in the economic history of industries is the deterministic nature of the industry life cycle. That is, industries are assumed to follow a specific life cycle characterized by stages of nascence, growth, maturity, and decline apparent in firm numbers, production volume, and technological activity. At a high level of abstraction, the evolution of any industry is a function of changes in product market demand, technology, the surrounding institutional environment, and organizational solutions. A new industry emerges as a result of a technological opportunity that encourages the entry of a large number of firms. Discontinuities may appear, such as a change in the competences required for producing the product, a radical change in the physical product,

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J.-A. Lamberg et al. (eds.), *The Evolution of Global Paper Industry 1800–2050: A Comparative Analysis*, World Forests 17, DOI 10.1007/978-94-007-5431-7_1,

or a sharp increase in the price-performance ratio (Ehrnberg 1995). This phase is followed by an era of increased entry and radical innovations, which form alternatives that compete for consumer acceptance (e.g., Abernathy 1978; Agarwal and Bayus 2002). As the winner, that is, the dominant design (e.g., Anderson and Tushman 1990; Murmann and Frenken 2006; Suarez 2004), emerges, a shakeout in firm numbers takes place (e.g., Klepper and Miller 1995; Willard and Cooper 1985). Thereafter, the industry shifts to an era of incremental change and stagnation in firm numbers (e.g., Abernathy 1978; Kim and Pennings 2009; Roy and McEvily 2004).

Overall, the main explanatory mechanism in the industry life-cycle literature is technological change and size advantage in R&D (Klepper 1996). As the dominant design emerges, many firms increase their production volumes to serve the growing market. When the overall production exceeds demand, a shakeout follows. At this point, large firms are at an advantage because they can spread their R&D costs over a larger production volume. The cost spreading effect is especially strong in process R&D. The shift in emphasis from product to process R&D that occurs after the emergence of the dominant design therefore favors the larger firms. The research on firm survival following Klepper's theoretical framework has concentrated on the effects of entry timing (e.g., Agarwal and Bayus 2004; Dowell and Swaminathan 2006), pre-entry experience (e.g., Buenstorf and Klepper 2009; Cattani 2005), and innovation (Cantner et al. 2009; Cefis and Marsili 2006). Such empirical works have demonstrated consistently that early entrants, experienced firms and entrepreneurs, and innovative firms have better chances of survival (see Peltoniemi 2011 for an extensive review). In addition to accumulated competence, early entrants and experienced firms benefit from their larger size compared to recent and inexperienced entrants at the outset of the shakeout.

Evolutionary scholars, on the other hand, have suggested that evolutionary processes (a) are characterized by a large turnover of firms (total number of entries and exits over time) and (b) that this process is needed for the selection of successful firms. This hypothesis has also been verified in a number of empirical contexts (Carroll and Swaminathan 2000; Dobrev et al. 2001). In a similar vein, many scholars assume that the characteristics of the institutional environment are a necessary explanation for the emergence and destruction of industries. For example, research in new political economics (North 1990) perceives institutions as a mechanism that directs investments and activities. In the same spirit, authorities in the national innovation systems literature (e.g., Nelson and Winter 1982; Nelson 1993) have found that the innovation environment (basically regulative system, organization of research and development, etc.) may dramatically affect the distribution of large firms among different countries.

Like any other theoretical model, the industry life-cycle explanation reaches its limits as complexity increases. An important source of complexity in the global economy is the similarities, differences, and interactions between different regions within a particular industry. Even if the abovementioned literatures are combined, we still lack an understanding of two key issues in industry evolution: (a) To what extent are evolutionary explanations geographically and temporally universal, causing similar patterns in different types of countries (cf. Mowery and Nelson 1999), and

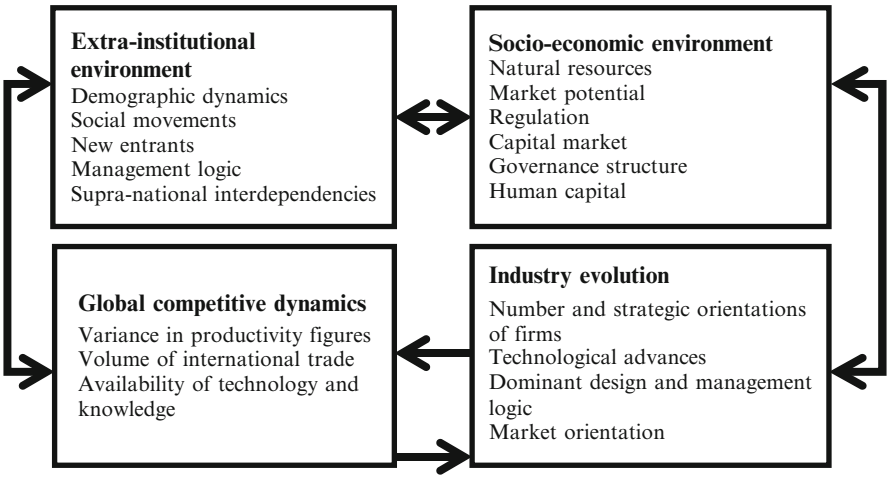

Fig. 1.1 Conceptual framework (Source: Modified from the model in Lewin et al. 1999)

(b) what kinds of causal relationships are there between industrial decline in one geographic region and rise in another (cf. Jarvinen et al. 2009; Murmann 2003)?

Building on earlier work in evolutionary research (Lewin et al. 1999; Murmann 2003), Fig. 1.1 summarizes on an abstract level how the above factors work in a dynamic interrelationship. First, there are *external* factors exerting influence on changes in industry structure, production volume, and technological solutions. The *national socioeconomic* environment plays a role in terms of the availability of raw material and energy, market potential affected by demographics and literacy, regulation and the availability of capital, and educated workforce. The *global competitive dynamics* come into play through international trade, which emerges early in paper products. Moreover, technology is transferred from one region to another, and there is variation in productivity across countries. Finally, the *extra-institutional environment* drives changes at the macrolevel: social movements, such as environmentalism, have far-reaching effects on industry evolution, and the industry-specific management ethos may drive important changes in terms of the attention paid to various competitive arenas, such as innovations, demand characteristics, and technological improvements.

The model embraces three major themes including (1) industry structure and production volume; (2) technology, raw materials, and products/markets; and (3) regulation, government policy, and culture. Focusing on these broad themes enables us to study three theoretically interesting phenomena. First, we are interested in the international interdependencies in industry structure and the rise and fall of national industries. Second, we aim to shed light on the mechanisms of international fluctuations in technological leadership and the tension between raw material availability and distance to market in determining the competitive advantage of nations. Third, we will discuss the degree of determinism of industry evolution and the degrees of freedom that national institutions have in influencing it.

We approach these questions from a historical perspective. That is, this book focuses on industry evolution in specific countries relative to global industry dynamics. Instead of studying several industries, we examine the global pulp and paper industry. Studying the pulp and paper industry in several countries and geographic regions allows us to achieve important goals. First, historical studies on a large number of countries help to identify what is specific in each industrial history relative to the general patterns explicable by existing theoretical knowledge. Second, rich historical studies are needed to identify the set of factors influencing both the rise and fall of industrial populations. Although we have fairly robust knowledge of such factors at a general level, we do not know what factors are needed in specific historical contexts and how they interact. Third, studying different countries with a shared research agenda enables us to study and compare global industry dynamics with an intensity that is not possible in studies relying on single data sources or econometric methods.

1.2 Forest Industry Research

The factors that potentially influence and retrospectively explain forest industry evolution have received a significant amount of scholarly research attention. Table 1.1 lists the most relevant topics in the research segment broadly focused on forest industry evolution. It is important to note that the themes listed below have a universal characteristic in the sense that although research has focused on specific countries, the theme-specific explanations are relevant across national boundaries. Another genre, which we may refer to as country-specific historical studies, has produced an impressive number of publications that deal practically with all the explanations listed but in limited geographic regions. Recent country-specific histories of forest industries include several doctoral dissertations (Bouwens 2004; Melander 1997; Moen 1998; Peterson 2001; Toivanen 2004), other published research (Ainamo 2005; Alajoutsijärvi et al. 2005; Boothman 2000; Iwai 2003; Iwamoto 2003; Kreiser et al. 2006; Lamberg and Laurila 2005; Palo et al. 2001), and international comparisons (Lamberg et al. 2006; Lehtinen et al. 2004; Palo and Lehto 2012; Palo et al. 2001; Sajasalo 2003; Siitonen 2003).

The first conclusion from the literature review is that the field is fragmented: There are a large number of themes in relation to the amount of published research. Second, there are noteworthy differences in the popularity of the categories. Recently, environmental and ethical issues has been the most popular research theme, followed by operations management, strategy and structure, and technology, capabilities, and innovations. Third, the popularity of certain themes varies over the years. For example, operations management (e.g., supply chain modeling) was popular in the 1980s and 1990s but less so in the 2000s. Conversely, environmental and ethical issues have dominated scholarly discussion since the late 1990s, whereas strategy and innovations can be seen more as emergent themes in the most recent discussion.

Table 1.1 Identifiable research streams relevant to forest industry evolution

	Research themes	Description	Representative citations	Popular topic
Global competitive dynamics	Volume and structure of international trade	Overseas investments, developing economies, global competition	Eronen and Simula (1991), Joutsenvirta and Vaara (2009), Laurila and Ropponen (2003), Sajasalo (2003), Siitonen (2003), Waitt (1994)	1990s
	Availability of technology and knowledge	Sourcing, transfer, and absorption of technological knowledge, product innovation, efficiency, technological innovation	Chamberlin and Doutriaux (2010), Das and Alavalapati (2003), Diaz-Balteiro et al. (2006), Stendahl and Roos (2008), Diesen (1998), Hazley (2000), Jonker et al. (2006), Stier and Bengston (1992)	2000s
Industry evolution	Number and strategic orientation of firms	Industry decline, changes in product lines, consolidation, cluster effects, collaboration between industry and society	Arbuthnott et al. (2010), Hienrich (2001), Mei and Sun (2008), Aguilar (2009), Ahola (2006), Christensen and Caves (1997), Jarvinen et al. (2009), Lamberg and Ojala (2006), Melander (1997, 2005, 2006), Ojala et al. (2006), Vihervaara and Kamppinen (2009), Wolf et al. (2007)	1990s and 2000s
	Technological advances	Measuring technological change, modernization, aligning R&D	Berends and Romme (2001), Comstock and Sjolseth (1999), Diesen (1998), Ghosal and Nair-Reichert (2009), Lundmark (2005), Lundmark and Söderholm (2004)	1990s and 2000s
	Dominant design and management logic	Integration, business units, mergers, supply chain management, production strategies, performance	Jantunen et al. (2009), Mei and Sun (2008), Ohanian (1994), Roos et al. (2001), Shadbegian and Gray (2006), Laurila and Lilja (2002), Lehtonen and Holmström (1998), Lilja et al. (1992), Tainio et al. (1989)	1990s and 2000s
	Industry life cycle	Technological and organizational development, institutions	Hansen (2006), Laurila (1997), Reinstaller (2005), Skippari et al. (2005), Stanturf et al. (2003)	2000s

(continued)

Table 1.1 (continued)

	Research themes	Description	Representative citations	Popular topic
Socioeconomic environment	Industrial relations	Job losses, work processes	Freudenburg et al. (1998), Leppanen (2001)	2000s
	Regulation	Government actions, firm reactions to regulation	Baker (2004), Lanoie et al. (1998), Lehtinen et al. (2004), Palo and Lehto (2012)	2000s
Extra-institutional environment	Social movements	Relationship of regulation and technology development, certification, corporate social responsibility, other environmental, and ethical issues	Barla (2007), Molina (2001), Norberg-Bohm and Rossi (1998), Vidal et al. (2010)	2000s
	New entrants	Potential of new technologies, transformation economies	Jokinen et al. (1994, Laestadius (2000), Solberg et al. (2003)	1990s

Reflecting the generic nature of heavy industries, many of the themes would be the same in the context of any manufacturing industry. The automobile industry, for example, has attracted a rather similar set of topics since the late 1960s, partly reflecting the current challenges faced by the industry and partly the tendencies in the general social sciences literature (Vuori and Piik 2010). Moreover, the specific characteristics of the forest industry in procurement and manufacturing have guided the selection of research topics. Therefore, environmental and ethical issues have gained popularity in conjunction with the rising preoccupation with pollution, environmental regulation, and human interest issues. Most recently, research on environmental and ethical issues has focused on developing countries. This relates to the public discussion and criticism of corporate activities in plantation, forest use, and emissions in these countries. Furthermore, the popularity of operations management issues reflects the traditional manufacturing nature of the industry. In this setting, the industry itself is interested in issues and research results with the help of which the efficiency of paper mills, and the entire value chain, could be improved.

Taken together, the literature focusing specifically on the themes relevant to the evolution of the forest industry reflects the problems and interests relative to the scholars who conduct the research, yet also the changing interests of the stakeholders, including firms, governmental agencies, nongovernmental organizations, and media. As a consequence, many topics have been paid academic attention in terms of published research, yet only the stream focusing on environmental and ethical issues may be seen as constituting an internally coherent research field rigorous enough to catalyze increasing numbers of new studies.

From the perspective of industrial history, the pulp and paper industry is an increasingly attractive research context—not only because it represents a maturing industry in the midst of radical changes but also due to the earlier academic work that has not yet resulted in comprehensive understanding of the historical development on a global scale. To name a few such studies, we mention those by D'Aveni and Ilinitch (1992) on diversification in the forest industry context, by Ghosal and Nair-Reichert (2009) on innovation management, and by Lamberg et al. (2006) on competitive dynamics and firm-specific strategic patterns. These works demonstrate the apparent opportunities in studying forest industry with historical comparative lenses. However, the field still lacks a comprehensive comparative account of industry evolution during the era of modern papermaking. This book therefore fills important gaps in our knowledge about the historical development of the pulp and paper industry and its evolution more generally, especially as a collection of rich historical analyses combined with systematic comparative perspective.

1.3 Research Framework

The number of paper industry firms has been decreasing steadily since the 1950s and is presently less than half the number in 1960 (Järvinen et al. 2009; Ojala et al. 2006). There is no particular reason to expect any change in this trend, especially

since the structure of the industry is still fragmented compared to almost any global manufacturing industry. In terms of technological development, the emphasis has been on improving the papermaking process instead of developing product innovations. Ghosal and Nair-Reichert (2009) demonstrate this in their empirical research on innovativeness and technological change in the pulp and paper industry. They conclude that technological development in the industry is different from that in many other industries but not less. More specifically, the papermaking process has achieved significantly higher efficiency in recent decades. Despite such improvements, the financial performance of firms in Europe deteriorated in the late 1990s and in the North American market already in the 1960s (Ahola 2006; Lamberg 2005). The economic logic of this downward trend is the combined effect of increasing process efficiency, decreasing prices, and relative stability in paper consumption. Finally, the environment in which the firms are embedded has changed dramatically. Companies in particular have come a long way from the self-regulated system of cartels and investment quotas (Dick 1982; Guthrie 1946; Kuisma 1993) to the global value architecture in which the characteristics of specific national contexts seem to have a marginalizing effect on their strategies (Järvinen et al. 2012). Taking into consideration the special circumstances of the global paper industry in the early 2010s relative to the fragmentation of the existing research, it is appropriate to pose the research questions summarized in Table 1.2 that serve as guidelines for our a comparative analysis.

1.4 Structure of This Book

This book is divided into 11 case study chapters and a conclusion, addressing respectively the history of the paper industry in 3 Nordic countries (Finland, Sweden, and Norway), the USA, Germany, Canada, Japan, the UK, the Netherlands, Southern Europe (Spain, Portugal, and Italy), Southern America (Chile, Brazil, and Uruguay), and Russia. In Chap. 2, "The Evolution of Pulp and Paper Industries in Finland, Sweden, and Norway, 1800–2005," Joonas Järvinen, Jari Ojala, Anders Melander, and Juha-Antti Lamberg analyze the development of the pulp and paper industry in three Nordic countries (Finland, Sweden, and Norway). The case study reported in this chapter examines the similarities and differences in the evolutionary paths of the Nordic pulp and paper industries. The Nordic countries are very similar in their pulp and paper industries, which is due to cultural similarities and also to factors related to geographical location (proximity to the continental and UK markets), natural resources (abundance of forests and water-power, navigable lakes and rivers), and human resources (abundance of cheap labor in the labor-intensive stage of the industry development). The industry evolution of the Nordic countries can be summarized as follows: late mechanization due to poor standards of living and limited domestic markets in the first part of the nineteenth century, rapid development of the pulp industry based on wood (spruce) in the latter part of the nineteenth century, building up of a heavily export-oriented industry in the interwar period, and vertical

Table 1.2 Research questions

Theme	Country-level research questions	International comparison	Theoretical interests
Industry structure and dominance	How have firm numbers and firm size distribution evolved? How has production volume fluctuated in relation to socioeconomic and institutional change?	What are the relationships of the timing of industry emergence, growth, and shakeout in different countries? What are the drivers of the temporal distribution of production volume globally?	International interdependencies in changes in industry structure The rise and fall of national industries
Technology, raw materials, products	What are the roles of the availability of technology and raw materials, on the one hand, and demand characteristics, on the other hand, in national technological advances?	What are the relationships between technology transfer, technology leadership, raw material dependence, and product variety globally?	International fluctuations in technological leadership The tension between raw material availability and distance to market in determining the competitive advantage of nations
Regulation and government policy	What have been the targets and results of national policy agendas?	What are the effects of policy interventions on industry vitality?	The extent to which industry evolution is deterministic

integration of pulp and paper production and concentration on the production of the more value-added paper grades in the post-Second World War period. In Finland especially, the pulp, paper, and allied trades dominated the whole export-oriented economy until the late twentieth century, which gave to the papermakers' association considerable weight over often highly favorable trade and fiscal political decisions (e.g., devaluation of the national currency and entry into EFTA).

In Chap. 3, "Waves of Technological Innovation: The Evolution of the US Pulp and Paper Industry, 1860–2000," Hannes Toivanen explores how technological innovation applies as an explanatory holistic framework for the United States pulp and paper industry. The chosen case method analyzes the role of technological transformation in shaping the organizational evolution of the United States pulp and paper industry from the late nineteenth century until the late twentieth century. The early waves of innovation included the introduction of the sulfite pulp process that very rapidly transformed the industry in the direction of vertical integration at the close of the nineteenth century. This technological transformation created a vibrant and very rapidly expanding newsprint industry, which was followed by a transition to tariff-protected paper grades after the abolition of tariffs on newsprint in 1913. The emerging mass consumer market and the packaging revolution created

a basis for the corporate strategies of vertical integration, economies of scale, and internalization of research and development in the interwar period. Many large-scale pulp and paper companies diversified their production into specialty products such as sanitary papers. The innovation of machine-coated paper suitable for mass printing technology offers another illustrative example of an interwar technological transformation. The diversification of the industry continued in the 1950s as offset printing, and the food and drink container industries created markets for new paper and board grades. Other significant structural and technological transformations of the North American pulp and paper industry in the twentieth century included the replacement of the sulfite process as the dominant pulping technology by the sulfate process and the improvements in the bleaching of sulfate pulp, which by 1960 triggered fundamental organizational and geographical changes in the industry. The importance of technological innovation peaked by the 1950s, after which the industry growth was triggered by corporate strategies of expansion and diversification.

In Chap. 4, "The Paper Industry in Germany, 1800–2000," Olli Turunen analyzes the evolution of the German pulp and paper industry from the early nineteenth century to 2000. The chapter outlines the highly complex evolution of the German paper industry in its institutional and economic framework. The chosen business history case method illustrates how a country with a large domestic market and high domestic production capacity failed to create a strong domestic pulp and paper industry with prestigious companies and brands as well. Compared to the other traditional pulp- and paper-producing countries, like the Nordic countries, Canada, the United States, or Japan, "the German pulp and paper industry" with a distinctive character did not seem to exist. Rather, Germany is known for its large markets for paper and paper products. At the same time, Germany is a major paper producer in the world. The reason for this paradoxical situation can be found in the turbulent history of Germany. The country evolved from countless states into the German *Reich* in 1871, fought the two World Wars with devastating effects on the country's economy, and was divided for decades into two ideologically disparate states, the Federal Republic of Germany and the German Democratic Republic until the overnight unification in 1990. Due to a turbulent history and the limited relative importance of the paper industry among the larger industries in Germany, the major international paper producers were able to gain a foothold in German markets relatively easily in the 1990s. Today, the German paper industry consists of large multinational companies as well as small niche domestic producers.

In Chap. 5, "An Accomplished History, An Uncertain Future: Canada's Pulp and Paper Industry Since the Early 1800s," Mark Kuhlberg traces the industry's development from the early 1800s until today, focusing in particular on Canada's corporate strategy, industry structure, and the role of the government. In terms of corporate strategy, Canadian producers have relied heavily on the strengths of acquiring the country's natural resource bounty. There were many factors that contributed to this strategy. Importantly, Canada's colonial past left all the country's timber tracts and water powers in the hands of the provincial governments, instead of private control. The industry structure dispersed into two sectors, the preponderant one was shaped by big, initially predominantly American-owned corporations in the newsprint sector,

which sold largely to the US market. The other was driven by relatively small, largely Canadian-owned firms that manufactured other than newsprint grades for the domestic markets. By the end of the Second World War, the Canadian pulp and paper industry had established itself as a dominant player on the world's stage. The growth of the industry was due to Canada's abundant natural resources but also generally favorable tariffs for newsprint in the American market and within the British Empire. The growth of the newsprint sector continued after the Second World War, but Canada's share of the world's total production declined from 60% to roughly 20%. Intensified international competition, the disappearance of favorable tariffs, and the advantages afforded by natural resources as well as decreasing demand for newsprint in the American market are among the most important reasons for the decline of the industry.

In Chap. 6, "From the Non-European Tradition to a Variation on the Japanese Competitiveness Model: The Modern Japanese Paper Industry Since the 1870s," Takafumi Kurosawa and Tomoko Hashino describe the development of the modern Japanese paper industry and the production of Western machine-made paper (*yoshi*) since the 1870s. The modern Japanese paper industry evolution differs markedly from the development of the European paper industry. It has been characterized by rapid growth, low import dependency, and cartelization. The rapid industry growth was caused by a major domestic demand for paper, fueled first by modernization in the late nineteenth century, then the emergence of journalism and publishing in the interwar period, and finally the postwar economic boom. Interestingly, the traditional Japanese paper (*washi*) held onto its market even after the establishment of the *yoshi* paper industry. The distinctive nature of the modern Japanese paper industry is due to the country's isolated geographical location, abundant raw material resources, and large domestic market. These factors have contributed to Japan's high self-sufficiency and low direct foreign investment ratio.

In Chap. 7, "The British Paper Industry, 1800–2000," Timo Särkkä investigates the birth of British mechanical papermaking, its growth to maturity, and decline in importance. The case method illustrates how the nature, the scale, and the distribution of papermaking changed in Britain from 1800 to 2000. The analysis focuses on historical particulars such as technological transformation, raw materials, trade policies, production capacity, and employment. Britain was the first country in the world to pioneer paper manufacturing. In retrospect, it is matter of particular significance to analyze both the reasons for this early impetus but also the consequences of being first in a line of papermaking businesses. In the first part of the nineteenth century, Britain was the world's largest and lowest-cost producer of paper. The reasons for Britain's early success include improvements in papermaking technology together with significant advantages which explain its overall industrial success, such as a supply of cheap and accessible coal, craftsmanship, a stable society, and an efficient transport system. Regarding the British paper industry, the domestic demand is the key to understanding the early British paper industry. Growing population, new patterns of social consciousness, increased literacy, and heightened social awareness are all included in the important reasons underlying the domes tic demand for paper. The First World War revealed Britain's vulnerability in terms of

raw materials supply. Due to changes in raw materials and papermaking technologies, British papermakers lost their technological edge over the major overseas competitors. The removal of the tariff barriers after the Second World War subjected British markets to competition, which explains the British paper industry's rapid decline in global importance.

In Chap. 8, "The Paper and Board Industry in the Netherlands, 1800–2000," Bram Bouwens focuses on the development of the paper and board industry and the corporate strategies in the Netherlands, which was one of the most important centers of hand-made paper manufacture in early modern Europe. The Dutch paper producers retained traditional production methods until the late nineteenth century, after which the industry was quickly industrialized as the utilization of wood as a raw material revolutionized the whole industry. The Dutch business system was highly coordinated during most of the twentieth century. Price fixing, cartel agreements, and the process of concentration through mergers and acquisitions characterized the industry. The post-Second World War years especially were prosperous for the Dutch paper and board producers, but in the mid-1960s, the industry was faced with saturated markets and increased competition from the Nordic producers. The example of the Dutch paper and board industry illustrates vividly how national boundaries quickly lost their significance at the turn of the new millennium. The Dutch paper and board industry became part of international decision-making within a local context. It also reveals the vulnerability of a national paper industry as multinational corporations closed down their production facilities in the Netherlands.

In Chap. 9, "Is there a Southern European Model? Development of the Pulp and Paper Industry in Italy, Spain and Portugal (1800–2010)," Miquel Gutiérrez-Poch analyzes the particulars of the development of the papermaking industry in Spain, Portugal, and Italy. These three Southern European countries have a considerable number of characteristics in common as regards the historical development of their pulp and paper industries. A strong hand-made paper manufacture tradition, late and slow mechanization of the industry, modest domestic supply of fibrous raw materials in the first half of the twentieth century, as well as strong and export-oriented sulfate pulp industry based on eucalyptus fiber in the latter part of the twentieth century (in Spain and Portugal) are among the most important common characteristics of the industry development in the Southern European cases analyzed. The chapter poses an important question as to whether there is indeed a specially defined Southern European evolutionary path with which to analyze, define, and respond to the problems the papermaking industry is facing in the region.

In Chap. 10, "The South American Pulp and Paper Industry: The Cases Brazil, Chile and Uruguay," Maria Barbosa Lima-Toivanen illustrates how the pulp and paper industry in South America, particularly in Brazil, Chile, and Uruguay has evolved from its birth to its present organization. Compared to the mature western paper markets, South America is an emerging economic region, especially in terms of pulp production. In recent years, Brazilian and Chilean pulp and paper producers have invested heavily in technology in order to benefit from natural resource advantages and fast-growing eucalyptus plantations. Today, South American companies

have become global cost leaders in pulp production. The industry in the country cases analyzed is heavily export-oriented and highly concentrated. Operations are facilitated by similarities of culture and language and geographical proximity, but there are also notable differences in industry structure. In Chile, the industry is controlled by large domestic companies, whereas in Brazil and Uruguay, the capital-intensive profile of the industry is attributable to the presence of multinational companies. Increasing pressure on the environment and the impact of investments on local communities have brought the question of corporate social responsibility onto the agenda.

In Chap. 11, "The Pulp and Paper Industry Evolution in Russia: A Road of Many Transitions" Olga Mashkina analyzes the evolution of the development of the pulp and paper industry in Russia. The chapter focuses on changes in firms, industry structure, and changes in regulation and government policies during the era of the Russian Empire, the Soviet era, and the era of transition to a market economy. The Soviet regime inherited from the Czarist era a paper industry consisting of a large number of small, nonintegrated mills. The Soviet economy brought the pulp and paper industry to a new level by building more mills, improving efficiency and technology of the mills, and consequently increasing productivity as well. Despite the huge potential afforded by the abundant supply of domestic raw materials, the pulp and paper industry of the Soviet era was, however, frustrated by low domestic demand, high transportation and energy costs, unclear legislation, structural inefficiency, as well as lack of investments in up-to-date technology. These factors delayed the modernization of the industry, which until recently has been characterized as labor-intensive, an export-oriented strategy and a highly concentrated corporate structure. The era of the market economy has also been characterized by a resumption of the old patterns inherited from the Soviet period despite the rapid change of formal institutions.

In Chap. 12, "Global Demand for Paper Products: 2006–2050," Joonas Järvinen, Juha-Antti Lamberg, Tomi Nokelainen, and Henrikki Tikkanen focus on analyzing the global demand for paper and paper products up to the year 2050. The analysis evolves from a realization that there exists a saturation point after which the increasing wealth of nations and individuals does not increase the consumption of paper. In other words, it is argued that there is a natural limit to how much paper an individual may consume. This simple but important realization leads to a thought-provoking market forecast for paper consumption in ten economic regions (Western and Northern Europe, Southern Europe, Eastern Europe, Northern America, South America, Africa, Eastern Asia, Southeast Asia, Southern Asia, and Western Asia). The analysis is based on the two most reliable variables regarding future developments, namely demographic changes and historical consumption patterns. The analysis concludes that continuing population growth, urbanization, and increase in the wealth of nations are likely to increase the demand for paper and paper products globally. However, the growth is forecast to spread rather unevenly over different economic regions. In the already very mature markets (e.g., Western and Northern Europe and Northern America), paper consumption is expected to grow modestly; in the currently quickly growing markets (e.g., Eastern

Asia, especially China), the growth is likely to slow down, and in the emerging markets (e.g., Southeast Asia and Southern Asia), there is still ample room for growth. These developments may have considerable effects on the global paper industry structure in the near future.

Finally, the concluding chapter by Jari Ojala, Miikka Voutilainen, and Juha-Antti Lamberg combines the theoretical framework presented in the introduction with the empirical findings of the country-specific chapters. Moreover, the concluding chapter includes an analysis of industry life cycles in pulp and paper industries, showing periods of emergence, maturity, and shakeout.

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Chapter 2
The Evolution of Pulp and Paper Industries in Finland, Sweden, and Norway, 1800–2005

Joonas Järvinen, Jari Ojala, Anders Melander, and Juha-Antti Lamberg

2.1 Introduction

In this chapter, we study Finland, Sweden, and Norway as examples of countries with small firm populations without intense domestic competition. This has enabled firms to build certain organizational capabilities while neglecting others. The basic story line in the Nordic paper industry evolution is that a few firms that emerged as industrial populations were (a) built on to exploit abundant resources (timber, water, labor), (b) focused to a large extent on exporting their products, and (c) relied on cooperation between competitors to succeed in competition with the large firms populations of Britain and Germany – the two main markets for Nordic paper industry products.

As we lack a comprehensive comparative account on the evolution of the Nordic paper industries, we start our inquiry by analyzing the historical development of the paper industry in Finland, Sweden, and Norway, thereby excluding Denmark and Iceland (Jorgensen 1964). What follows is a comparative analysis of the antecedents and consequences of the evolution of firms in the context of peripheral competitive dynamics. We focus especially on the reasons why the evolution in the countries

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J.-A. Lamberg et al. (eds.), *The Evolution of Global Paper Industry 1800–2050: A Comparative Analysis*, World Forests 17, DOI 10.1007/978-94-007-5431-7_2,

ultimately differed: despite similarities in institutional and geographic conditions the three countries all represent unique evolutionary paths.

The existing research on the Nordic pulp and paper industry can be divided into two groups. In the first stream of literature, we find extensive historical works attempting an in-depth understanding of the industry evolution in a single Nordic country (Fasting 1967; Melander 1997; Moen 1998; Sajasalo 2003; Kuisma 2006, 2008). In the second stream, we find literature endeavoring to describe and explain national differences (Artto and Juurmaa 1998, 1999, 2001; Moen and Lilja 2001; Peterson 1996, 2001; Ojala et al. 2006; Jarvinen et al. 2009; Lehtinen et al. 2004). Reviewing the latter body of literature, one can only underline the conclusion above that there is little research available presenting systematic comparisons between all the Nordic paper-producing countries. As will be discussed in the following, structural factors such as geography, wood and energy supply, institutional heritage, and general societal development all suggest a great similarity between development paths in the Nordic pulp and paper industries. It is therefore surprising to note that only few of the comparisons presented so far report fairly wide differences in the evolutionary paths between these countries. In the following, the systematic historical review will shed more light on these similarities but also on the differences in industrial development. We will first analytically describe the path of three major Nordic forest industry countries – Finland, Sweden, and Norway. In the discussion, we will compare these countries, and in the concluding section, the aim is to explain the Nordic paths in the context of the global pulp and paper manufacturing industry.

2.2 Evolution of the Finnish Paper Industry

2.2.1 Before the First World War

The history of papermaking in Finland has often been considered to begin in 1667, when the oldest known handmade paper mill started up (Kuisma 2006; Nykänen 2005; Kecskemeti 2008; see also Figs. 2.1 and 2.2). However, during the next 200 years, paper production grew slowly due to the small population and low standard of living, resulting in little demand for paper (Kuisma 2006). By the beginning of the nineteenth century, there were still only five paper mills in the country; all of them are small and producing paper for domestic consumption only. The first modern Fourdrinier type of paper machine started its operation in 1842 in Tampere (Sjunnesson 1997).

The innovations from 1840 onward that enabled the use of wood as a raw material in papermaking were crucial to the growth of the Finnish papermaking industry. The introduction of the sulfite pulp process (in the 1870s) was important particularly for the industry since it used spruce as raw material and finally made it possible to manufacture various paper grades from wood pulp (Kuisma 2006). The beginning of the growth of paper manufacturing was closely related to the developments in pulp manufacture. The growth of the Finnish paper production from the 1870s onward commenced essentially from the paper mills established adjacent to the relatively new

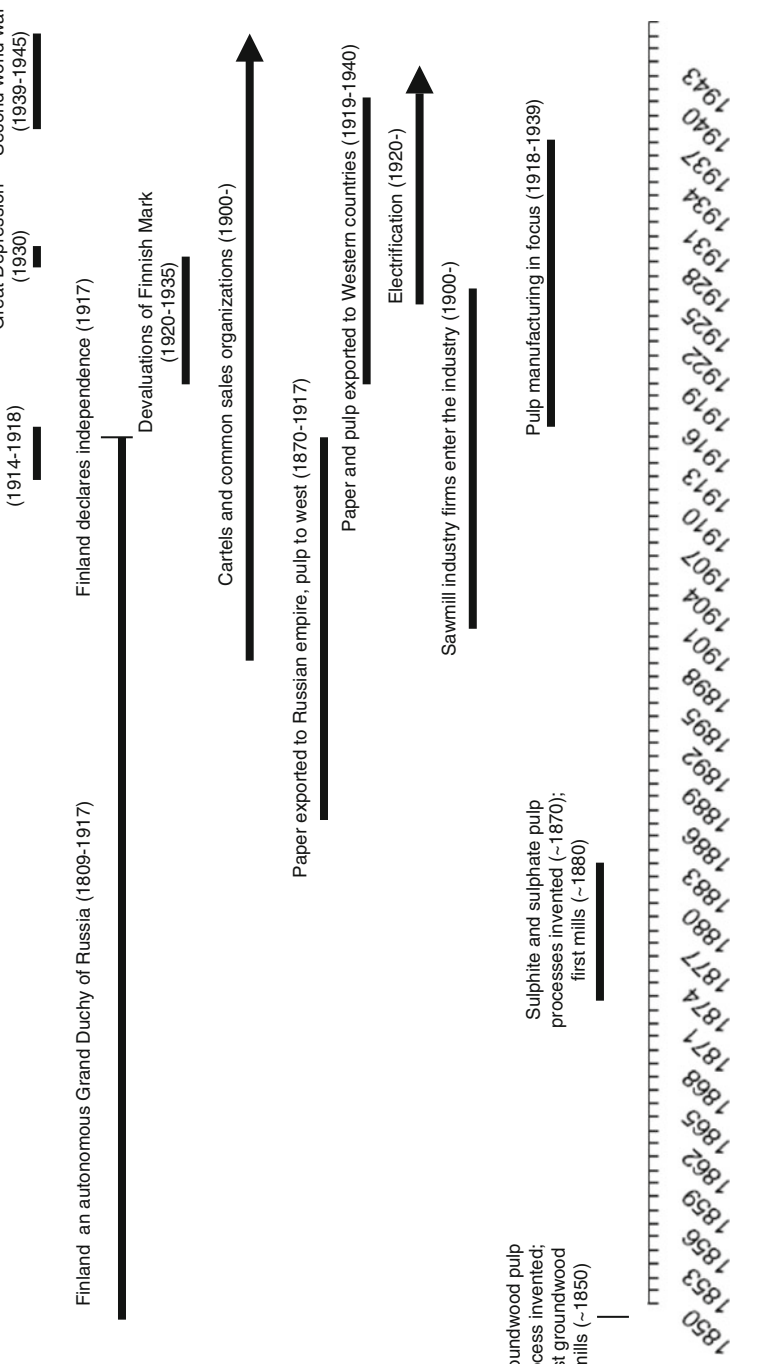

Fig. 2.1 Evolution of the Finnish paper industry 1850–1945

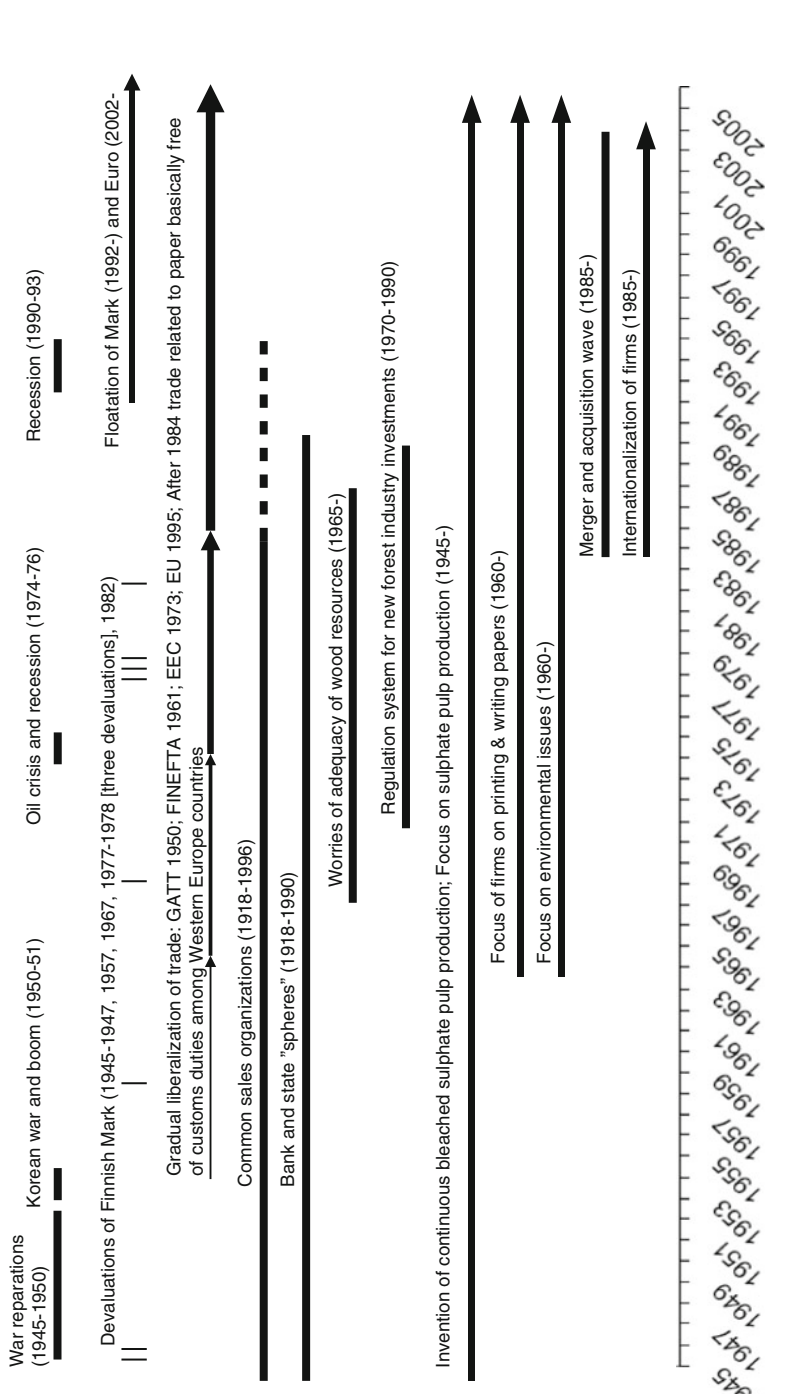

Fig. 2.2 Evolution of the Finnish paper industry 1945–2005

groundwood pulp mills. By 1890, the number of pulp and paper facilities in the country was over 30. The production figures of the industry were still modest in 1890: 13,000 t of paper and 27,000 t of pulp (Ahvenainen 1979; Kuisma 2006).

The period from 1890 to 1913 was an era of considerable growth for the industry, fueled by a boom in the world economy. The role of the imperial Russia of which Finland was an autonomous Grand Duchy 1809–1917 was particularly important for this growth. During the period 1890–1913, paper production increased from 13,000 t in 1890 to almost 170,000 t (Kuisma 2006). The annual production of pulp grew even faster, from 27,000 t to 300,000 t. Although the most common way to enter the industry was by first establishing a ground wood mill and then progressing to chemical pulp and paper production, starting from the beginning of twentieth century, many existing sawmills integrated forward by starting to produce pulp (Ahvenainen 1984, 1992a, b; Häggman 2006; Kuisma 2006). Although, on average, the size of the firms operating in the paper industry was small, a few vertically integrated forest industry firms were among the largest firms in the country (Häggman 2006; Lamberg 2006; Ojala and Lamberg 2006).

The First World War occasioned considerable changes in Finnish industry. The collapse of the imperial Russia and Finnish independence in 1917 caused Finnish industry to lose the important Russian market (Heikkinen 2000; Kuisma 2006). The Finnish Civil War of 1918 further impaired the operating preconditions of the industry, and its output plummeted. Since the Finnish domestic market was far too small to absorb the output of the industry, it was essential to find new markets for the production. A natural export market for the industry was Western Europe (the UK in particular) but also North America (Häggman 2006). Entering the markets was not easy, however, due to the more competitive paper industries in these areas (Heikkinen 2000; Häggman 2006). The factors that enabled Finnish pulp and paper to gain a foothold in the Western markets were cheap resources (wood, labor, and energy in particular), common sales organizations or cartels, and several devaluations of the Finnish *markka* during the period (Häggman 2006).

2.2.2 The Interwar Period and the Second World War

The years from 1920 until the end of 1930s were generally a time of growth for the industry (Ahvenainen 1974; Häggman 2006). Even the Great Depression in the late 1920s and early 1930s did not change the long-term trend of growth. The interwar period was characterized notably by an increase in pulp production, but the growth in paper production was also considerable (from 180,000 t in 1920 to 760,000 t in 1938). Although the firms were still, on average, smaller than their counterparts in Western Europe and North America, Häggman (2006) counts that of the 20 largest industrial firms in Finland in 1927, 14 were forest industry firms – including wood product firms like sawmills.

The Second World War halted the growth of the industry. The beginning of the Winter War at the end of 1939 soon ended pulp and paper exports. The situation with regard to the industry recovered with the end of the Winter War in spring

1940, and export markets opened up in some directions (Aunesluoma 2007). The production figures for the industry for 1940 were considerably lower than for the year before: paper production decreased from 700,000 t to some 300,000 t and pulp production from 1.6 million tons to some 650,000 t. The output of the industry remained at this level for the rest of the wartime. The main export market for the industry during the wartime became Germany, an important political ally of Finland at the time.

2.2.3 From the Second World War to the Early 1970s

The recovery of the industry after the war was slow. During the first years after the peace, in the late 1940s, a large share of the production capacity of the industry was directed to delivering war reparations to the Soviet Union. The Western markets also started to open up. The devaluations of the Finnish *markka* 1945–1947 helped the industry to retain its competitiveness in these markets (Aunesluoma 2007). The common sales organizations were also important in gaining a foothold in the markets (Heikkinen 2000). Almost every Finnish firm was part of these organizations. The UK market soon regained its position as the most important export market of the industry.

The instability of the late 1940s culminated in the Korean War at the end of 1950, resulting in a significant rise in the prices of all commodities, including pulp and paper (Jensen-Eriksen 2007). This was decidedly positive for Finnish industry. In general, the years from the Korean crisis until the first oil crisis of 1973 were characterized by considerable economic growth in Western Europe: on average, the gross domestic product of these countries grew 4.8% annually. The growth figures for paper consumption were even higher, on average 5–6% annually (Jensen-Eriksen 2007). Because Western Europe was also by far the most important market for the Finnish pulp and paper industry, the growth in demand enabled significant growth potential for the industry during 1950s and 1960s. In general, during this period, Finnish industry started to integrate forward in the value chain, from pulp to paper production (Lamberg and Ojala 2006; Peterson 1996, 2001) and from small-scale to large-scale production. The Finnish firms made a number of investments in new large-sized paper machines specifically intended for the production of different types of printing and writing papers (cf. Heikkinen 2000; Jensen-Eriksen 2007).

In addition to the growth in paper consumption in Western European markets, several important trends affected the evolution and growth of the industry during the period. First, the development resulting in the gradual liberalization of trade among European countries firstly enabled Finnish industry to export paper products to Western Europe without too high tariffs (Heikkinen 2000). These included the trade agreements with EFTA in 1961 and the EEC in 1973 (Jensen-Eriksen 2007). The pulp and paper industry was heavily involved in the process of negotiating the agreements.

Second, currency devaluation was a frequently used way to maintain the competitiveness of the industry (Heikkinen 2000; Jensen-Eriksen 2007). Third, during this growth period, pulp and paper firms started to worry about the availability of wood (Jensen-Eriksen 2007; Peterson 2001). As early as in the early 1960s, tree felling in Finland exceeded new growth, and timber prices started to increase. This resulted in regulation and increased silviculture. Also, the central organizations of the forest industry and the Bank of Finland started to self-regulate new investments in the industry. The regulation system continued in force until the end of the 1980s (Jensen-Eriksen 2007). Finally, issues related to environmental protection became important starting from the early 1960s (Jensen-Eriksen 2007). One important factor contributing to this was the Water Law enacted in 1962. In particular, starting from late 1960, pulp and paper firms started to invest in more environment-friendly production technologies (Jensen-Eriksen 2007).

2.2.4 The 1970s and the 1980s

The first oil crisis in 1973 and the ensuing worldwide recession started a more unstable and slower growth period in the world economy, including Western Europe. Despite this, Finnish paper production continued to increase, excluding few years (particularly during the first oil crisis). The growth period continued virtually until the beginning of 1990, when the next economic recession hit Finland and simultaneously the industry.

During the period 1975–1990, the industry concentrated significantly: the number of firms fell from 30 to less than 20 in 1990. The period starting from 1985 has nevertheless often been considered the most active phase of industry concentration in the industry (Moen and Lilja 2001; Näsi et al. 2001); it is evident that many firms disappeared much earlier. However, as the industry still consisted mostly of small and medium-sized firms in the 1970s (Peterson 2001), the acquisitions and mergers in the late 1970s and 1980s were not as visible as the later acquisitions and mergers. In managerial rhetoric, the mergers and acquisitions were considered necessary in order to achieve economies of scale.

With regard to important factors affecting the evolution of the industry during this time period, devaluation of the Finnish currency was still used to increase the competitiveness of the industry. Liberalization of trade continued further; the trade in paper products among Western European countries was essentially free of customs duty at the latest in 1984 (Heikkinen 2000; Kuisma 2008). During this time, the paper sales of the industry were still taken care of by a common sales organization, Finnpap, although the largest Finnish paper industry firm at the time, state-owned Enso-Gutzeit, opted out in 1986. The history of the sales organization continued until 1996 when Finland's EU membership made such associations illegal and the continued concentration development of the industry unnecessary (Heikkinen 2000).

2.2.5 *The 1990s and the Early Twenty-First Century*

The severe recession in Finland in the early 1990s also affected the Finnish pulp and paper industry, although its effect on the production figures was far less dramatic than the effect of the first oil crisis. Additionally, the production figures of the industry started to grow in 1992 after only 1 year of decline in total production. The growth of paper and board production also continued almost until the end of the analysis period, the total production being over 14 million tons in 2006. Despite the growth in total production, the industry continued to concentrate.

Although at the end of 1980s the concentration of the industry had made many of the Finnish firms among the largest in Europe, the concentration process continued at an accelerating pace during the 1990s (Moen and Lilja 2001). The process culminated in 1995 in the merger of the two largest firms, United Paper Mills (UPM) and Kymmene. After this merger, the industry consisted basically of three large firms (also among the top ten largest paper industry firms in the world), UPM, Enso-Gutzeit (which merged with Swedish Stora in 1998), and M-Real and a few smaller firms, such as Ahlström and Myllykoski, which also had large market shares in the segments they focused on.

Finnish industry internationalized considerably after the late 1980s, although the largest pulp and paper firms had international subsidiaries prior to this (Huolman 1992; Sajasalo 2003; Siitonen 2003). Factors contributing to increasing internationalization were the implementation of free trade and the European Community (EC) decision in 1985 to complete the unification of the Common Market by 1992 and Finland's EU membership from 1995 onward. New types of raw materials, a need to achieve economies of scale, and increasing competition in European markets were also behind the development trajectory (Kuisma 2008; Moen and Lilja 2001; Waitt 1994).

In general, the 1990s and the first years of the twenty-first century were an era of considerable growth for the Finnish large firms. Ojala et al. (2006) actually state that the period was the era of strongest growth ever for the Finnish large forest industry firms they analyzed. The firms were not, however, very profitable. As suggested by Ojala et al. (2006), the profitability of the forest industry declined throughout the postwar period (see also, e.g., Artto 1993; Artto and Juurmaa 1998, 1999, 2001).

2.3 Evolution of the Swedish Paper Industry

2.3.1 *Evolution Until the First World War*

The actual beginning of papermaking in Sweden can be traced back to 1612, when a handmade paper mill was established in Uppsala[1] (Rydberg 1990, see also Figs. 2.3 and 2.4). Until the nineteenth century, the number of paper mills remained

[1] Actually the first paper mill was built in 1573. However, the site was in Klippan, at that time a part of Denmark.

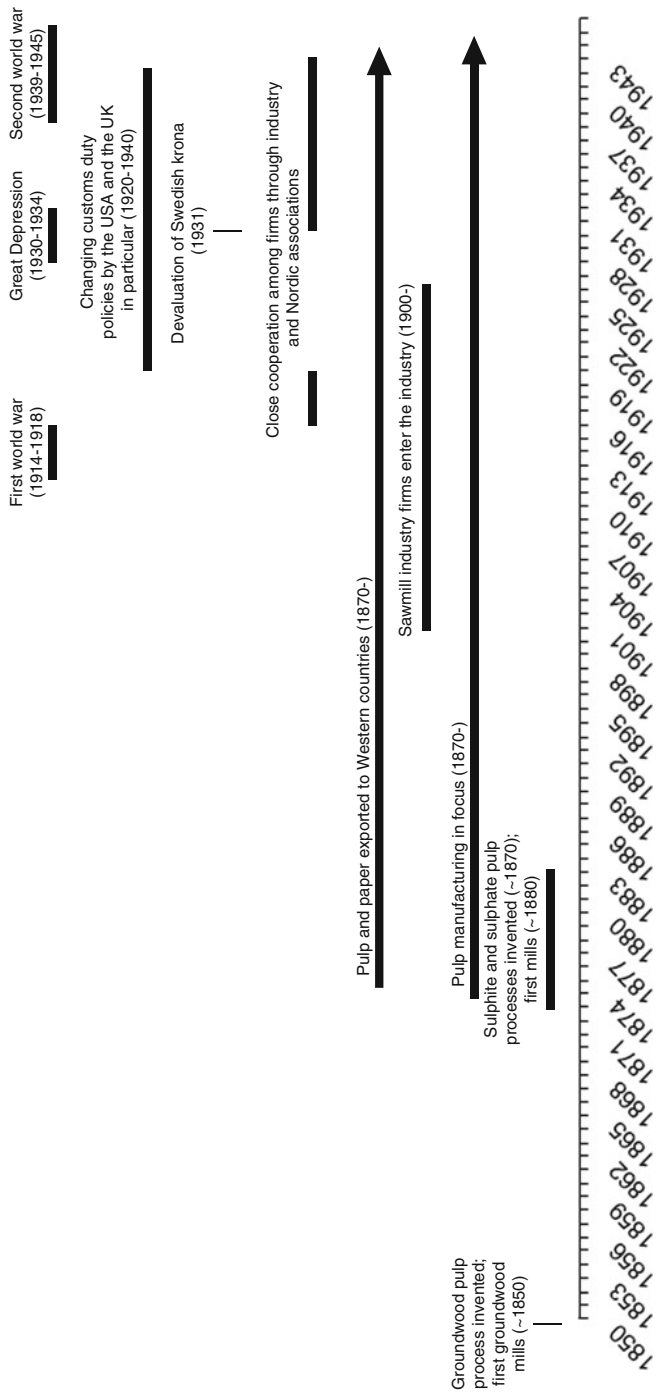

Fig. 2.3 Evolution of the Swedish paper industry 1850–1945

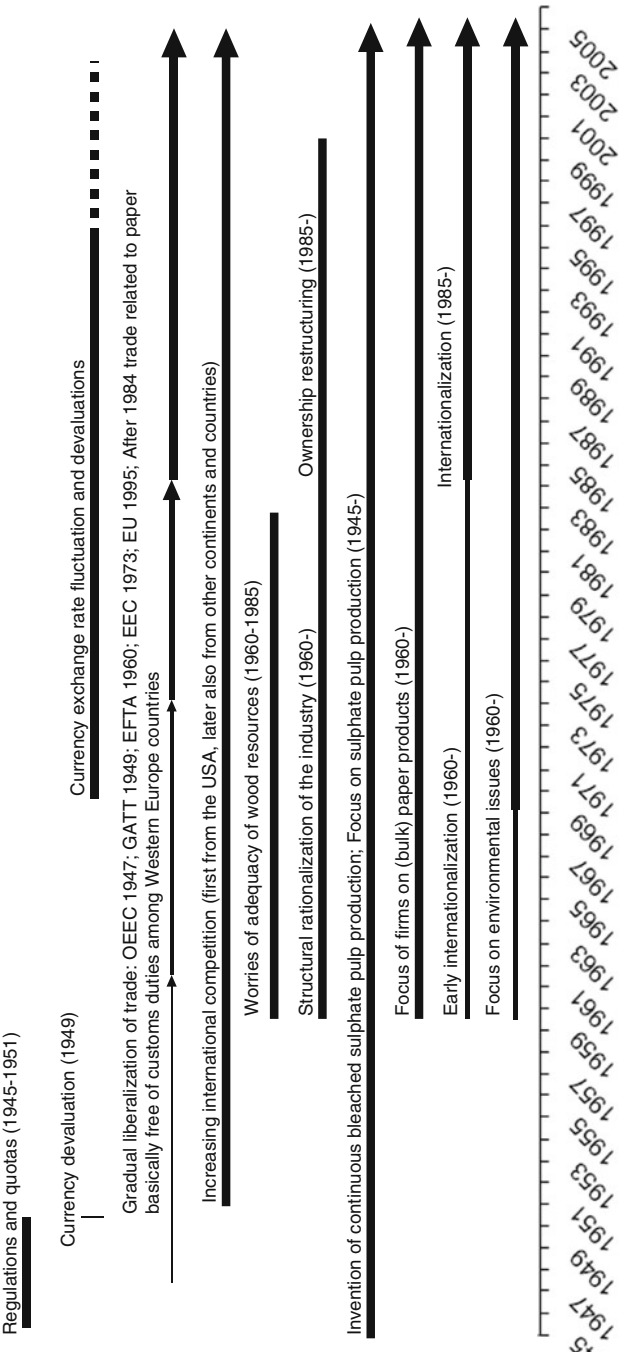

Fig. 2.4 Evolution of the Swedish paper industry 1945–2005

low. Due to the growing demand for paper resulting from a rising standard of living in the country, the number of paper mills started to increase rapidly during the first half of the nineteenth century, reaching a peak with over 80 in 1830. The production of paper was, however, only some 1,300 t (Rydberg 1990). The first modern paper machine was installed in Klippan in 1832 (Sjunnesson 1997), and at the beginning of 1850s, there were seven modern paper machines in operation (Rydberg 1990). Sjunnesson (1997) reports that in 1825 there were a total of 98 major paper mills in the Nordic countries: 10 in Denmark, 5 in Finland, 7 in Norway, and 76 in Sweden. However, these are only the numbers of paper mills that can be found from the sources.

During the second half of the century, the growth of the industry accelerated. The main reason for this was the development related to the use of wood as raw material. From the invention of the groundwood pulp process, Sweden was at the technological forefront of the industry, in particular when it came to wood pulp manufacture. One of the world's first groundwood pulp mills was established in Sweden in 1857 and the first chemical pulp mill in 1872 (Rydberg 1990). Although the technology of pulp manufacturing of wood was still in an experimental stage and the quality of wood pulp was not yet high enough to be used as the only raw material for paper, there were already some 30 pulp mills in the country at the beginning of the 1880s. The first paper mills to use wood pulp as raw material started up in the 1870s (Rydberg 1990). These mills were often founded by already established pulp mills. In 1885, 45 paper machines were installed, of which all but two were imported (Sahlin 1950). Bosaeus (1949) estimates that the annual growth in the period 1870–1900 was 16.7%, and in 1900, a total production of 300,000 t was reached

The period from 1890 until the First World War was the golden age of the Swedish pulp and paper industry. The perfecting of the sulfite and sulfate pulp processes during the 1880s, the changing attitude of papermakers toward wood pulp, the improved quality of wood pulp, and a period of considerable economic growth in Western Europe from the 1890s until the First World War were the main determinants of this considerable growth. Pulp production grew from 100,000 t in 1890 to some 1.2 million tons in 1914, making Sweden the largest exporter of pulp in the world (Rydberg 1990).

It was mainly the production of sulfite pulp that increased during this golden age. New chemical pulp mills were established especially along the northern coastline of Sweden, with abundant spruce resources for manufacturing sulfite pulp (Melander 1997; Rydberg 1990). The new pulp mills (mainly those along the northern coastline) were generally established by sawmill firms. This integration was obvious, at least when taking into consideration that the sulfate pulp process used as its raw material the sawdust produced by the sawmill industry.

Paper production in Sweden increased considerably in 1890–1914, from 40,000 t to almost 300,000 t. Some 50% of the paper was exported, mainly newsprint and kraft paper. As with pulp, the UK was the largest export market. Most of the paper mills and firms were still small in size. In 1920, the average production in a pulp and paper mill was 5,480 t a year (Clemensson 1948). Among the export-oriented mills, Wifstavarf dominated with a capacity of 80,000 t of pulp, and in paper production,

Holmen and Stora Kopparberg had a capacity of 70 and 50,000 t, respectively. Holmen was at that time one of the largest producers of paper in Europe (Clemensson 1948).

2.3.2 From the First World War to the Second

The last years of the First World War and the deflation crisis of 1920 were a difficult time for the paper industry in Sweden. Firms tried to improve their situation by closer cooperation. The associations for pulp and paper producers (already established at the end of the nineteenth century) had a central role in these cooperative activities (Rydberg 1990). For example, during the war, the industry associations founded a joint purchasing organization for raw materials, set minimum price levels for some of the end products, and fought against the export prohibition for newsprint paper, imposed by government in 1917 (Rydberg 1990).

Starting from the mid-1920s until the Second World War, the industry in general grew considerably. The industry and Sweden as a whole were, however, adversely affected by the Great Depression at the beginning of the 1930s. The devaluation of the Swedish *krona* in 1931 was important to help the industry to recover from the recession (Rydberg 1990). In total, between the beginning of 1920 and the Second World War, the pulp production of the industry increased from 1.3 million tons to some 3.5 million tons. This put the Swedish industry among the largest pulp producers in the world. In a same vein, the paper production of the industry increased from some 400,000 t to almost one million tons. Since the industry was export-oriented, the growth in paper demand in export markets was the main determinant behind the growth of the industry. The most important export countries were the USA and the UK. Large quantities of pulp were also exported to Germany and France and paper to France and South America.

The industry was also affected by changing customs duty policies, especially by its most important export countries: the UK, France, and Germany (Rydberg 1990). A result of the duty policies, the Swedish paper industry focused on low-duty products, such as newsprint and kraft paper. In order to respond to the political conditions, cooperation among the firms intensified even more. Industry associations had an important role to play in this cartelization process. Additionally, pulp and paper firms in the Nordic countries (Finland, Sweden, and Norway) established Nordic Scan associations for market cooperation on different types of pulp and paper. These were, in fact, export cartels.

2.3.3 From the Second World War to the Early 1970s

Although Sweden did not actively take part in the Second World War, the industry obviously suffered from it. Due to the collapse in exports, the role of domestic markets

became more important and so also did the production of by-products. The recovery of the industry after the war was rapid, and the industry attained prewar production levels only a few years after the war. The industry was, however, affected by various regulations and quotas. For example, for 1946, the Swedish government regulated export prices and set them lower than the equivalent world market prices. Additionally, a tax on paper products was introduced in 1948. The tax was in effect for 2 years (Rydberg 1990).

The 1950s started with the Korean crisis. In the same year 1950, the Swedish *krona* was devalued by 30%, enhancing the competitiveness of Swedish industry even more. In general, the period from the beginning of 1950s until the first oil crisis (1974) was an era of considerable growth in the pulp and paper industry. Paper production increased from 1.1 to 5.5 million tons in this period. The most important contributing factor to the growth was the growing demand for paper in Western Europe.

During this period, the structure of the industry started to change (see Peterson 1996, 2001). In the 1950s, competitive pressures originated especially in the USA (Melander 1997). First, North American pulp producers began to acquire control of the paper-producing companies in Western Europe and invested in new pulp mill capacity. Second, the American paper mills started to integrate vertically and to an increasing extent purchased their pulp from Canadian producers. Thus, at the same time as customers started to disappear in Western Europe due to US acquisitions, pulp exports from Sweden to the USA decreased (Kuhlberg 2012, in this volume). As a result, Sweden lost to Canada its position as the largest pulp exporter in the world. This trend, combined with the growing anxiety about raw material resources that began in the late 1950s (Melander 2005), led to a change of orientation among Swedish firms. Now the remedy was to go for integrated large-scale production units (Melander 1997; Peterson 1996; Rydberg 1990). As a result, the focus of the industry changed from pulp to paper production (Peterson 1996, 2001).

In addition to the structural change, liberalization of trade had also important effects on the industry (as also in the Finnish industry). Enhanced by the liberalization and in response to the US expansion, Swedish firms already began to internationalize in the 1960s, either by investing in pulp production abroad or acquiring converting firms in Western Europe (Melander 1997). Finally, issues related to the environment became increasingly important during the 1960s. The stricter antipollution legislation enacted in 1969 forced the industry to initiate extensive efforts to reduce pollution, and in the following decades, the industry invested heavily in environmentally friendly technology (Melander 1997).

2.3.4 The 1970s and 1980s

The oil crises during the 1970s and the following economic downturn had a negative effect on the Swedish pulp and paper industry. It took two devaluations of the

Swedish currency, in 1981 and 1982, to change the course of the industry (Melander 1997). For the rest of the 1980s, the industry grew considerably.

The structural change of the industry from small-scale to large-scale and from pulp to the integrated production of pulp and paper continued during the 1970s and 1980s. During the 1980s, the structural rationalization of the industry changed gradually into an "ownership rationalization," in many cases driven by the two dominating owner spheres (Melander 1997). Contributing factors to this development were, first of all, that the North American competitors were now able to compete successfully with Nordic producers in the pulp markets. Second, as Melander (1997) reports, pulp production was deemed vulnerable due to the currency fluctuations (a problem since the 1970s). Third, concerns about the future scarcity of wood resources drove the industry into more value-added products (Melander 1997; Peterson 1996, 2001). In the 1960s and early 1970s, the concerns were mainly focused on forecasted shortages of wood (actually timber harvests surpassed the growth of forests in only 1 year, 1974) (Melander 2005). The focus on problems related to wood supply, however, receded in the second half of the 1980s.[2] One factor contributing to this was the increased use of recycled paper and the internationalization of the industry (Melander 1997).

In addition, the trade agreement between Sweden and the EEC of 1973 resulted in a totally free trade area within the Western European countries in 1984. Further, the announcement in 1985 of the formation of a single market within EEC countries by 1992 contributed to the increasing internationalization of the industry. For example, during 1987 and 1988, Swedish firms acquired 12 firms within the EEC, mainly covering product areas such as tissue, paperboard, and corrugated board (Melander 1997). As a result of these developments, the independent firms in the industry could be divided into three groups at the end of 1980s: the large internationals (Stora, SCA, and Modo), the medium-sized firms, internationally specialized in a few products, and the very small niche firms (Melander 1997).

2.3.5 The 1990s and the Early Twenty-First Century

As in Finland, the growth of the 1980s turned into a recession of the Swedish economy at the beginning of the1990s. It did not, however, have any severe effects on the pulp and paper industry as the demand on export markets did not change much. Overall, the production of the industry continued to increase during the 1990s and early twenty-first century: the total paper production grew from 8.5 million to over 12 million tons. The total number of firms remained at about the same level for the whole period, varying from 36 to 30. Thus, the structure of the industry remained fairly stable. The greatest changes were the disappearance of MoDo as an independent firm and the merger between Stora and the Finnish firm Enso in 1998.

[2] Actually the problem was reversed. In the middle of the 1980s, the oversupply of timber was the major problem publicly debated (Ekonomisk debatt 1985:7).

2.4 Evolution of the Norwegian Paper Industry

2.4.1 Until the First World War

As with the Finnish and Swedish pulp and paper industries, it was the change in the raw material base of papermaking from the mid-1850s onward that contributed to the growth of the pulp and paper industry in Norway (Figs. 2.5 and 2.6). During the first half of the nineteenth century, the number of paper mills was small. For example, in 1825, only five handmade paper mills were in operation in the country, and their production output was low (Fasting 1967). This is natural, given the small population and low standard of living. The first modern paper mill was established in 1838 in Oslo (Fasting 1967), but in the following next decades, the mechanization of the industry was slow.

The first groundwood pulp mill was established in 1863 in Oslo, next to a paper mill (Fasting 1967). At the beginning of 1870s, there were already some 20 groundwood mills, and in 1892, these already numbered 58. The perfecting of the sulfite and sulfate pulp processes in the 1880s was followed by establishing pulp mills. As regards paper mills, there were at least 19 operational paper mills located next to either groundwood or chemical pulp mills in 1892 (Fasting 1967). Pulp production was 113,000 t and paper 19,000 t per year. Much of the production was exported, Britain being the main export market.

From the 1890s to the beginning of the First World War, the growth of the Norwegian paper industry was considerable. Contributing factors to the growth were, first of all, the demand from Western European markets. Additionally, the location of Norway close to Britain in particular offered an advantage to the industry in comparison to Finland and Sweden (Moen 1998). Furthermore, abundantly available hydropower enabled cheap manufacturing of groundwood pulp. The production of pulp already reached 681,000 t in 1913, while paper production reached 207,000 t. As regards both pulp and paper, most of the production was exported. Norway was among the largest pulp exporters in the world at the time (Moen 1998). As such, the role of the Norwegian industry was to be a raw material producer (i.e., pulp) for the British paper industry, in particular (Särkkä 2012, in this volume).

2.4.2 From the First World War to the Second

Norway did not actively participate in the First World War. The output of the industry actually grew during the first years of the war. From the beginning of the 1920s until the outbreak of the Second World War, the industry was characterized by modest growth. The growth was much slower than in Finland or Sweden, and after the Great Depression at the beginning of the 1930s, the growth of the industry was negligible.

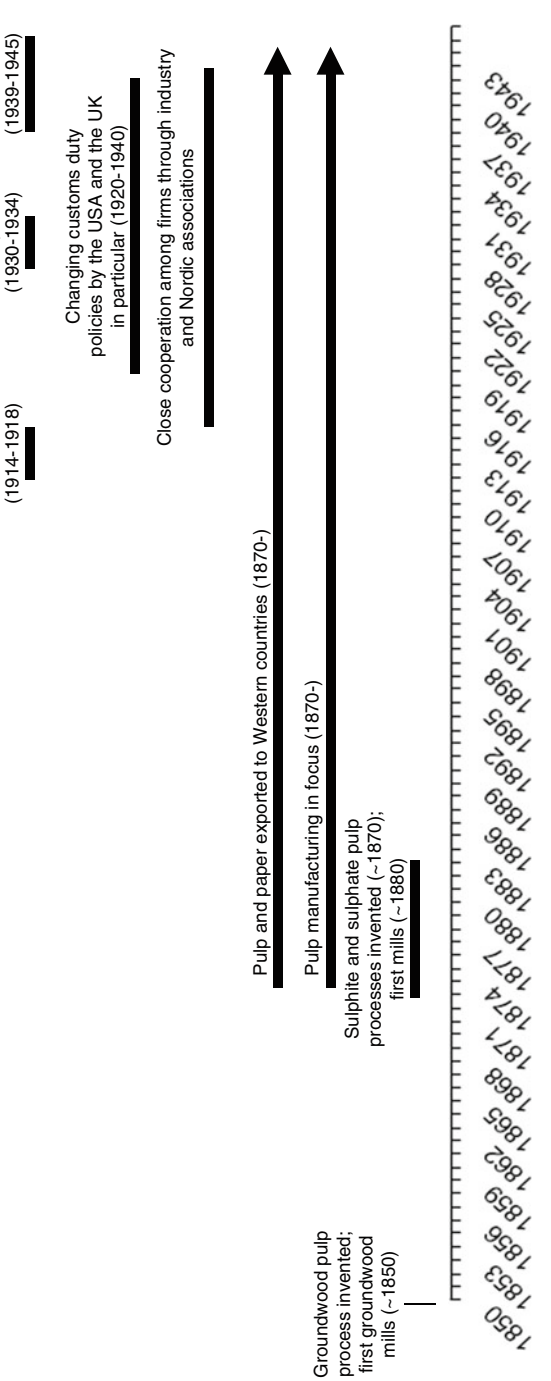

Fig. 2.5 Evolution of the Norwegian paper industry 1850–1945

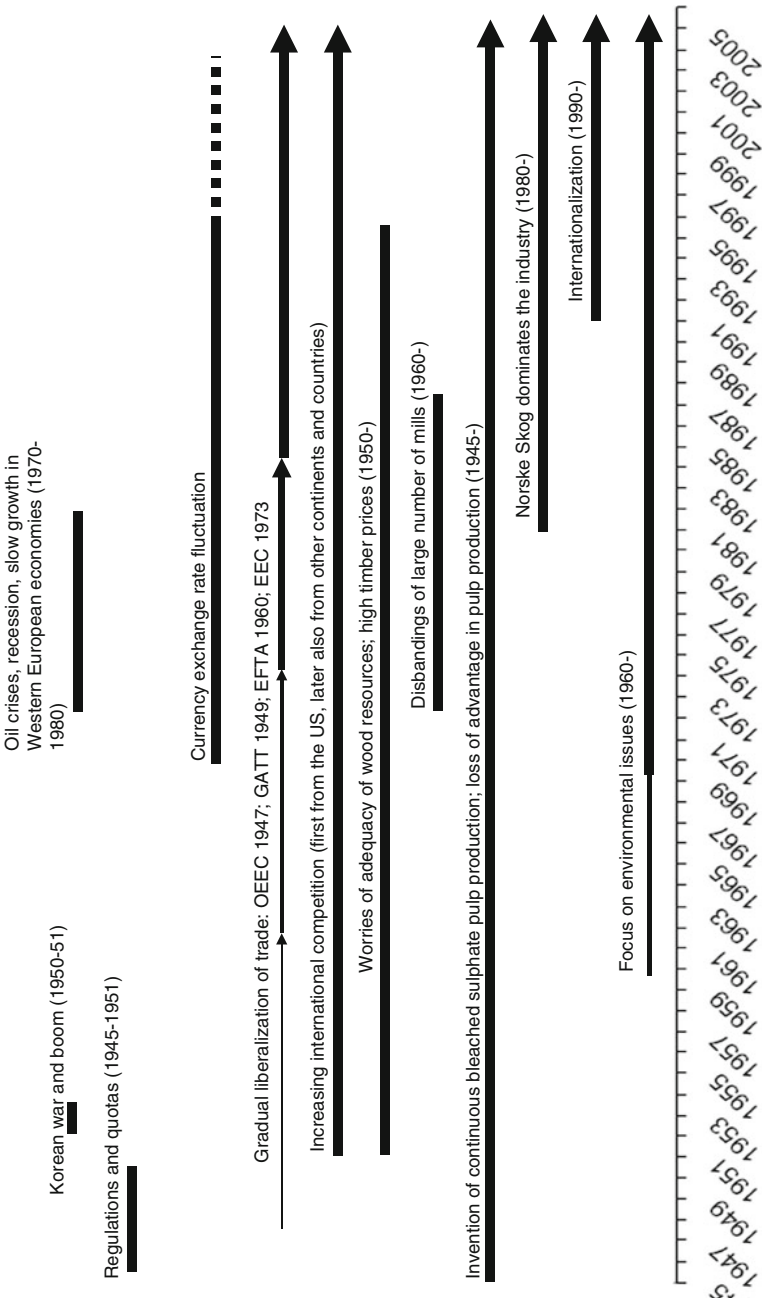

Fig. 2.6 Evolution of the Norwegian paper industry 1945–2005

On average, firms in the industry were small-sized and family-owned. The small-scale production of the industry was fairly obvious, given the focus of the paper side of the industry on manufacturing writing papers. According to Moen (1998), Norway was the largest exporter of writing papers in the world during the interwar period. The industry still ranked among the most important pulp exporters in the world during the interwar period.

As with Finland and Sweden, the industry was negatively affected by changing customs duty policies, especially those of the British government. One important way to respond to the changing market conditions was shared sale organizations or cartels. The Norwegian wood pulp company (Norsk Traemassekompani) was established in 1918 and organized sales for the majority of mechanical pulp manufacturers in the country (as well as a group of Swedish firms). Another joint sales association, Norwegian Newsprint Company, was founded in 1928. The Nordic Scan cartels established from the beginning of 1930s onward were also important for the industry.

2.4.3 From the Second World War to the Early 1970s

The Second World War had a decidedly negative effect on the Norwegian industry. The country was occupied by the Germans in 1940. The output of the industry dropped considerably in 1940 and stayed low during the war. The recovery after the war was fast, despite the regulation at the time. The production of paper reached the prewar level in 1948 (about 500,000 t). For pulp production, it took until the Korean crisis at the beginning of 1950s for the production figures to regain their prewar level.

Despite the considerable economic growth in Western Europe, the growth in the Norwegian paper industry was far more modest than that in Finland and in Sweden. This may be explained, at least partly, by the structure of the Norwegian industry. First, the firms and mills remained small-sized, and many of them were still owned and managed by families. Second, the firms operated mainly in only certain parts of the forest industry value chain (Moen 1998). Thus, vertical integration of the firms toward higher value-added products, which started to take place in the Finnish and Swedish industries during the period, was rare in the Norwegian context. Third, investments in new efficient pulp and paper machines that would have enabled economies of scale were modest when compared to the neighboring Nordic countries. Thus, according to Moen (1998), the competitiveness of the Norwegian paper industry in the Western markets started to lag behind other major paper-producing countries.

In addition to growing competition in the Western markets, several trends and factors affected the evolution of the industry. First, Norway's membership of EFTA enabled the industry to continue to export pulp and paper products to Britain without high customs duties. Second, concerns about the sufficiency of forest resources, but also high timber prices, characterized the industry from the beginning of the period

(Moen 1998). The industry responded to the raw material problem by maintaining a regulatory system: each mill was allotted a quota of timber from certain districts, and price levels of timber were fixed (Moen 1998). The industry also imported cheap wood from Sweden. Third, Moen (1998) reports that the price of electricity in the country was relatively high after the Second World War. After the war, there was even a shortage of electricity in the country, and many pulp and paper firms invested in new hydropower plants at the beginning of 1950s in order to ensure a supply. Finally, issues related to the environment became increasingly important from the 1960s onward. The antipollution legislation enacted in 1971 forced the industry to considerably reduce the amount of emissions (Moen 1998). In particular, this legislation drove most of the sulfite pulp mills out of business from the 1970s onward since the small firms operating the mills did not have the necessary resources to make the investments in cleaner technology. However, the same occurred in other Nordic countries as well.

2.4.4 The 1970s and the 1980s

Pulp production decreased during the 1970s but started to increase again at the beginning of the 1980s. Paper production remained at the same level (about 1.4 million tons) for most of the 1970s and early 1980s. By the turn of the 1990s, production had increased to 1.8 million tons. The period was also detrimental for many of the firms and mills in the industry. Moen (1998) calculated that 65% of the mills were closed during the late 1970s and the 1980s. The number of firms also decreased considerably (in 1974 there were 59 firms, in 2000 17) (Ojala et al. 2012, in this volume).

This decrease in the production figures combined with the mill closures indicates the deterioration of the competitiveness of the industry. The deterioration is also evident given that the positions of the largest companies on the list of the world's largest pulp and paper producers dropped considerably during the period (Moen 1998). Even the Norwegian domestic market was flooded with paper imports from Sweden and Finland. At the end of the 1980s, paper imports accounted for 45% of the paper consumption in the country. One of the main explanations for the decline in the competitiveness of the industry was the small-sized firms and production facilities. These mills did not reach sufficient economies of scale, which became the basis of competition in the extremely competitive Western European markets. The Nordic industries moreover lost their competitive advantage in pulp production due to the introduction of eucalyptus as a raw material. Norwegian firms were also slow to vertically integrate their paper production, and this contributed to the decline of the industry during the period (Lima-Toivanen 2012, in this volume).

Norske Skog, however, was an exception to the rest of the industry. After its establishment in 1962 as a cooperative owned by forest owners, the firm expanded considerably during the 1970s and 1980s by acquisitions and mergers, but also organically. At the end of the 1980s, it was already by far the largest pulp and paper

firm in Norway, controlling about 70% of pulp and paper activities (Moen and Lilja 2001). The rise in the production figures of the industry from the beginning of the 1980s is largely attributable to the growth of this company.

A few other factors contributed to the evolution of the Norwegian paper industry during the period. First, the liberalization of trade in Europe continued. However, in contrast to Finland and Sweden, the trade liberalization may be considered as a negative factor for the Norwegian industry. This is because it further opened the British markets to competition and resulted in the decline of the domestic paper industry in the country; hence, the traditional customers disappeared. Since Norway was an important exporter of groundwood pulp (but also chemical pulp) for the British industry, the decline of the British industry had a negative effect on the pulp production of the Norwegian industry (Särkkä 2012, in this volume). Additionally, the liberalization also opened the Norwegian market to competition. Second, concern about wood scarcity continued to characterize the industry during the period. The price of timber and several other important resources for the industry (electricity and labor) were rather high (Moen 1998).

2.4.5 The 1990s and the Early Twenty-First Century

The period from the beginning of the 1990s to 2005 was characterized by growth in the Norwegian economy. Norske Skog dominated the paper industry. During this period, the firm also became one of the largest pulp and paper firms in Europe (in 1999 the sixth largest, Moen and Lilja 2001). The firm internationalized considerably and was claimed to be the first truly international pulp and paper industry firm in the world.

2.5 Discussion: Comparing the Nordic Countries

When it comes to the pulp and paper industries, the three Nordic countries showed many similarities in their development paths until the 1970s, for example, similar technology and raw materials, together with the same European markets for the Nordic pulp and paper products since the mid-nineteenth century. An interesting question, however, is why there were also considerable differences in the Finnish, the Norwegian, and the Swedish development paths. Next, we present a comparative analysis of macro data on domestic resources, firm production, company structure, and technology development to help to understand the mechanisms causing increasing variation despite largely similar geographical and geopolitical conditions.

The most important resources for the pulp and paper industries from a Nordic perspective can be summarized as forests, energy, technology, and transport. In sum, Nordic forests have been the most important explanatory factor for the rise of pulp and paper industries in these countries since the invention of making paper

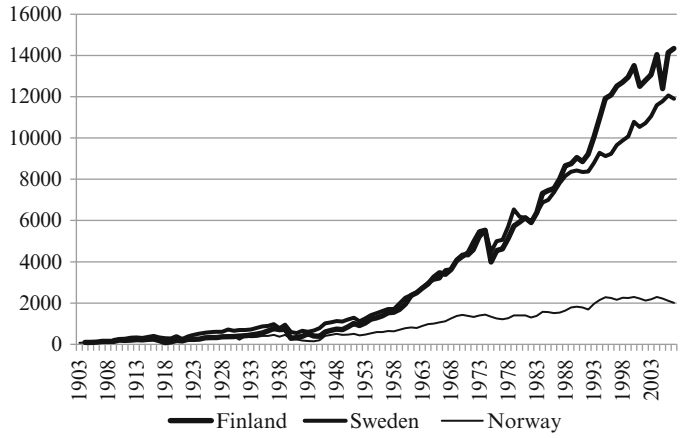

Fig. 2.7 Paper and board production in Finland, Sweden, and Norway, 1904–2007 (1,000 t) (Sources: National statistics in Finland, Sweden, and Norway)

from wood fiber. Energy-dependent production, for its part, has only been possible in the Nordic countries due to the very cheap energy supplies (hydro and later nuclear power). Technological know-how was first transferred from abroad, although some of the early machinery was already domestically built. It was not, however, until the latter part of the twentieth century than the Nordic countries became technology leaders in this branch of industry. Transport capabilities include both the facilities to transport end products to major export markets – as the paper industry in all three countries has been for the past 150 years, being mainly export-oriented. Domestic water routes and roads built to forest areas enabled in Finland and Sweden to make extensive use of their natural resources. Exports were transported with the existing shipping capacity. This led later to specialization in forest industry transports especially in Sweden and Finland (Ojala and Kaukiainen 2012). In the Finnish case, the rail connections to Russia played a vital role before 1918 and after 1945.

2.5.1 Industry Production and Productivity

Before the Second World War and during the second half of the twentieth century, the growth of the Finnish and Swedish industries was exceeded by that of the Norwegian industry (Fig. 2.7). The Finnish and Swedish industries increased their output of paper and board from about one million tons to 14 and 12 million tons in the last century, but the Norwegian industry went from 0.5 million to only a little over two million tons. The figures for pulp production follow the trends in paper and board production – this is natural since, especially after the Second World War, most of the pulp production was integrated with the paper production in all three countries. The growth of the production of the Finnish and Swedish industries is attributable especially to the growth of paper consumption in Western Europe after

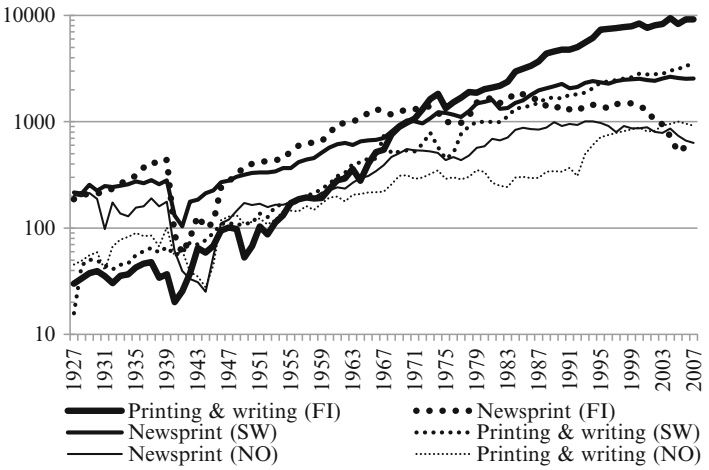

Fig. 2.8 Production of newsprint and printing and writing papers in the Nordic countries 1927–2007 (1,000 t, log. scale) (Sources: National statistics in Finland, Sweden, and Norway)

the Second World War and the resources invested in the industry both at country (e.g., currency devaluations) and firm (e.g., investments in new technology) level. In Norway, in turn, the decline of major export markets together with the rise of new industries (most notably oil industries) changed the focus of economic activities from the traditional forest industries (Moen 1998). Pulp production followed the same pattern as paper production, showing an increase in production Finland and in Sweden from the 1940s, but less in Norway.

The production profiles of the industries differ considerably from each other, however. In the Finnish context, newsprint was by far the most important paper grade until the Second World War (see Fig. 2.8). Particularly after the 1960s, the situation changed, and the focus of the industry changed from newsprint to different types of printing and writing papers. This change in the focus of the industry was related to the views of the industry that due to losing the competitive advantage in pulp production, the best way to respond to the changes in competitive situation was to focus on producing the most value-adding products (i.e., printing and writing papers) (Lamberg and Ojala 2006; Peterson 1996, 2001). As Fig. 2.8 shows, this change from newsprint to printing and writing papers occurred in Sweden in the mid-1980s and in Norway only during the first years of the third millennium. Thus, this early mover advantage in the Finnish case may, at least partly, explain the success of the Finnish paper industries over the neighboring countries. In addition, the concerns about the availability of wood during the 1960s and 1970s contributed to the changes in the focus of the industry. Thus, after the Second World War, the share of printing and writing papers of the total production of the industry increased from 10% to almost 70%. The share of newsprint, by contrast, decreased from 50 to 5%.

The Swedish industry also integrated forward in the value chain from pulp to paper production after the Second World War. Regarding the production portfolio of the industry, the Swedish industry commenced to focus on the production of those

paper grades that the industry participants considered could be produced only in limited volumes in Western Europe, first and foremost kraft paper, corrugated, and newsprint (Peterson 1996, 2001). The share of newsprint of total production remained at approximately 25% during the second half of the twentieth century and the share of packaging materials at almost 50%. Although the amount and share of printing and writing papers also increased during the period, the share of their production remained decidedly lower than in Finland.

Newsprint was the most important paper grade for the Norwegian paper industry for most of the twentieth century. For example, during the 1970s and 1980s, newsprint accounted for almost 60% of the total production of the industry. During the 1990s and the first years of the third millennium, the production of printing and writing papers, however, increased considerably, and the share of the production exceeded the share of newsprint production, as noted above (Fig. 2.8). The share of production of wrapping papers (a segment in packaging materials) decreased slightly during the second half of the twentieth century. In the Norwegian case, it is important to note that from the 1960s onward, most of the production capacity of the industry was owned by Norske Skog. Thus, the increase in the production of newsprint and printing and writing papers during the 1980s, in particular, is largely attributable to the investments of this company alone.

2.5.2 Firm Evolution and Employees

The number of firms in the three Nordic countries has differed considerably. The Swedish industry has clearly had the largest number of firms (almost 180 at maximum), whereas the Finnish industry has always had the smallest number (less than 60 firms at maximum). This means that Finnish companies have on average been larger paper producers than their Nordic counterparts. The Finnish firms during the twentieth century have always been the largest ones, whether in terms of the average amount of paper production per firm or average number of employees. Furthermore, the difference in the average size of the Finnish and Swedish firms has increased in comparison to the Norwegian firms during this century.

When the figure for the average size of the firms is combined with the figures for firm numbers, it is evident that the evolution of the Finnish in particular but also the Swedish industry has been driven by economies of scale in pulp and paper production, particularly after the Second World War. The Norwegian firms, by contrast, have until recently focused on small-scale production and newsprint (especially Norske Skog). This may be one of the main reasons why the Norwegian industry lost its competitiveness and the industry declined during the second half of the twentieth century.

As to the absolute number of employees (Fig. 2.9), the Swedish industry was the largest one until the 1990s – the figure only includes domestic employees, not the personnel abroad in multinational companies. The number of employees in the Swedish industry also increased considerably in the first half of the twentieth

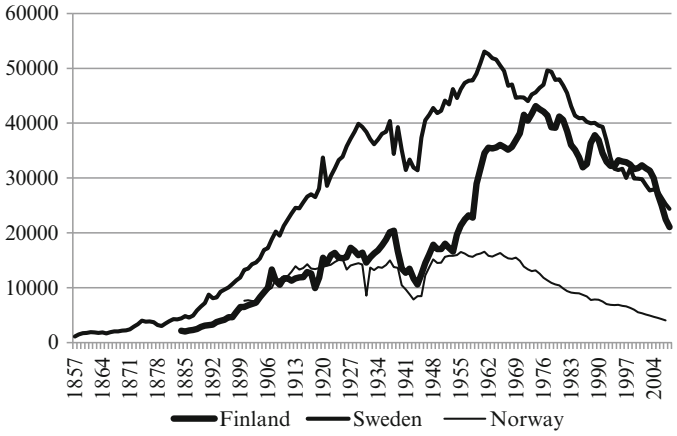

Fig. 2.9 Total number of employees in the Nordic pulp and paper industries (Finland: 1884–2007; Sweden: 1860–2007; Norway: 1900–2007) (Sources: National statistics in Finland, Sweden, and Norway)

century, whereas the growth was much more moderate in the Finnish and Norwegian industries during that period. The growth in the number of employees in the Finnish industry was especially significant after the Second World War, and during the 1960s, the level of employment was already close to the level of the Swedish industry. This growth, however, is more due to the change in the focus of certain Finnish forest industry companies from sawmills to pulp and paper, which appears in the statistics as a leap in the number of employees. Nevertheless, as new capacity was built at the same time, there certainly was a leap in number of employees in the Finnish forest industries at the time. Although the number of employees in the Norwegian industry almost equaled the number of employees in the Finnish industry before the Second World War, the number of employees did not follow the growth that took place in the Finnish industry after the Second World War. Since the 1970s, the number of domestic employees in each industry has declined considerably; as the production figures still grew, this meant an increase in productivity.

2.5.3 Technology Change

Technology change in the paper industry was considerable during the twentieth century, although the focus was on process innovations. Table 2.1 presents the average width of paper machines, which can be used as a proxy for the technological development in the industry in the three Nordic countries during the twentieth century. As the figure and earlier literature show, the Swedish industry was at the technological forefront in the first half of the century. For example, several new technological innovations related to pulp and paper production were introduced in Sweden.

Table 2.1 Width of paper machines (cm) in the companies originating in three Nordic countries

	1910	1938	1950	1974	2000
Finland	634	892	1,112	2,251	6,533
Sweden	721	933	965	1,565	1,988
Norway	412	554	595	884	1,156

Sources: Phillips (1910, 1950, 1971, 1974, 2000)
Note: According to the headquarters of the companies; thus, Finnish figures, for example, in 2000, also include mills abroad owned by Finnish companies

After the Second World War, the average paper machine width in the Finnish industry started to considerably exceed widths in both the Swedish and Norwegian industries. By 2000, the differences between the industries had become considerable: the average machine width in the Finnish industry is three times that of the average machine width in the Swedish industry and almost six times larger than in the Norwegian industry. This growth, however, can be partly explained by the fact that number of Swedish pulp and paper-producing firms were taken over by Finnish firms around the turn of the millennium: as these companies (like Stora and MoDo) had large machines, these machines are considered in the table to belong to the Finnish origin firms. Thus, the figures in the table are really comparable until 1974, but not after that. The development was the result of considerable investments by the Finnish forest cluster in pulp and paper production technology.

The close relations between forest industry firms and machinery builders (Alajoutsijärvi 1996) and the consultancy companies (Ainamo 2003, 2005) are an important determinant in the paths of Nordic forest industries. Even in this respect, there are certain differences, as in Finland consultancy gained even more importance during the latter part of the twentieth century and machine building concentrated to Valmet, later Metso Group.

Productivity growth in the pulp and paper industries has been considerable. As the output per machine and factory has increased as a result of economies of scale and the number of employees has decreased, the rise in productivity is an obvious result. The productivity of the Finnish industry exceeds that of the Swedish and especially the Norwegian industries for most of the period, although the differences are fairly small (Fig. 2.10). This is despite the significant differences in the average size of the machines and firms in the three countries.

2.6 Conclusion: The Nordic Pulp and Paper Industry in the Global Context

The Nordic pulp and paper industry had a comparative advantage in the global pulp and paper industries from the late nineteenth century until the turn of the millennium. What exactly was this comparative advantage, and what makes Nordic players different from their international competitors? Firstly, the 100 year success of the

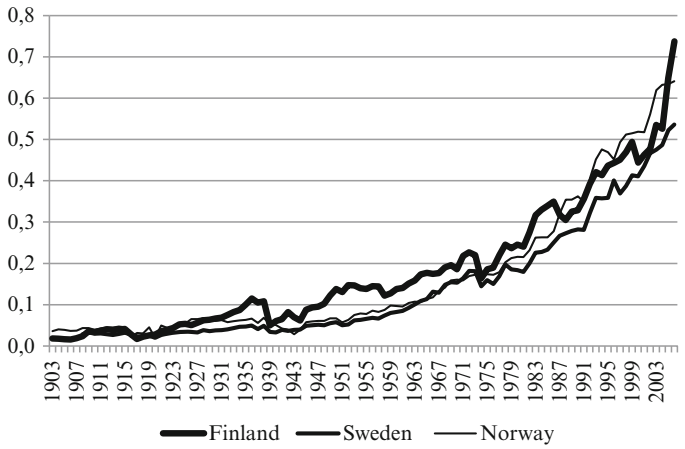

Fig. 2.10 Productivity (total production 1,000 t/number of employees) in the paper industry in Finland, Sweden, and Norway, 1904–2007 (Sources: National statistics in Finland, Sweden, and Norway)

Nordic pulp and paper industry is related to the vast forest areas taken into productive use in this branch of industry. As the domestic markets have been limited, the access to growing markets in Europe has played a vital role in this process. In the late nineteenth and early twentieth centuries, the newsprint market in Britain (especially for Sweden and Norway) and Russia (especially for Finland) were the dominant ones, later came Germany and other European countries. The domestic cooperation in the export sales was typical for Nordic countries, though Nordic sales cartels also existed. The export associations – or rather cartels – were also vital to get reliable market information from abroad. Furthermore, the joint efforts in exports made the competing domestic companies stronger and united in the international markets – and also delayed the concentration process within the industry (Heikkinen 2000). International markets also meant that Nordic forest industries gained vital know-how from abroad; during the late nineteenth century, British and German machine-building companies, for example, were important for the Nordic pulp and paper industries. By the late nineteenth century, the evolution of the Nordic paper industries also made them technology leaders and thus exporters of this know-how.

The structure and size of Nordic companies explain the relative position of Nordic paper industries in global competition. As the focus was mainly on exports, the companies in all three countries were relatively large ones already in the late nineteenth century. Thus, the companies got the advantages of economies of scale, but also of economies of scope as specialization in certain paper products has been a typical phenomenon in the Nordic industries. Sweden and Finland followed a similar trend to develop paper production from newsprint to packaging, to printing and writing, and ultimately to high-quality magazine papers. The paper industry in Norway has partly followed the same pattern, although newsprint remained a

dominant product for much longer – basically due to the strategy of Norske Skog as the largest paper-producing company in Norway. Company ownership in Nordic countries has been partly similar to that in many other paper-producing countries, namely, consisting of both listed and family-owned companies. Nordic peculiarities are first state-owned companies and second cooperatives. Both state- and cooperative-owned companies witness the political and social interest in forest industries in general in these countries. Furthermore, through cooperatives mainly owned by the forest owners, the interest in forest industries has spread to a large proportion of the population in these countries. In the listed companies, there were restrictions on international ownership until the 1990s; the forest industry was even further restricted due to forest ownership (especially in Sweden).

Capital for investments was raised in the Nordic countries in the same way as in many other countries. The vertical integration from sawmills to pulp and later to paper industries also seems typical in Nordic countries (Bjuggren 1985). Foreign direct investments did not play any significant role in any Nordic country in the pulp and paper industries, although throughout history, foreign technology has been transferred a number of times to the Nordic countries. However, the Nordic countries entered as foreign direct investors gradually from the 1920s onward. However, it was not until the 1990s that globalization and multinational companies in the Nordic pulp and paper industries really emerged. In all three countries, companies first sought scale advantages through domestic mergers and restructuring during the 1970s and 1980s, and only after that started to internationalize their production – even though the markets for the products were always outside their national boundaries.

For Finland, forest industries were in general the most important export industry until the early 1990s. Thus, it is no wonder that the forest industry as a whole and the pulp and paper industry in particular played a special role in national politics. In Sweden, too, the pulp and paper industry played an important role in exports, but less so in Norway.

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Chapter 3
Waves of Technological Innovation: The Evolution of the US Pulp and Paper Industry, 1860–2000

Hannes Toivanen

3.1 Introduction

Technological innovation, big and small, has played a critical role in the evolution of the modern United States pulp and paper industry since its origins in the early nineteenth century. New technological knowledge and its implementation, more than anything else, gave entrepreneurs, firms, industries, and whole regions the ability to create or capture new markets, or erect new production hubs, and to forge ahead competitors.[1]

Successive waves of technological innovations in products and processes gave rise to the different branches of the pulp and paper industry and, in combination, brought about the industry's tremendous expansion over two centuries. Following a similar pattern, but differing in scale and span, these waves were set in motion by pioneering technological departures and gained powerful, often global, momentum with business success.

Sometimes new technological skills allowed entrepreneurs to seize or create new markets missed by others. At other times, persevering technological research, development, and learning allowed whole regions to turn long-neglected natural resources into a bonanza. Either way, these aspirations materialized in nascent high-technology industries, attracting investments, talent, and winning national acclaim.

The struggle for survival often provided almost equal impetus to innovation. More than a few times, managers turned to disciplined research and development to combat challenges such as a new political economy, severe economic depression, or

[1] This chapter draws extensively on Toivanen (2004) and sources provided there, unless otherwise quoted.

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J.-A. Lamberg et al. (eds.), *The Evolution of Global Paper Industry 1800–2050: A Comparative Analysis*, World Forests 17, DOI 10.1007/978-94-007-5431-7_3,

the gradual decline of demand for their existing products. In these cases, the industry fended off a death sentence with its capacity for renewal, but rarely produced triumphant and lasting victories.

When moving from nascent to mature industry, the last phases of these waves often followed similar paths. All too often a gold rush followed new promise, and sooner or later, the new industry branch suffered from persistent and ever-growing overcapacity, leaving capital-expensive mills and factories with dwindling profits. Typically the industry responded with a bureaucratic search for production efficiency and industry consolidation, which supplanted technological creativity and entrepreneurship, often already exhausted, as competitive strategies.

The largest waves enveloped powerful relocational dynamics. Several times technological breakthroughs transformed neglected natural resources into valuable industrial raw material, literally turning waste into money. The most important of such events concerned Northern spruce and Southern pine but also touched upon other regions and species. Upon the discovery of a new regional source of pulpwood timber, the industry started migration by building new regional industrial systems and sometimes fundamentally altering the national structure of the industry.

By placing waves of technological innovation at the center of my analysis of the long-term evolution of the US pulp and paper industry since the early nineteenth century, I want to explore how well technological innovation applies as an explanatory and holistic framework for the whole industry. Naturally, several other factors shaped the evolution of US pulp and paper industry, too.

Political economy exercised a powerful influence on the industry. Antitrust, since its invention, has been omnipresent in the industry and shaped nearly every major period of transformation. Tariff questions have often sparked sudden changes of fortunes and always also been at the center of the industry. Before mass broadcasting and the Internet, newsprint also carried political value that often fuelled regulators' interest and motives. Often completely ignored, the patent system and other intellectual property rights have been important, too.

Labor and industrial relations in the industry have been exhaustively investigated in the literature but continue to be poorly integrated in explaining industry's long-term evolution (e.g., Zuboff 1984; Zieger 1984). In the USA, the issue of race deserves attention as a factor especially in the context of the industry's expansion in the South (Minchin 2001). Other important factors poorly analyzed or overlooked here include also environmental regulation, and the list could be continued.

Whereas I focus on specific technologies and waves of innovations that spearheaded industry-wide change, many other technologies shaped the industry as well. The general progress of knowledge and mechanical arts and more specifically chemistry, electrification, the railways, as well as digital and many other technologies have all shaped the industry. Yet these have usually originated outside the industry and have rarely carried critical strategic importance for particular firms or industries. Thus, general-purpose technologies not harnessed by pulp and paper industry leaders as agents of strategic change are not studied in detail here.

Although the above issues matter, and I remain sensitive to some of them, the main focus of my analysis is on the role of new knowledge and technology for the evolution

of the pulp and paper industry. Drawing on a historical analysis of the industry's evolution, I will look at the role of technology and entrepreneurship through Schumpeterian lenses, blending the history of technology, business history, and innovation studies.

In what follows, I will present the evolution of the US pulp and paper industry since its early nineteenth-century origins as a series of successive industrial spurts propelled by technological innovation, notwithstanding its last sequel, starting around the 1980s or 1990s, which is a story of decline and survival.

3.2 The Birth of the Modern Pulp and Paper Industry, 1860–1915

The birth of the modern US pulp and paper industry during the nineteenth century centered on three phenomena: The complete transition from rags to wood as raw material for pulp was embodied in the proliferation of the sulfite pulp process as the main production technology. Secondly, the widespread adoption of vertically integrated mill and company organization introduced superior economies of scale. Thirdly, the adoption of the organizational structure of large-scale enterprise by industry leaders afforded them a sophisticated bureaucratic control of all aspects of papermaking from forestry to marketing to critical technological knowledge and beyond.

Certainly many other factors also played a role. The improvements in the paper machine and other equipment were significant, and so were many other factors. But none of these amounted to anything with as much potential as wood pulp technologies, vertical integration, and the organizational structure of large-scale enterprise.

3.2.1 The Departure from Rag

The transition from rags to wood fiber during the last half of the nineteenth century marked the beginnings of the modern pulp and paper industry. The relinquishing of rag-based pulp occurred in overlapping phases and was shaped by broad social and economic forces of the US society. Population growth, and institutional change that included urbanization, increased education, as well as the impact of the Civil War, engendered an increased demand for paper that precipitated the discovery of new sources of cellulose.

Since the 1850s, the supply of rags used for pulp had steadily failed to meet the increasing demand, and eventually, in the aftermath of the Civil War, the shortage culminated in the "American Paper Panic." The shortage of Southern cotton rag and the burgeoning demand for newspapers prompted the opening of the two first groundwood mills in the United States. The groundwood pulping process consists of placing pieces of wood under pressure against a grindstone with a water source to take the fibers away to make the pulp for paper (Smith 1970, pp. 132–133).

The revolutionary groundwood technology was put under careful patent protection by its inventors, who also licensed and commercialized it. The patent holders of the early pioneering wood-grinding machine made modest attempts to license and commercialize the invention, but the technology did not live up to the huge expectations in the 1860s USA. The early commercial success of groundwood pulp technology in the USA was limited because it produced mainly poor-quality paper and, more importantly, because the difficulty and cost of separating the pulp from the water frustrated attempts to scale up production (Smith 1970).

These pioneering attempts harnessed technology to secure fiber supply and improve profitability when producing newsprint. Customers, that is, newspapers, responded by changing increasingly to newsprint made from groundwood pulp. Entry into the groundwood pulp and paper industry was facilitated significantly in 1884, when the expiry of the critical patent made the groundwood pulping process freely available (Hunter 1947, pp. 376–380; Magee 1997, pp. 179–180; McGaw 1987, pp. 195–198; Smith 1964, 1970, pp. 128–139, 138–139).

In the absence of significant improvements, the technology became freely available in principle. In practice, however, specialized machinery suppliers controlled and perfected the grinding, washing, beating, and screening technologies required for the mass production of groundwood pulp. The late nineteenth-century paper firms rarely developed organizational capabilities in machinery but rather chose to rely on specialized shops. They and the relative simplicity and technological maturity of groundwood pulping made it a reliable process and thus a viable investment for many paper firms. A critical problem persisted, however, as the quality of groundwood left much to desire, and its main marketing advantage was availability rather than quality (McGaw 1987, pp. 108–116, 158–173).

3.2.2 Sulfite Pulp

Booming prices and demand for newsprint, as well as a worsening shortage of cotton rags, fueled and intensified the search for improved wood pulp technologies in the mid-nineteenth-century USA. Different wood pulping processes developed at the time had definitive technological requisites that determined their economic application and the geographical location of the industry. The mechanical grinding of wood into groundwood pulp took place under pressure, was very power intensive, and consumed a tremendous amount of timber. The sulfite process was a chemical, acid cooking process that consumed non-resinous wood in even larger quantities than the groundwood pulp process but required relatively little energy. The demand for cheap power and a large supply of non-resinous wood, such as spruce, directed these processes toward the Northeast USA where hydropower and forests were ample in the vicinity of major markets.

The development of sulfite pulp marked a leap forward in the quality of wood pulp papers and thus completed the transition from rag pulp. Moreover, improvements and changes brought about by the introduction of the sulfite pulp process fueled the

surge of the whole paper industry, as it proved capable of catering to the needs of a rapidly expanding newsprint industry and other markets.

A mix of groundwood and sulfite pulp resulted in a strong white paper instead of the yellow and weak groundwood paper. The increased hardness of the groundwood-sulfite paper also made it a superior alternative for the demands of newspaper printing. Emphasis on this mass product market set the course for the subsequent developments of the technology. Besides improving the qualities of paper, sulfite pulp induced economies of scale and speed. The right mix of groundwood and sulfite pulp formed such a strong web on the paper-forming felt of the paper machine that it enabled the transition to more efficient and larger papermaking machinery. Thus, sulfite pulp was the critical complementary technology to groundwood pulp, new power intensive techniques of wood grinding, and the faster and larger papermaking machinery that are traditionally proscribed as the causes of the structural change in the North American pulp and paper industry between 1880 and 1920 (Cohen 1984; Magee 1997).

Following in many ways the development path of the groundwood pulp process, the sulfite pulping process was barely at an experimental stage in the late 1860s, and the need for further improvement placed it squarely under tight patent monopolies over the next four decades. The hope of a breakthrough in sulfite technology fueled the efforts of a few experimenters whose work was widely circulated in the industry. Europeans especially engaged with the new technology. The specialist community recognized the interior lining of the sulfite digester as the critical problem they must solve in order to stabilize the process and decrease the cooking time. The potential economic bonanza gave rise to a feverish international patent race and effort to build working applications (Hunter 1947, pp. 390–393).

Although it was mostly Europeans who advanced the sulfite technology, the vast spruce stands of the Northeast USA and Canada, as well as the metropolitan US newspaper markets, directed entrepreneurs' attention there. Such market opportunity attracted entrepreneurs. One of them, William A. Russell, a member of an established pulp and paper family of entrepreneurs from Lawrence, Massachusetts, imported the latest know-how on sulfite cooking to the USA in 1887. He aspired to gain control of the rapidly expanding industry by establishing a virtual monopoly of the sulfite process in the USA. He succeeded in developing a mass production sulfite pulp and newsprint process, but his patent monopoly dreams collapsed during a prolonged legal battle and because of rampant imitation. Quickly the new technology put the industry into a fundamental transition.

3.2.3 Newsprint: Vertical Integration and the Rise of the Large-Scale Enterprise

The competitive advantage of sulfite pulp and newsprint technology prompted significant structural and organizational changes in the US pulp and paper industry at the turn of the century. The new technology swept through the industry rapidly,

Table 3.1 Number of sulfite mills and digesters and annual production of sulfite pulp in the United States, 1897–1908 (tons of 2,000 lbs.)

Year	Mills	Digesters	Reported production
1897	49	205	432,140
1900	71	265	643,250
1907	86	320	1,128,720

Source: Toivanen (2004)

Table 3.2 Wood pulp made for sale or for use in establishments other than those which produced in the United States, 1899–1909 (tons of 2,000 lbs.)

Pulp	1899	1904	1909
Ground	280,052	273,400	310,747
Soda	99,014	130,366	155,844
Sulfite	271,585	376,940	444,255
Combined	650,651	780,706	910,846

Source: Toivanen (2004)

Table 3.3 Wood pulp produced including that used in mills which manufactured in the Unites States, 1899–1909 (tons of 2,000 lbs.)

Pulp	1899	1904	1909
Ground	586,374	968,976	1,179,266
Soda	177,114	196,770	298,626
Sulfite	416,037	756,022	1,017,631
Combined	1,179,525	1,921,768	2,495,523

Source: Toivanen (2004)

as new firms and established ones rushed to invest in superior production technology and the best mill sites. New mills were as a rule vertically integrated, that is, they combined pulp processing and a paper machine into a single production line, often extending backward to large pulpwood timber stands and forward to delivery networks, often railways (Table 3.1). This made the operation of mills and companies more complex. A steady supply of timber, continuous industrial processing, and steeply rising capital requirements were only a few of the new management challenges of a vertically integrated sulfite newsprint company.

Within a decade, the industry underwent a fundamental transition, largely concerning the vertical integration of pulp and paper production. The combined annual US production of paper doubled to 4.2 million tons between 1899 and 1909, as did the production of pulp (Tables 3.2 and 3.3). Most growth occurred within vertically integrated pulp and paper mills. Production of pulp at vertically integrated mills increased by some 300% in 1899–1909 and production of groundwood and sulfite pulp at vertically integrated mills by 284 and 397%. Thus, sulfite pulp and

vertical integration played a critical complementary role in the transformation of firm and industry level structures.

The innovation of large-scale enterprises afforded managers an efficient way of dealing with the increased complexity of pulp and papermaking, as well as better leverage over technology and critical knowledge. Several of the new large-scale pulp and paper companies were also an answer to an intensifying antitrust climate, when accusations of cartels and government investigations increased (Lamoreaux 1985; Amigo and Neuffer 1980, pp. 8–12).

The wave of vertical integration was one response on the part of the industry, but the horizontal combination movement was similar in magnitude. The watershed event for the industry occurred in 1898 when William Russell merged several New England mills into the first large-scale pulp and paper firm, the International Paper Company, which has since towered over the global industry. Indeed, the horizontal combination movement swept across all segments of the industry, as described by Lamoreaux (1985) and Toivanen (2004) in their studies.

International Paper was an attempt to combine the advantages of horizontal and vertical integration. It was labeled as a newsprint cartel by critics, but its managers focused on internal efficiencies. It kept paper production stable but increased the daily production capacity of sulfite pulp from 490 ton in 1,898–858 ton in 1900 and achieved a capacity of about 1,000 ton 1909.

Other companies, old and new, followed its example. During the 1890s, entrepreneurs entered the sulfite pulp and paper industry with breathtaking investments. New companies, such as Great Northern and St. Regis, each built record size vertically integrated mills to supply expanding newsprint markets, and many others followed suit. Few, if any, of the old rag-paper companies survived the transition, although some incumbents did. The Champion Coated Paper Company of Ohio, for instance, abandoned its old book paper mill and opened the world's largest coated paper mill in Hamilton in 1901 and embarked on massive expansion. So did Kimberly-Clark Corporation, the West Virginia Pulp and Paper Company, and many others, but many proprietary firms also demised.

3.2.4 Sulfite Pulp and Paper Industry Consolidated

By the early twentieth century, the long and sustained wave of technological innovation in sulfite pulp process lost its momentum. Its wide adoption had facilitated the rise of vertical integration and large-scale enterprise in the industry, and essentially it dominated the industry instead of spearheading change. In tandem with its diffusion, sulfite technology had become common knowledge and did not provide anybody with any particular secretive competitive advantage, notwithstanding minor advantages gained through learning by using and other incremental improvements.

Newsprint was the dominant product of new mills, and its production almost doubled between 1899 and 1904, when the industry boomed (Table 3.4). Much of

Table 3.4 Production of selected paper grades in the USA, 1899–1947 (tons of 2,000 lbs.)

	1899	1904	1909	1914	1919	1929	1939	1947
Newspaper	569,000	913,000	1,176,000	1,313,284	1,323,880	1,772,591	954,259	833,038
Wrapping paper	535,000	644,000	763,000	881,799	831,371	1,605,783	2,238,993	2,903,459
Board	389,000	559,711	883,099	1,291,805	1,867,064	4,451,187	6,025,494	10,408,982
Book paper	304,000	454,000	677,000	913,300	962,095	1,497,912	1,534,591	2,207,923
Fine paper	119,000	147,000	198,000	247,728	325,183	607,590	723,102	1,171,539
Tissue	28,406	43,925	77,745	115,401	190,561	387,811	648,429	1,088,656

Sources: Census of Manufactures (1913, 1923, 1936, 1947) and Toivanen (2004)

the new industry and mills were located at the great spruce reserves close to the main markets, the metropolises of the Eastern seaboard. Newsprint and other sulfite pulp and paper mills concentrated heavily in the Northeast and to lesser degree to the Midwest and mid-Atlantic.

Most importantly, the industry was now bristled with professionally managed, vertically integrated, large-scale enterprises, and the old family and proprietary paper firms had all but disappeared.

3.3 Product Innovation, 1910–1930

A wave of unprecedented product innovation was launched upon the maturation of the sulfite newsprint industry. Within a couple of decades, much of industry switched from newsprint to new paper products and markets, such as corrugated shipping containers and sanitary papers. This transition was fueled by the struggle for survival and was a consequence of a new political economy.

In 1913, the booming sulfite newsprint industry suffered a devastating blow, when it lost all tariff protection. Until 1909, the industry had enjoyed the protection of tariff barriers as high as 20% duty, but the government lowered these tariffs. Newspapers continued to call for the total abolition of tariffs on newsprint, and in 1913, this was done with the Underwood-Simmons Tariff in the guise of a Woodrow Wilson reform. Newsprint lost its tariff protection completely, whereas most other paper grades continued to benefit from protective US tariffs (Lamm 1927).

A rapid period of growth in the Canadian newsprint industry followed. The expansion of the Canadian pulp and paper industry accounted for the growth of imports of newsprint into the USA from 2,000 ton in 1904 to 220,000 ton in 1913 and eventually to 730,000 ton in 1920. Between 1913 and 1920, the Canadian newsprint capacity grew from an annual 350,000 ton to about 880,000 ton. During this period of transition, technological routines in the Canadian pulp and paper industry were geared almost exclusively toward the large-scale production of newsprint. Much of the Canadian growth resulted from the massive investment of US firms in new production capacity there (Dick 1982; Toivanen 2004).

The effects of the tariff revision on pulp and paper industry were amplified by intensified antitrust scrutiny, as well as the onset of depression in 1914. The government conducted extensive investigations on the price of newsprint and trade practices of the industry in the midst of the war effort. The Federal Trade Commission concluded its investigations in 1917, and soon the book and newsprint industries were both indicted. The government dissolved many central industry associations as well and even regulated the price of newsprint for a few years (Whitney 1958; Lamm 1927).

The new political economy and the depression prompted a rapid transformation of the industry, best illustrated by the industry's leader. IP responded to the changed conditions by eventually relocating all its newsprint capacity to Canada and diversifying US newsprint production into specialty paper grades. In 1912, the company announced that it would shift 20% of its US production capacity from newsprint to

specialty papers, such as tag and box papers. In addition, the company intensified its vertical integration with the Continental Paper Bag Company, which converted paper into specialty paper bags.

The whole industry followed suit in switching from newsprint to printing paper, board, wrapping paper, and whatever promised better profit than depressed newsprint. The combined effect of this transition was an increase in the strategic importance of process and product innovation while that of newsprint declined.

3.3.1 The Emergence of the Sanitary Paper Industry, 1914–1930

The surge forward in the sanitary paper product industry showcases best how the industry responded to the shock of the Underwood Tariff Act of 1913. Scrambling for new business, as Heinrich and Batchelor have argued, newsprint companies converted to tariff-protected paper grades. Companies with long technological histories in the investigation of product diversification and wood-based substitutes for cotton rags, such as the Wisconsin-based Kimberly-Clark Corporation, enjoyed distinct advantages (Heinrich and Batchelor 2004, pp. 40–41).

The company intensified its research and development program for cellulose and in 1915 succeeded in producing cellucotton, a cotton-like absorbent material derived from wood cellulose. This product was especially well suited to hygienic and sanitary use in hospitals and surgery, and US participation in the First World War created an enormous demand for the new innovative product, first commercialized as surgical dressings. Kimberly-Clark expanded production capacity in tandem with increasing wartime demand, but the armistice in 1919 not only caused all orders to be canceled but also flooded the market with army stock (Heinrich and Batchelor 2004, pp. 39–75).

Kimberly-Clark responded by exploring the possibility of entering other consumer nondurable products and in 1919 launched Kotex, the first wood cellulose-based feminine hygiene product. Although Kotex clearly appeared to be a more hygienic and easily disposable product than other existing female hygiene products, its success entailed entry into a culturally sensitive mass consumer market, something of which traditional paper companies had little experience. Kimberly-Clark contracted leading advertising and marketing experts to support its new product line, thereby taking the pulp and paper industry into a wholly new market and area of expertise (Heinrich and Batchelor 2004, pp. 39–75).

Around 1920, Kimberly-Clark introduced its third major product emanating from the post-Underwood Tariff research and development program, the cleansing tissue Kleenex, and others followed. The demand for these products was enormous. Kleenex annual sales went from zero to 500,000 dollars in 1926 and to one million 3 years later. The company's wartime expansion of production capacity was in full use, and it continued aggressively to build more capacity, thereby gradually lowering the unit price of its products (Heinrich and Batchelor 2004, pp. 39–75).

Kimberly-Clark led the industry's foray into consumer nondurables, but others followed. The Philadelphia-based Scott Paper Company also launched cellucotton research and products after 1914 and remained the industry's second company until

the 1950s. While some other paper companies followed suit, the most important entries in the new product segment were by traditional consumer product companies. A group of department stores launched a rival to Kotex in 1923, severely undercutting the Kotex price. Johnson & Johnson, a company established in 1891 and specializing in cotton-based surgical products, entered the Kleenex market in 1926 (Heinrich and Batchelor 2004, pp. 39–75).

These innovations created a basis for the expansion of the pulp and paper industry into the consumer nondurable market, a phenomenon that steadily increased the demand for tissue and many other types of wood cellulose-based products, such as baby diapers (Table 3.4). In the case of tissue paper, perhaps the most obviously consumer product, the impact on the structure of the paper industry was evident. From 1914 until mid-century, tissue paper production more than doubled every decade, and by 1947, its production tonnage exceeded that of newsprint.

3.3.2 The Rise of the Corrugated Paper Packaging Industry, 1900–1930

The modern paper container industry evolved relatively slowly from the inventions of the folding box and of corrugated paper in the mid-nineteenth century. This industry was small and mostly concerned New York and other metropolitan communities of inventors and firms, which developed machinery for the production of corrugated paper suitable for shipping and delivery of different goods. Consequently, much of the knowledge fell under strictly policed patent portfolios (Bettendorf 1946; D'Ambry 1951). Beginning in the 1890s, these patents on manufacturing equipment began to expire; relatively rapid diffusion of new manufacturing equipment lowered barriers to entry and prompted corrugated paper firms to focus on product innovation instead of corrugating equipment.

Soon paper companies from major national freight hubs were focusing on the potential of corrugated paper products in emerging mass distribution markets, especially in railway freight. Until 1890, corrugated paper had been used only as bottle wraps, cushioning, dividers, and partitions in wooden boxes. The disintegration of the patent pool prompted firms to develop new corrugated paper products, and the single most important one was the corrugated paper box (Bettendorf 1946, pp. 65–69).

Innovation in corrugated paper and board was concentrated in Ohio and some other major national mass distribution centers. One of the newcomers to corrugated paper containers was the Hinde and Dauch Company located in Sandusky, Ohio. Since 1900, it had assumed the leading role in the nascent industry and emerged within 15 years as the world's largest manufacturer of corrugated paper specialties. Its growth reflected the tremendous expansion of the paperboard and paper converting industries in the USA during the early twentieth century.

The single most important factor for the growth of these two segments was the establishment of the paper box as the standard shipping container between 1900 and 1919. The paper box completed the emergence of the American mass consumer mar-

kets and mass distribution infrastructure, and yet it took two decades to be universally accepted. By the outbreak of the First World War, entrepreneurs had overcome these early obstacles, and the paper shipping container industry boomed.[2]

The developers of the paper box advocated the "packaging revolution" and hoped to replace the common and standard wooden cases and crates with corrugated paper boxes in railway freight. Despite its multiple advantages, the paper box encountered resistance from the administration of a massive technological system that formed the American railroads. The railroads fell under the heavy-handed regulation of the Interstate Commerce Commission that skewed how costs and efficiency were calculated, as Steven Usselman has demonstrated, and was at the center of a much broader American political debate on the character of big business (Usselman 2002; McCraw 1984).

The paper box, the railroads and lumber companies argued, did not afford sufficient protection to shipped goods and cost everybody money, and therefore paper boxes were charged at a higher rate than the much heavier wooden ones. The corrugated paper industry sought to demonstrate the reliability of the paper box by standardizing it and introducing it as a credible and certified railroad shipping container equal to the wooden ones. The paper package was first introduced to the railroads in the form of cereal boxes in 1903, when some Northeast cereal manufacturers succeeded in making an exception to the railroads' official freight classification. Soon other categories were allowed for shipment in paper packages, such as hardware, stationary, rubber tires and other rubber goods, shoes and leather goods, soap, washing compounds, and other heavier commodities.

Opposition to the paper box continued intensely, and only gradually and in phases did it gain a larger share of the fast-growing US shipping container market. A watershed was reached only in 1919, when the different railroad regulations were consolidated into one that represented the concluding point for the paper firms' efforts to reform the shipping container regulation. The new regulatory guidelines established broad and inclusive standards that enabled railroads and shippers to choose freely between a wide range of competing shipping containers.

The rise of the paper box constituted a real threat to the interests of the lumber industry. The manufacturers of wooden boxes argued that paper boxes had captured between 30 and 40% of the railroad shipping container business by 1911. The corrugated paper industry also purchased about one third of all US-produced paperboard.

3.3.3 Vertical Integration and New Wave of Production Innovation

The opening of the markets led to the exponential growth of the corrugated paper container industry, but the development mattered even more to paper and board producers. Indeed, the paper box was an important part of the industry's departure

[2] For the rise of mass distribution, see Chandler (1977), and for mass consumer markets, Strasser (1989).

from newsprint. The best measure of the significance of the growth of the corrugated paper industry was the rapidly increasing production of paperboard in the USA, as all corrugated paper was converted from it. Paperboard surpassed newsprint as the most consumed line of paper in the USA in the late 1910s, and its annual production increased from 357 thousand metric tons in 1899 to 1,678 in 1919 and 5,392 in 1939 (OEEC 1951).

Growth presented the same challenges as newsprint firms had experienced two decades earlier, overproduction, collusion, and exhausted technological creativity. In 1921, the antitrust authorities accused the Corrugated Paper Manufacturer's Association of price-fixing and other unfair trading practices. The association consisted of ten corrugated converting firms that served the New York City market only and were not integrated backward into paperboard production. The case was embedded in a broader effort on the part of the government to intensify the competitive environment of American business and was intended to send a signal to the rest of the industry (Daly 1971, pp. 28–29).

During the 1920s, individual paper container firms responded to these challenges by adopting clear corporate strategies of vertical integration, economies of scale, and internalization of research and development. The industry leader, the Hinde and Dauch Paper Company, pioneered these new tactics. It expanded its paperboard manufacturing capabilities in Ohio, added new converting factories within the vicinity of major metropolitan areas, established a vertically integrated subsidiary in Canada, and acquired major interest in the Frohman Chemical Company that supplied chemicals essential for papermaking. Other leading corrugated firms soon followed suit, thereby changing the basic dynamics of the industry's evolution.

Most importantly, corrugated and other specialty converting firms turned to intensified production innovation. The principal objective was to frustrate any possible forward integration by their paper and board suppliers, a move unsuccessfully attempted by many companies in the 1920s. As the basic converting machinery technologies came publicly available, the paper container industry focused on product patents. The most famous example of these tactics was perhaps the "Bliss Boxes," a family of standard corrugated paper boxes patented by Herbert R. Bliss and his two brothers and licensed to converting firms through the expiry of patents in 1938. Such rapid diffusion of product innovation in the corrugated paper industry presented a challenge to the largest firms, and they responded by claiming extensive intellectual property rights to specialized product areas. By 1919, Hinde and Dauch centralized product development and the management of intellectual property rights in company headquarters in Sandusky, Ohio. In the following years, these routines were increasingly systematized as the company grew in size. The company actively expanded its already large paper product patent portfolio, organized innovation into a department of experimental box design, and added specialized patent engineers who monitored North American and international corrugated paper box patents that should be considered for acquisition by the company. The company's expert patent attorneys also examined rival products and vigorously pursued potential infringers to settle whether in court or out of court (Toivanen 2004; Bettendorf 1946).

Industry-wide, these efforts were, to say the very least, intensive enough to deny the entry of new firms into the corrugated paper industry. During the 1920s, many of the large-scale pulp and paper firms attempted to diversify into more profitable specialty products. Thomas Heinrich has described the difficulties of the International Paper Company to diversify into new products during the 1920s and 1930s. Although the company did indeed emerge as the world's largest producer of paperboard during this period, it did not integrate forward into paper box converting until 1940. A history of similar efforts by a Wisconsin pulp and paper firm, the Marathon Paper Mills, suggests that the organization of intellectual property rights constrained its ability to enter new markets (Heinrich 2001). Its ambitious and entrepreneurial owner and director, Clark D. Everest, cried after several failed attempts to acquire or merge with paper converting company: "…90% of the business and all the profitable business is covered by what someone claims to be an infringement. Just how we come out on this, I don't know" (Toivanen 2004; Karges 1968). Patent portfolios, in effect, blocked his attempts to integrate from paper and board production forward into the paper converting business.

The innovation of the paper box in the early twentieth century was one of the fundamental innovations spearheading the industry's expansion. Paper containers established paperboard as the most important industry branch by the 1910s, and despite its leading position, its growth rates were second only to the much smaller tissue paper segment. Its weight among the key paper grades listed in Table 3.4 increased steadily, and by 1929, it accounted for half of all production and for much more in 1939 and 1947.

Corrugated paper and other paper box inventions also fostered the especially fruitful culture of innovation and thereby helped the industry to venture into many new areas.

3.3.4 Innovation in Machine Coated Magazine and Printing Papers

Innovation in machine coated magazine and printing papers created another major industry segment in the course of the twentieth century. New magazine and advertising strategies created a considerable demand for this innovation in the 1920s and increased further the introduction of office and home copy and printing technologies in the latter half of the twentieth century (Moran 1973; Strauss 1967) (Table 3.5).

The American printing and publishing industry was transformed in the 1920s and early 1930s by the introduction of capital-intensive custom-built web rotary magazine presses that mass-produced color magazines and catalogues with unprecedented economies of scale, as one observer put it: "Two million magazines or mail-order catalogues are now printed with no more difficulty than were three or four thousand a quarter of a century ago" (Baker 1933, p. 15).

In addition, the American printed media underwent a significant structural change in the 1920s and 1930s, when a new format of mass-circulation magazines began to replace the incumbent magazines established during the magazine

Table 3.5 Estimated Consumption of book paper by magazines in the United States, 1925–1944 (tons of 2,000 lbs.)

Year	Consumption
1925	354,000
1930	524,300
1935	418,400
1940	656,700
1941	704,400
1942	730,800
1943	635,500
1944	545,500

Source: Toivanen (2004)

revolution of the late nineteenth century. Utilizing a new visual appeal with glossy color printing and photographs, such titles as *Reader's Digest, Fortune, New Yorker*, *Time, Look,* and *Life* took the industry by storm.[3] Yet the transition into the mass production of color magazines and catalogues was critically held back in the early 1930s due to a lack of good enough paper (Twyman 1970, pp. 32–47).

Indeed, printing firms' experiences of running the newly installed magazine rotary presses were characterized by frustration in the early 1930s. The leading American printing house and operator of the world's largest printing plant in Chicago, the W. F. Hall Printing Company, complained that bad paper clogged the printing machine and distorted the visual imprint. The struggles of a company printing annually 180 editions of catalogues and almost 190 million magazines exemplified the challenges felt throughout the industry. In order to realize the business potential of the new printing technology, an innovation in printing paper was critical (Ellis 1940, p. 216; Moran 1973, pp. 173–221; Smith 1964).

3.3.5 Innovation and Control

The printing industry presented a very explicit wish list to the paper firms. Superimposed colors and the speed of the press necessitated paper with a high level of ink absorption capacity, and both sides needed to be absolutely identical. Secondly, a new type of density of paper was needed that did not sacrifice ink absorption capacity to superior surface quality and the lay of the ink on the paper. Thirdly, paper rolls needed to be wound with uniform and precise tension so as to fit the delicacy of the high-speed color printing process that was too often disturbed by curling paper (Reed 1958).

The paper industry's leading companies responded with sizeable research programs and machine coated printing papers. Publishers and printing houses maintained a critical position, however. As users, they not only controlled how new

[3] See Toivanen (2004, pp. 238–248) for extended discussion and sources.

Table 3.6 Annual value and production of machine coated paper production in the USA, 1947–1963 (thousands of dollars and tons of 2,000 lbs.)

Year	Value	Quantity
1947	100,609	623,724
1954	252,617	1,222,873
1958	362,505	1,547,408
1963	498,637	2,171,778

Sources: Census of Manufactures (1954, 1958)

papers met their requirements but constantly set the research and development agenda in detail. In many ways, they induced the innovation of new machine coated paper that suited new mass printing technology (Elson 1968, p. 310).

This relationship between users and producers soon showcased familiar tensions over control of innovation, when publishers and printing houses worked to lower barriers to entry for latecomer paper firms. The pioneering paper firms responded with collusion and enhanced proprietary control of innovation, whereas latecomer paper firms turned to patent infringement and innovation to gain entry into the rapidly growing machine coated paper industry. Rivalry between paper firms increased R&D and the proprietary nature of machine coated paper, but weakened the industry's bargaining position with publishers and printing houses.

The efforts of one latecomer, Westvaco, serve to illustrate the rivalry between paper firms. Westvaco explored patent agreements with the pioneering companies, such as Kimberly-Clark, Mead, Champion, and the Consolidated, and simultaneously maintained a research program to invalidate their existing patents. In turn, the pioneering companies pooled their patents and launched R&D cooperation.

The industry remained relatively concentrated, with the four largest machine coated paper firms controlling much of the markets in the late 1930s. Publishing and printing houses sought to increase the number of suppliers by setting narrow standards for machine coated printing papers and withdrawing from intimate cooperation in innovation, as both of these eased entry and served to bring down the price of machine coated paper.

Such struggles worked in different directions. Paper firms developed new innovations, most notably much lighter paper appropriate to the growing importance of airmail. Production did increase, but so also did the price of paper (Tables 3.5 and 3.6). The advent of the regulated war economy froze competitive forces for almost a decade, but did not alleviate the tensions between firms and industries (Wood 1971, pp. 172–173).

The industry's problems abated when the proprietary nature of machine coated paper technology came to a sudden end through a 1953 court ruling. Fighting incumbent machine coated paper firms, Westvaco and some others continuously challenged the validity of critical patents, culminating in a court decision declaring the fundamental aspects of machine coated patents invalid (Consolidated v. Kimberly-Clark 1952).

A wave of on-machine roll coater imitations developed without publicity by imitator paper firms were now patented and put on the market. The first to move was the third largest US pulp and paper firm, St. Regis Paper Company, which in 1953

patented an on-machine roll coater developed in the late 1940s, thereby ensuring the company's entry into the high-volume magazine paper industry. Others soon followed suit (Booth 1990).

3.3.6 Consolidation, Diversification, and New Growth

Leading book and printing paper firms had invested for many decades in the development of new technology and based their competitive strategy on the aggressive control of technology. With the collapse of proprietary barriers to entry, they quickly adopted a new strategy, consolidation and economies of scale and diversification.

They invested heavily in the on-machine coaters and the production of competitive magazine and printing paper. The large capital requirements discouraged and prevented smaller paper mills from entering this line of paper business. By applying the coating directly to the paper in the Fourdrinier machine, large-scale paper firms achieved tremendous economies of scale and brought down the price of on-machine coated paper. However, this also tied mills to a single market because the change of paper grade would have required slow and expensive retooling of the Fourdrinier machine (Mosher 1968).

Diversification in the industry was prompted, again, by outside technological innovations. Offset printing as well as the fax and other office copy and printing equipment soon created a demand for a new type of sheet print paper. Machinery and processes for production of office copy and print paper were developed by specialized equipment suppliers, such as Black Clawson or the Rice Barton Corporation, which sold to any paper company. Moreover, these two companies specialized in off-machine blade coating equipment, which allowed the mills much more flexibility in terms of what type of paper they produced and required less capital than the on-machine coating solutions. Off-machine coaters were now supplied by competitors not engaged in the manufacture of paper and who sought to maximize sales without concern for possible overcapacity (Booth 1990).

Pulp and paper and off-machine coating machinery supplier firms carefully monitored developments in the office copy markets and became quickly convinced of their future expansion. Potential markets for off-coating machinery in the USA included mostly newsprint mills increasingly squeezed by the Canadian competition in the 1950s and whose managers explored options to shift production capacity into more profitable paper grades. In a signature move soon emulated by many, the second largest US pulp and paper firm and predominant West Coast newsprint producer, Crown Zellerbach, built a very large coating mill in St. Francisville in the 1950.

Other growth opportunities emerged from the fusion of plastics and paper, when the extrusion coating of paper and board created markets in the food and drink container industries. Here, again, companies with existing capabilities in container paper and board, as well as coating technologies, enjoyed advantages but were soon followed by imitators (Boese 1984, pp. 322–328; Coffing 1970).

Table 3.7 Wood pulp production in the United States by grade, 1909–1959 (thousand tons of 2,000 lbs.)

Grade	1909	1914	1919	1929	1939	1947	1959
Groundwood	1,179	1,294	1,519	1,638	1,445	2,050	2,883
Sulfite	1,018	1,151	1,420	1,689	1,946	2,773	2,442
Soda	299	348	411	521	442	491	410
Sulfate	Na	53	120	911	2,963	5,355	12,317
Total[a]	2,496	2,893	3,518	4,863	6,993	11,917	20,933

Source: Toivanen (2004)

[a]Note that total wood pulp includes specialty wood pulps, such as semichemical and defibrated pulp not given here

The production of machine coated paper soared as a result of a massive wave of investment in new manufacturing capacity during the 1950s, as is evident in Table 3.6. The industry did not repeat the price decline of so many other paper industry segments, however, because the market for machine coated papers was fragmented into specialty products. While the annual production of machine coated paper increased two and half-fold between 1947 and 1963, the annual value increased fourfold during the same period. Nevertheless some segments experienced very difficult times, in particular the firms that produced standardized mass-circulation magazine papers.

3.4 Rise of the Sulfate Pulp and Paper Industry, 1930–1960

The most significant structural and technological change in the North American pulp and paper industry in the twentieth century was the replacement of the sulfite process as the dominant pulping technology by the sulfate process. Between 1914 and 1959, the annual production of sulfate pulp increased over 232-fold from 53 ton to over 12,000 – averaging 13% annual growth over almost half a century. This growth accounted for most of the expansion of the whole US pulp and paper industry, as the share of sulfate pulp of the national annual production increased from about 2% to almost 60% within the same period (Table 3.7).

3.4.1 Regional Learning in the Sulfate Process

Throughout the early twentieth century, the North American sulfate industry was characterized by strong regional differences and interregional competition (Grace 1957). The nascent industry originally arrived on the continent through Canada from Scandinavia but practically disappeared from there while reaching a considerable size in the US Lake States by 1920. The growth of the US industry took off with the emergence of Southern mass production in the 1930s.

A fundamental geographic and technological difference was established by the different technological routes chosen in the South and the North. The industry had to choose between stationary and rotary furnaces as a basic approach in sulfate pulp. Northern papermakers sought to improve the known technology of the rotary furnace, although it did not lend itself to the mass production of sulfate pulp. Thus, Northern papermakers chose to modernize the industry through gradual improvements (Toivanen 2004).

The technological alternative, the revolutionary but untested stationary recovery furnace, required too much maintenance and was technologically too immature to be considered by working mills, Northern engineers argued. Yet its basic design allowed the mass production of sulfate pulp, an ideal that appealed particularly to Southern engineers and companies, who invested heavily in experimenting with the new technology in the hope of achieving superior economies of scale. Although Southern experiments and development work were important, eventually the new critical inventions, stationary furnaces, allowing truly mass production, came from outside the industry (Toivanen 2004, 2011).

The geographical differences in technology strategies are best explained by the different industrial organizations of the Northern and Southern paper industries. In the North, small units predominated in the industry, and this industrial organization fueled a continued belief in the viability of the rotary recovery furnace and also led managers to downplay the fact that its scale economies were inherently limited. Between 1915 and 1935, most North American sulfate mills trusted improved rotary furnaces, and the Southern experiments counted as an exception. Southern firms and industry did not have large existing markets and were better positioned to embark on the risky development of radical innovation (Kellogg 1923, p. 16; Grace 1957).

Whereas rotary and stationary furnaces differed in many aspects, they shared a common need for improved energy efficiency. Much of this was advanced in stationary furnaces, but the results benefited particularly the rotary furnaces. Between 1900 and 1930, the energy efficiency of the recovery cycle was improved from consuming external energy of five million Btu/ton to a surplus of equal size in rotary furnaces. These critical innovations were accomplished by relatively small companies in Louisiana and Alabama, where they explored how to make paper from the highly resinous Southern pine that was impossible to pulp with the sulfite process.

The improved energy efficiency and the opportunity to exploit the cost advantage of the neglected Southern pine coincided with the Great Depression, which forced the industry to review its strategies. A reinforced research and development effort ensued, as did investments in new technology in the South. Demonstrating technological advancements, the average capacity of sulfate pulp digesters increased progressively in the period 1914–1954, facilitating new investments in the technology with the rise of economies of scale (Table 3.8).

An investment rush in the South soon followed. First, a number of Southern firms built new mills, but others followed. Encouraged by their example, the leading companies examined the feasibility of Southern strategy. Most Lake States companies decided against entry into the South, but the industry's largest company, the International Paper Company, embraced it wholeheartedly fully. IP's and other

Table 3.8 Number of sulfate pulp digesters, average digester capacity, and total digester capacity (tons of 2,000 lbs.) in the United States, 1914–1954[a]

Year	Digesters	Average unit capacity	US production capacity
1914	23	3,383	77,820
1919	59	4,288	252,995
1921	70	3,755	262,821
1923	101	4,115	415,628
1925	114	4,365	497,647
1927	122	5,709	649,490
1929	113	7,517	849,400
1931	183	7,155	1,309,400
1937	268	12,569	3,368,460
1947	387	15,081	5,836,464
1954	622	32,275	11,151,218

Source: Toivanen (2004)

[a]Note that total US capacity is calculated maximum throughput and differs from the actual annual sulfate pulp production

companies' decisions to build new capacity in the South accounted for most of the growth in sulfate pulp production shown in Table 3.8.

The introduction of kraft paperboard enabled IP to implement its Southern strategy just when it appeared to be frustrated by the worsening of the Great Depression (Heinrich 2001). After 1925, IP accelerated its expansion in the South and sent the price of kraft downward. It built mill after mill in the South, capturing one third of the US kraft paper markets by 1928. After initial experiments, IP scaled up its investments and, in 1930, organized its Southern operations into a separate subsidiary, the Southern Kraft Corporation, and continued its Southern expansion to the dismay of competitors.

Before this investment, many industry insiders believed that the pulp and paper giant had reached its limits. IP, however, between 1920 and 1940 pursued an ambitious product diversification program into power utility, specialty papers, Canadian newsprint, and Southern kraft. The last of these constituted the cash cow of IP that supported its other ailing ventures (Heinrich 2001).

The Southern sulfate industry specialized first in board, rapidly capturing market share from Northern producers, who despaired in the face of intensifying relocational dynamics. In 1926, the South captured about 22% of the total national production capacity and ranked third in the country. By 1931, its share increased to 36%, and the second region, the mid-Atlantic, amounted to 10%. At the same time, national production capacity increased from about half a million tons to 1.3 million.

The South's ascent can be attributed to IP, whose behavior spearheaded a more extensive, industry-wide structural change, as some followed and others felt the pain. The industry's continued expansion in the South occurred in tandem with new advances in Southern mass sulfate technology, such as the first continuous chemical recovery plant of IP's Panama City mill (Smith 1970, pp. 414–420; Boyd 2001).

The first wave of the Southern strategy of IP was timed to meet the competition by incumbent sulfate firms in the South and the Lake States, and its tactic was to put

North American sulfate paper and board prices under pressure. In the South, its success was evident. Early pioneers of the sulfate process had erected 20 small- or medium-size mills across the Southern pine belt by 1920, but a decade later, the investment rush had decreased the number to 17, as new record size vertically integrated mills retired older mills. Controlling one third of the Southern mills, IP became the dominant firm in the sulfate industry in the USA (Tindall 1967, pp. 84–85).

The organization of the Southern sulfate industry underwent a profound transformation, whereas the old organization of the Lake States sulfate industry persisted. After decades of technological learning and innovation, American paper firms perfected the mass production of sulfate pulp and papers by the outbreak of the Second World War, a technological turning point that was to shape the industry globally by making sulfate pulp the standard (Kellogg 1923, pp. 37–42).

3.4.2 Technology and Strategies of Growth in the Sulfate Pulp and Paper Industry, 1940–1960

After the expansion of the Southern sulfate industry, the American and global engineering community embarked on a research and development effort that transformed the sulfate pulp and paper processes into an industry standard, practically displacing other processes. American sulfate innovation had concentrated on overcoming problems in making pulp from highly resinous Southern pine, but subsequent innovations focused on establishing economies of scale, applying the process to all kinds of fiber sources, and producing new types of high-value quality papers from the sulfate process.

The economy of the sulfate process was significantly improved by the introduction of new stationary chemical recovery units that offered new economies of scale. Two large US boiler manufacturers created this technology and commercialized full-scale turn-key installations. The new technology, the stationary spray recovery unit that was based on Southern sulfate pulp technology, allowed the scaling of production processes. The rotary spray unit, which was based on the Northern sulfate production process, reached its maximum size at 100 ton a day. Further increase in size was impractical, as the drying power of the rotary increased slowly with size (Grace 1957).

The diffusion of new superior chemical recovery technology ended the competition between Northern and Southern technologies and gave a lasting advantage to Southern technologies and business strategies (Toivanen 2004). New Southern installations all aimed at economies of scale. In 1936, seven pulp and paper mills were under construction, the combined effect of which promised to double the Southern production of sulfate paper to almost two million tons a year. Southern sulfate production increased from 3,275 thousand tons in 1935 to 9,128 in 1940, amounting to over 80% of the total US capacity (Lorenzi 1953; Smith 1970, p. 408).

Between 1940 and 1960, the spray recovery chemical unit was accompanied by two other important process innovations. Multistage bleaching enabled the production of white kraft and sulfate papers, and the continuous cooking sulfate

digesting process resulted in new economies of scale. This convergence of relatively distinct sustained waves of technological learning created an oxymoron that integrated mass production with product differentiation. In practice, improvements in sulfate bleaching technology decisively expanded the range of sulfate paper products that had a sustained price advantage over sulfite papers. These innovations prompted an almost complete forward integration of the North American sulfate pulp industry. Between 1928 and 1939, 87% of all sulfate pulp was manufactured by firms for their own use, but by 1947, the share had increased to 96%, a level at which it stabilized (Census 1947).

Improvements in the bleaching of sulfate pulp constituted the second wave of technological learning that facilitated the tremendous expansion of the sulfate pulp industry. Bleaching of pulp and paper had always constituted a serious challenge to the industry, but in the early 1920s, papermakers learned to reduce the cost of chemicals by using a two-stage hypochlorite bleaching method. It could not be applied on massive scale to sulfite pulp, because its fibers were too weak for hard chemical treatment. Sulfate pulp, and especially kraft pulp, in contrast, produced strong fibers that withstood such treatment. Thus, the "multistage bleaching" eliminated the trade between whiteness of sulfate pulp and its fiber strength.[4]

The Swedish innovation of the continuous sulfate cooking system, known as the Kamyr system, was another decisive advance in achieving economies of scale in the sulfate pulp and paper industry. Complementing the continuous chemical recovery cycle, continuous chemical bleaching, and continuous Fourdrinier papermaking machine, continuous sulfate cooking was the ultimate realization of a totally continuous sulfate mill. Before the Kamyr process, sulfate pulp cooking had been characterized by batch production even at the largest mills (Toivanen 2004, pp. 199–203).

Kamyr commercialized turnkey installation worldwide. Often record size, like the Finnish mill with the record capacity of 350 daily tons by 1955, they leveraged quick industry-wide change. The Kamyr continuous kraft cooking system also attracted the attention of North American pulp and paper firms. In 1955 alone, Kamyr supplied three big mills in the USA, and worldwide, Kamyr installed 50 continuous cooking systems between 1948 and 1959, and its remarkable economies of scale had a considerable effect on the North American pulp and paper industry.

Sulfate pulp leveled most of the growth of the US pulp and paper industry. It is illustrative that the production of bleached sulfate pulp increased 80,000-fold in the USA between 1931 and 1958 and almost 100,000-fold if one also includes semi-bleached pulp (Tables 3.8 and 3.9). The share of sulfate pulp of the total US pulp production increased from 42% in 1939 to 45 in 1947 and to 59 by 1958 (Toivanen 2004).

By 1960, the sulfate revolution in the American pulp and paper industry was complete. It had unfolded in three waves, each triggering fundamental organizational changes in the industry. During the maturation of the sulfate pulp process, the technology initiated the industry's emergence in the South, whose pine belt and

[4] See Toivanen (2004, pp. 199–201) for detailed discussion of alternative technologies and sources; OEEC (1951).

Table 3.9 Production of bleached sulfate pulp in the USA, 1931–1958 (tons of 2,000 lbs.)

Year	Production
1931	50,000
1939	500,000
1947	1,100,000
1958	4,000,000

Source: Toivanen (2004)

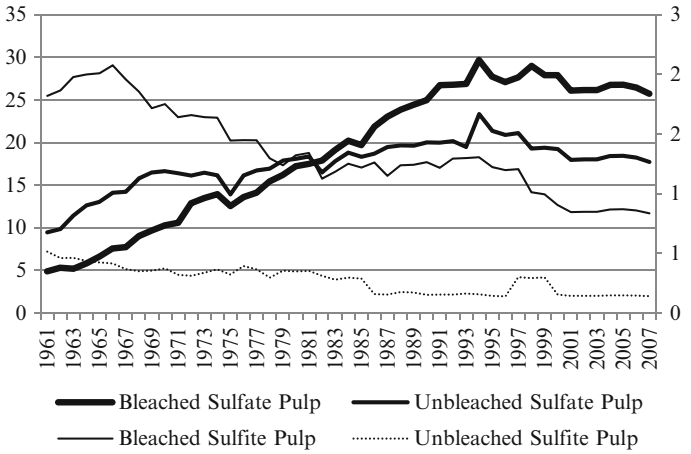

Fig. 3.1 US sulfate (*left axis*) and sulfite pulp (*right axis*) production, 1961–2007 (millions of tons) (Source: FAO)

newly built industrial infrastructures afforded important economic advantages. In the second wave, after 1934, further maturation of the sulfate pulp process and good experiences occasioned massive relocation to and investment in the South. Finally, the completion of continuous cooking provided further economies of scale, and the perfection of bleaching processes made the sulfate process viable for the production of all types of papers. The last two innovations reduced the advantage enjoyed by the South and consolidated sulfate pulp as the industry standard in the USA and worldwide. In the later half of the twentieth century, sulfate pulp simply marginalized all other pulp processes, as is shown in Fig. 3.1

3.5 Consolidation and Maturity, 1960–1990

If spectacular waves of innovation had characterized the evolution of the pulp and paper industry in the USA since its beginnings, around the 1960s, it entered a phase that centered on two organizational phenomena: consolidation and maturity. During this period, the character and organization of the industry changed fundamentally. The South emerged as the largest production hub, followed by the West and North.

All leading companies adopted the organization of large-scale, vertically integrated, multidivision and multiproduct forest product enterprises. Moreover, leading firms assumed national or even global scope, thus ending an era of regional specialization. Finally, companies' competitive strategies converged, with the exception of a few specialized producers, reducing the strategic importance of innovation and increasing that of economies of scale.

This structural and organizational transformation unfolded over several decades, enveloping the cyclical booms and busts of the industry. Although this process can be aptly described as the structural adjustment of the industry and firms therein to broader economic trends, it was also importantly facilitated by the political economy and rise of competing industries, such as the plastics, electrical industries, and certain others.

3.5.1 The Antitrust Experience

Political economy was decisive in the organization of the industry. The passing of the Celler-Kefauver Antimerger Act in 1950 marked the beginning of a new antitrust experience throughout the whole US economy, and the pulp and paper industry was quickly targeted for government action. Through extensive investigations, government officials developed industry-specific standards to regulate its vertical and horizontal organization (Toivanen 2005).

Between 1950 and 1990, antitrust disadvantaged pulp and paper firms whose competitive strategy was based on regional or product specialization. As in other industries, antitrust appeared to encourage successful and growth-seeking paper firms to diversify into new areas of business. Unlike in other industries, successful pulp and paper firms relatively rarely undertook so-called conglomerate mergers and preferred to diversify and expand into other segments of the forest product industry. In the context of the pulp and paper industry, new incentive structures emanating from antitrust facilitated the rise of large-scale forest product giants that resembled each other in terms of strategy and structure.

The antitrust experience of pulp and paper between 1950 and 1990 can be divided roughly into two stages. Between 1950 and the mid-1970s, questions of competitive structure dominated the antitrust framework. Between 1970 and the mid-1980s, antitrust in pulp and paper centered on cartel and price-fixing cases. Between 1954 and 1987, the government investigated 14 merger cases, the majority of these concerning vertical integration. Between 1951 and 1978, the government pursued five major cartel cases, of which three in the late 1970s. With the inauguration of the Reagan administration, the government relaxed its antitrust policies significantly, also in the case of the pulp and paper industry.

The effects of antitrust enforcement were clear, likewise the message sent by test cases to rest of the industry. In the early 1950s, antitrust officials forced sanitary paper companies to lower barriers to entry, when they successfully prosecuted a subsidiary of Kimberly-Clark, International Cellucotton, for monopolistic behavior and unfair trading practices in specialty product segments. A few years later, the Federal Trade

Commission prevented the Scott Paper Company, Kimberly-Clark's chief competitor, from expanding its market dominance through vertical integration (Toivanen 2005). These antitrust cases concerning the sanitary paper industry established the framework for the application of the Celler-Kefauver Act in the pulp and paper industry, as they demonstrated how much a company could dominate a given market.

In the wake of these cases, the FTC established similar standards for geographical regions. When one of the leading Pacific paper companies, Crown Zellerbach, attempted to consolidate its regional position by acquiring a key pulp supplier, the FTC prevented the move by taking legal action in 1962. A decisive factor was that CZ would have controlled some 60% of Western coarse paper markets and much higher shares in specialized paper grades. In addition, the combination would have reduced the supply of paper to independent paper converters, thereby limiting the competition in paper products, such as paper bags. In bag paper, the combination would have controlled 80% of Western markets.

The case marked a culmination point for the evolution of the Pacific pulp and paper industry, an industrial organization relatively independent of the rest of the nation. Together, the Midwest, Southern, mid-Atlantic, and Northeast regions constituted a relatively well-integrated geographical paper market, where mills from all different regions competed for the same customers. The same firms operated in all these regions because the expansion of the Southern pulp and paper industry during the 1930s and 1950s had been pioneered primarily by a small group of Northeast and Midwest firms. In contrast, the Pacific market was isolated behind the Rocky Mountains and subject to higher freight rates. It was dominated by firms of local origin. Within a few years, the two leading Pacific companies entered the East by acquiring Lake States paper companies and proceeded from there to Atlantic seaboard and the South.

Moving in the opposite direction, International Paper sought to acquire Pacific companies and forests, but FTC permitted this only under strict conditions regarding IP's shares in various Pacific market segments. Similar antimerger cases followed in other industry segments. The rulings against firms were based on perceived injury to competition occurring when a large pulp and paper enterprise acquired smaller regional firms, pulp supply mills, specialized paper converter, or trade arms.

Through these cases government made clear that industry's attempt to consolidate through mergers would be blocked and established strong incentives for firms to diversify into different product segments.

If antimerger policies encouraged product and regional diversification, they also probably contributed to the peak in cartel cases in the 1970s, when government weeded out widespread collusion in key industry sectors. These cases included two allegations: Smaller firms complained that large-scale multidivisional forest companies attempted to drive them out of business with artificially low prices. Secondly, and somewhat contradictorily, government and end users claimed that paper companies achieved artificially high prices through price-fixing. Reflecting the size of these major cases, *The Corrugated Container Antitrust Litigation* (1977) resulted in the highest settlement in the US history, approximately $550 million (Toivanen 2005).

Taken together, the antitrust and cartel cases limited the attractiveness of vertical or regional specialization as a competitive strategy, the industry's historical habit of

price-fixing, and finally facilitated the emergence of a relatively homogenous organizational structure and strategy of the leading firms. This was further fueled by the continued expansion of the industry (Fig. 3.1), which prompted firms to find avenues of growth when regional or product specialization were increasingly problematic.

3.5.2 Organizational Convergence

In 1970, a spectacular phase of expansion of the US pulp and paper industry appeared to have run out of steam like the rest of the economy. Since 1950, American pulp and paper firms had modernized machinery, acquired foreign subsidiaries, and invested tremendous amounts of new capital. The industry had witnessed a rapid structural change, too, as a wave of mergers and acquisitions swept through it. The consolidation in the pulp and paper industry tended to favor vertical integration and, when possible, diversification into new paper products. Thus, the leading firms, which spearheaded the structural change, arrived during the 1970s at similar diversified, multidivisional corporate structures (Toivanen 2003; Ahola 2006).

Consolidation in the North American pulp and paper industry between 1950 and 1970 resulted in an industry with a handful of leading large-scale enterprises whose structures resembled each other. Spectacular mergers were typically attempts to create fully diversified pulp and paper firms, whereas only a few decades earlier, the industry had been characterized by careful vertical specialization. The new corporate structure brought important changes in the organizational capabilities of the firms, such as technological knowledge, manufacturing, finances, and scale and scope of operations. These changes, in turn, triggered pressures to adopt new organizational innovations that allowed greater managerial control and efficiency (Toivanen 2003).

Again, it was the industry leader, the International Paper Company, that spearheaded industry-wide organizational change. In the 1950s, it started to extend its geographical coverage to the Pacific, making it the first truly national US pulp and paper firm. It also decided to pursue expansion of its existing diversified paper product lines. Simultaneously, the company forged a global strategy by acquiring subsidiaries and contracting partnerships in Latin America and Europe. Yet the real avenue of expansion turned out to be specialized container products in the USA such as liquid packaging, corrugated containers, and folding cartons. After several decades of unsuccessful attempts, the company eventually emerged as a potential leader in these specialized market niches (Toivanen 2003; Lamberg 2006).

Why did it take several decades and many attempts for IP to successfully diversify from newsprint and book paper across almost the whole spectrum of paper and forest products? The answer lies only partially in the organizational capabilities of the company itself. Its financial situation in the 1950s was excellent, and it had acquired new technological capabilities in paperboard and paper converting in the years since the Second World War. Also decisive was the loss of competitive advantage by the leading firms in specialized paper products, as exemplified by

the difficulties of the Hinde and Dauch Paper Company and the Union Bag and Paper Company. These firms struggled with rapid technological change that resulted in the convergence of paper coating and converting operations. Much of the new business in the paper container industry after 1950 was in specialized grocery packages that required coated paperboard.

The enormous expansion of IP culminated in the reorganization of the company in 1977. Just as the company had half a century earlier pioneered centralized corporate structure in the pulp and paper industry, it now perfected the product-diversified, multidivisional corporate structure by replacing geographical divisions with product-focused divisions. The company reorganized into consumer packaging, industry packaging, specialty packaging, white paper, and wood products and resources divisions. This organizational innovation clarified the technological capabilities and underlying markets of the respective divisions. Although a new benchmark for the industry, IP merely exemplified one set of forces that drove large-scale pulp and paper enterprises toward diversification and a new corporate structure (Toivanen 2003).

A parallel is to be seen in the rise of Westvaco. In 1953, the world's largest manufacturer of corrugated paper specialties, the Hinde and Dauch Paper Company, and the leading US book and magazine paper producer, the West Virginia Pulp and Paper Company (Westvaco), announced a merger that created the seventh largest US pulp and paper firm.

The managements of Hinde and Dauch and Westvaco also recognized the convergence of their respective organizational capabilities. Hinde and Dauch was the leading corrugated paper converter and produced much of its own paperboard. However, new opportunities in the grocery packaging business required knowledge of coated paperboard, which it largely lacked. Westvaco, in turn, was the technological leader in paper coating and also a great manufacturer of paperboard. The merger of the two companies practically integrated their respective technological capabilities and gave the firm a competitive advantage in the emerging markets in paper packaging.

The merger with a leading paper converting firm prompted Westvaco managers to revise the corporate strategy. Reversing a strategy of vertical specialization in coated and book paper, Westvaco launched an aggressive strategy of expansion that extended the geographical and product scope of the company. Most importantly, Westvaco focused on regrouping the North American operations of its new division. Within two decades following the acquisition of Hinde and Dauch, Westvaco evolved from a producer of specialized coated and book paper into a firm with a wide product range and national, even global, scope (Toivanen 2003).

Among the pulp and paper firms that adopted the diversified structure, the Weyerhaeuser Company was a relative latecomer, perhaps because of the unique evolutionary path taken by the firm. The company cautiously diversified, or integrated forward, from its businesses in lumber and forestry into the production of pulp and paper. Incumbent pulp and paper firms typically diversified from the manufacture of high-volume undifferentiated paper products into specialized product lines, but Weyerhaeuser took the opposite path (Toivanen 2003).

By 1960 Weyerhaeuser was a relatively large pulp and paper firm, but the strategy of specialization had constrained the realization of potential economies of scale.

The acquisition of the Hamilton Paper Company in 1960 marked a departure from the strategy of specialization in the company's pulp and paper operations. Emulating the pooling of capital and technological knowledge in other pulp and paper firms, Weyerhaeuser now began to adopt a more aggressive strategy of expansion in paper. Yet again the firm embarked on a unique tactic, perhaps tapping its experience in forestry, and often reduced risks and costs of new investments by partnering with other firms. The opening of bleached sulfate mills in Canada in 1965 was typically such a partnership, likewise the move that completed the development of the firm's diversified structure (Toivanen 2003; Ahola 2006).

Weyerhaeuser had entered pulp and paper from forestry with the production of pulp and thereafter gradually added new paper product lines. With accumulating experience and the development of new organizational capabilities, the firm's ambition increased, and it began to make ever more significant moves into pulp and paper. Finally, in 1979, Weyerhaeuser entered the newsprint sector by establishing a mill in Longview with the Japanese Jujo Paper Company. The partnership completed a half century of evolution from a forestry and lumbering firm into pulp and papermaking. The unique organizational capabilities and managerial experiences of the company determined the strategy of expansion, yet the resulting corporate strategy was similar to those of other leading pulp and paper firms.

Many other firms followed suit, leading to a transformation of the industry. Specialized firms and smaller mills disappeared, geographical and industry concentration increased, and economies of scale assumed all-encompassing significance in the industry.[5]

3.5.3 Concentration

Overall, the trends of concentration and the drive toward economies of scale are well reflected in the aggregate production statistics. The total US market pulp, paper, and paperboard production capacity increased from 61,899 thousand tons per year in 1970 to 112,429 thousand short tons per year in 2000. The average annual growth rate for production between 1970 and 1980 was about 2.2% and slowed down to 1.8% during the 1990s (Li et al. 2004).

Between 1970 and 2000, concentration was a dominant central trend in the US industry. The top ten companies accounted for less than 35% of total national production capacity in paper, paperboard, and pulp in 1970, and this share increased to half by 2000. Moreover, the production capacity of each of the top ten companies doubled in that period (Ince et al. 2001).

A particular period of transition occurred in the 1980s, when important mergers and acquisitions took place. Nine of the top industry producers were acquired by

[5] For Mead and Champion, see Ahola (2006). For International Paper, see Lamberg (2006).

Table 3.10 Survival and growth of US pulp and paper mills by region, from 1970 to 2000

Region	Number of mills	Survivors (%)	Capacity share		Average mill growth
			1970 (%)	2000 (%)	
South	182	87.90	47.70	57.10	3.20%
North	404	69.90	36.40	29.10	−3
West	77	75.30	15.90	13.80	0.60%

Source: Li et al. (2004)

other companies. The market share of the 15 largest paper and board companies rose from 54% in 1983 to 68 by 1987. The market share of the top 15 pulp producers likewise rose from 56 to 70%. A merger wave swept through the industry in the 1980s and 1990s, strengthening concentration (Damani 2004; Urmanbetova 2004).

Another trend was the continuing pursuit of economies of scale. Between 1970 and 2000, the number of mills decreased as their capacity increased. The number of US pulp, paper, and paperboard mills decreased from 666 in 1970 to 530 in 2000, whereas average capacity increased from 62 to 114.4 million tons (Ince et al. 2001).

Finally, relocational dynamics subsided in the industry during the closing decades of the twentieth century. Boosted by the sulfate process innovation and establishment of distinct Southern forest product industrial system, the South emerged as the center of US pulp and paper industry, as shown in Table 3.10. The West still showed some growth until 2000, but a process of deindustrialization was already underway in the North, notwithstanding some key states, such as Maine.

3.5.4 The End of Specialization

Structural opportunities in the pulp and paper business triggered a phenomenal phase of industry growth between 1950 and 1990. Facilitated by innovation in machinery and paper products, the industry received a powerful impulse for efficiency improvement and market expansion. In order to capitalize on these opportunities and offset new competition from small and entrepreneurial rivals, as well as to navigate the new political economy, managers of incumbent forest products firms forged corporate strategies of expansion and diversification.

Typically, firms acquired new technological capabilities that enabled the vertically integrated production of new specialized paper products, in particular for the paper container market. When engaging in corporate expansion and diversification, the large pulp and paper firms relied on their existing organizational capabilities, as well as on past experiences that emphasized economies of scale and industry leadership. The consolidation wave resulted in the adoption by most of the leading North American pulp and paper firms of a diversified and multidivisional structure. By the late 1970s, the leading pulp and paper firms already resembled each other more than ever, and the homogeneity only increased as the century drew to its close.

3.6 The Evolution of the US Pulp and Paper Industry in Perspective

The expansion and evolution of the US pulp and paper industry since early nineteenth century were punctuated by successive waves of technological innovation. The largest of these, such as those concerning sulfite and sulfate pulp, corrugated paper containers, or newsprint, triggered fundamental structural changes. Smaller waves, such as those concerning tissue paper or machine coated printing papers, afforded avenues of expansion and growth. More than any other dynamic or structural factor, such waves, big and small, spearheaded the structural evolution of the US industry until the late twentieth century.

The importance of technological innovation reached its peak in the US pulp and paper industry by the 1950s and thereafter gradually lost its strategic importance. The industry and its leading firms attempted to preserve the strategic role of specialization, but the political economy effectively prevented this. The maturation of knowledge and technology mattered, too, and the fact that commercial turnkey equipment suppliers and consulting houses emerged as key providers of competitive technology, thereby lowering the barriers to entry into specialized markets.

Moreover, just as innovative paper products, such as toilet paper or the paper box, created completely new markets or captured markets from other existing products, the paper industry's business came under attack from synthetic materials and electronic computing. Yet, it appears that the most daunting challenge emerged from within the industry itself, as the Southern Hemisphere innovations in eucalyptus and acacia pulp processes and paper products undermine the Northern Hemisphere's competitiveness in forest industries. In a way, the US story is now replicating itself on a global scale. But as one door closes, another opens, and the US industry may well be preparing another long wave of innovations in bioenergy (Toivanen and Barbosa Lima Toivanen 2009).

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Chapter 4
The Paper Industry in Germany, 1800–2000

Olli Turunen

4.1 Introduction

Considering its size as a producer, an exporter and a market, it is strange that there should be so few German pulp and paper companies among the industry's international leaders. Germany is the biggest paper exporter in the world, the biggest paper producer in Europe and the fourth biggest in the world, yet only three German pulp and paper companies made it into the top 100 of the industry in 2010 and none made it into the top 50 (PPI 2011). Germany is also the biggest market in Europe and a major export market for European pulp producers. Due to the scarcity of domestic raw materials, it is a minor pulp producer compared to Finland and Sweden. However, its huge papermaking industry on a European scale makes Germany the biggest importer of pulp. Almost one fourth of all paper consumed in Europe is consumed in Germany (Verband Deutscher Papierfabriken 2011).

Most historical studies on the pulp and paper industry in Germany are regional studies (Geuenich 1959; Günter 1987; Heinzig and Richter 2005; Schmidt 1994), more ambitious works on the history and culture of papermaking (Kirchner 1897; Sandermann 1997; Schmidt-Bachem 2001; Tschudin 2002) or business histories (Schütze 1999). This chapter, in its limited space, combines this historical knowledge with relevant descriptive statistics in order to reach a better understanding of why the German pulp and paper industry, although operating in the major European market and producing more than anybody else, has not created dominating companies inside the country nor major international corporations worldwide as in chemicals, machinery or metals. The approach is historical: answers are sought relying on existing research and statistical sources to describe changes in production, trade, raw materials and technology; changes in firms and industry structure; and changes

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J.-A. Lamberg et al. (eds.), *The Evolution of Global Paper Industry 1800–2050: A Comparative Analysis*, World Forests 17, DOI 10.1007/978-94-007-5431-7_4,

in regulation. In addition, this chapter discusses government policies and major historical events and their effects on the pulp and paper industry.

This chapter presents a traditional chronology of German economic history (Ziegler 2000). Due to constitutional, environmental, legal and institutional change, the great turning points in German history had a decisive effect on the conduct of business. German early industrialisation started at the beginning of the nineteenth century. The pressure and shock created by the Napoleonic Wars caused the Prussian authorities to realise that profound economic and social reforms were needed if Prussia was to avoid declining into a third-rate power. The situation of paper manufacturing from the Napoleonic Wars and early days of industrialisation until the revolutions of 1848 is discussed in the first section. The midpoint of the century is a useful watershed, since it marked the invention of mechanical wood pulp as raw material for papermaking (Krawany 1910). Section 4.2 examines the industrial take-off in papermaking, which Dieter Ziegler (Ziegler 2000) dates to the period between 1848 and the founding of the German *Reich* in 1871. The era is marked by series of innovations that later defined the modern pulp and paper industry. Production increased 2,000% during the period (Salzmann 1911), and the production of soda pulp and sulfite pulp began in 1871 (Krawany 1910).

During most intensive industrialisation (*Hochindustrializierung*) from the founding of the *Reich* to the First World War, Germany surpassed its competitors. It became the leader of the second industrial revolution with highly competitive chemical and electric industries, and its net national product tripled (Pierenkemper and Tilly 2004). This is discussed in Sect. 4.3. The economic chaos and hyperinflation during the Weimar Republic as well as the development in the industry development during the Third Reich is considered in Sect. 4.4. Sections 4.5 and 4.6 describe the differences in between German Democratic Republic and the Federal Republic of Germany and the consequences of the reunification.

4.2 Early Industrialisation

The first German paper mill was founded in 1390 by Ulmer Stromer in Nuremberg; mills in Ravensburg (1402), Augsburg (1407), Strasbourg (1415) and Lübeck (1420) soon followed. At the end of the sixteenth century, there were 190 operational paper mills (Sandermann 1997). Once Johannes Gutenberg had introduced movable type and mechanical printing to Europeans in the middle of the fifteenth century, humanism and the Reformation took care of the demand for books and pamphlets. The demand created a flourishing paper industry during the sixteenth and seventeenth centuries. Therefore, the paper industry, in the sense of manufacturing, predates by far the rapid industrialisation of the nineteenth century; in 1908 there were more than 60 mills that had been operational ever since the eighteenth century, and 15 of these dated back to the sixteenth century (Krawany 1910). However, the reasons for Germany's prominence as regards comparative volume in the pulp and paper industry are more recent.

Table 4.1 Pulp- and paper-producing firms and personnel, 1875–1939

	Firms with more than five employees[a]	Personnel	Average firm size
1875	998	43,369	43
1882	1,197	53,644	45
1895	1,628	79,753	49
1907	1,772	114,377	65
1925	1,421	128,609	91
1933	1,022	98,359	96
1939	1,644	130,211	80

Source: Kaiserliches Statistisches Amt and Statistiches Reichsamt (1881–1943)

[a]Data records all production facilities (*Niederlassung*) as units. The number of actual companies is therefore smaller. Until 1907, firms with more than five employees are recorded. After that, handmade paper industry is excluded

It is difficult to posit comparable figures on the state of proto-industrial papermaking in Germany at the turn of the nineteenth century from the scarce sources and extant literature. There is a mention in 1785, according to which there were 400 paper mills in Germany producing 20,000 bales annually (Munsell and Henry 1980). In 1802 in Prussia, 1,300 people were employed in paper mills. This was approximately 17% of the total workforce employed in manufacturing and factories. Therefore, papermaking seems to have constituted a considerable share of industrial production, which, however, employed only 0.12% of the total population (Kaufhold 1976).

The *Statistik der Rheinbundstaaten* of 1812 mentions that paper was produced in excess of domestic demand. Its author states that in the former earldom *Grafschaft* of Mark alone, there were 18 paper mills, and in Mühlheim and Herborn there were many more. Coloured paper was manufactured in Duisburg and papier-mâché in Düsseldorf (Demian 1812). These are probably only a fraction of the paper mills since there is an official document from the Ruhr valley, mentioning 12 paper mills on the banks of the River Ruhr in the district (*Landkreis*) of Düren in 1804 alone. In 1807, there were 16 mills with 350 employees with a turnover of 650,000 francs, and in 1812 there were 17 mills with 38 vats to produce paper (Geuenich 1959).

The Statistical Handbook of the German Confederation (including Austria but not Hungary) in 1821 (Höck 1821) counts 500 paper mills with annual an production of about 50,000 bales of paper. The average production of a mill was therefore 100 bales. According to the handbook, domestic production could satisfy demand for print, notepaper (*Konzeptpapier*) and packing paper, whereas writing paper and finer grades had to be imported from France, the Netherlands and Switzerland. According to Munsell in 1831, 12,000 quintals, about 610 ton, of paper was imported to compensate for the insufficiency in German production (Munsell and Henry 1980) (Table 4.1).

The trade deficit remained stable despite a considerable increase in domestic production from 1.13 million reams in 1819 to 1.57 in 1827, a rise of 36%. This meant that number of paper mills increased from 329 in 1819 to 392 in 1827 and

vats used for production increased from 472 to 654 in the same period (Ferber 1829, 1832). If compared to the figures by Franz Krawany for the whole of Germany, this would mean that approximately half of the production facilities were in Prussia. In 1830, there were 780 paper factories and manufactures with 20 paper machines and 987 vats. The small number of machines shows how the industry was still manual excluding the milling process of rag. In 1846, the number of factories was 857 with 142 machines. There were still 1,097 vats in use (Krawany 1910).

Prior to the developments in technology in the middle of the century, paper mills had two obvious constraints in terms of location. Since paper was made of rag, the major manufactures were often located in the vicinity of textile-producing areas. Furthermore, papermaking required water as a power source and as part of the production process. The contemporary sources abound in disputes about these issues. In 1707, the papermaker Georg Thomas Hiller of Fockendorf in Altenburg complained that the mill race he shared with the local miller could not carry enough water for the paper mill (Heinzig and Richter 2005). Since clean water was essential for the quality of the paper, in the seventeenth and eighteenth centuries many manufacturers moved from the towns and cities closer to mountain regions in order to compete with the quality of French and Dutch papermakers (Günter 1987). The problem with raw material is described in *Jahrbücher der Preussischen Monarchie* from 1801. An article complains that the shiploads of exported rags are detrimental to the Prussian paper industry (Anonymous 1801). This was not a problem in the *Herzogtum* of Jülich, near Cologne, with a flourishing linen industry, which provided raw materials for the paper mills (Geuenich 1959). There were also complaints about the quality of German printing paper since the want of rags and the increasing demand meant that more and more paper was made from the same amount of rags (Munsell and Henry 1980). Before the turn of the nineteenth century, paper mills were to be found in large numbers in Silesia, Bohemia, Moravia, Brandenburg, East and West Prussia, Saxony, Württemberg, Baden and Upper and Lower Austria (Sieglerschimdt 1996).

In terms of trade, business and manufacturing environment, the German states posed some specific challenges, for politically and economically post-mercantile era Germany was a patchwork of small states. After the *Reichsdeputationshauptschluss* in 1803, most German states (*Länder*) were part of the French-led Confederation of the Rhine or otherwise dependent on Napoleon. Prussia and Austria struggled against the French influences. After Napoleon, the German Confederation, a combination of 39 states created by the Congress of Vienna in 1815, had neither legislative power nor a common customs policy. In addition to areas of modern Germany, it included Austria (but not Hungary) and Bohemia, whereas West and East Prussia were not part of the confederation (but other provinces of Prussia were). Customs frontiers between the states of the confederation formed a notable barrier to trade. By removing the internal tariffs between the provinces, the Prussian tariff law of 1818 formed for the first time a greater German economic area. This reform, inspired by Friedrich List, was soon followed by several other tariff policy arrangements to curb Prussia's influence. As a breakthrough, the *Deutsche Zollverein* (customs union) was formed by 18 states in 1834. In 1854, this arrangement included all the German

states but not Austria, the two Mecklenburgs and the Hanseatic cities. The customs union formed a unified economic zone and enabled common economic goal setting. In trade, the German states became better able to defend themselves against foreign protective tariffs and export policies. The founding of the German Empire in 1871 brought an end to the *Zollverein* since the constitution of the Empire stipulated that Germany constitutes one single country for tariff and commercial purposes (Anonymous 1899; Walter 2003).

In addition to a very fragmented state structure, the area that was later to become Germany had some distinct political features that had considerable effect on industrial development. In France and southern and western Germany, Napoleon had freed the populace from the most of the old feudal duties, but in Prussia, which was to guide the German industrialisation, the nobility had retained its power as the dominant group in society. The fact that the *Junkers* class dominated society, politics, economy and army for the most of the nineteenth century was important to the industrial development of Germany (Hallgarten and Radkau 1974).

Papermaking, like any other entrepreneurial activity, was strictly regulated during the preindustrial era. The German states and statelets monitored prices, controlled entry to the market and guaranteed the exclusivity of the guilds. Mercantilist policies were still practised at the beginning of the nineteenth century. State-owned companies had a decisive role, and this limited the scope for private initiative, though the state's role was changing towards a facilitating state which promoted industry. For example, in 1818 the first Fourdrinier machine in Germany was installed to the state's model factory in Berlin (Krawany 1910). To start a firm one needed authorisation. Concessions, charters, privileges like exemption from taxation, subventions and monopolies bound entrepreneurs closely to the ruler. Therefore, adeptness in diplomacy, intrigue, bribery and adaptation to administration were as important as capital, suitable workforce and technological and organisational skills (Berghoff 2004, p. 185; Schmidt 1994). For instance, when the export of rags was banned and gathering privileged in the *Herzogtum* of Jülich in 1726, a century-long dispute about who may collect and use the rags ensured. This ended in 1810 when the Federation of the Rhine declared freedom of trade (Geuenich 1959). Export bans on rags had been already been imposed in the seventeenth century (Toscana 1628, Brandenburg 1685, France 1697) (Kirchner 1897).

4.3 Industrialisation and Papermaking

As early as in 1852, a considerable change had occurred in German paper production and the direction of trade. Table 4.2 illustrates the transition from handmade paper manufacturing to mechanised industry from the 1850s onwards; the number of paper machines increased by 427% from 1846 to 1880. In trade, 20 years earlier hundreds of tons of paper was imported, but now, as the statistics of the German *Zollverein* (customs union) indicate in Table 4.3, Germany had become a major exporter. The quantity ratio of exports to imports in the paper trade quadrupled from

Table 4.2 The shift from handmade paper to large-scale pulp and paper industry in Germany, 1830–1908

	1830	1846	1880	1900	1908
Factories/mills	780	857	572	476	518
Paper machines	20	142	748	N/A	907
Vats	987	1,097	N/A	N/A	169
Cardboard fa ctories			448	413	
Cardboard machines				1,291	

Source: Krawany (1910) and Bienengräber (1868)

Table 4.3 Paper imports and exports of the Zollverein (customs union) all paper grades, 1842–1864

	1842–1845	1846–1850	1851–1854	1855–1859	1860–1864
Imports[a]	8,137	5,218	5,682	14,078	29,649
Exports	12,814	17,876	46,091	79,937	167,772
Trade surplus	4,677	12,658	40,409	65,859	138,123
Ratio of exports to imports	1.57	3.43	8.11	5.68	5.66

Source: Bienengräber (1868)
[a]All figures in Zentners, 1 Ztr. = 50 kg = 110.2 lb

1.57 to 5.66 in the period 1842–1864. In value terms trade surplus was 1.8 million *thalers* and the ratio of exports to imports 6.2 (Bienengräber 1868). Although the paper industry was growing fast, Germany was still, along with Italy, a major rag-exporting country. The industry in Great Britain used 120,000 ton of rags in 1854, of which three fourths were imported mainly from the aforementioned countries (Munsell and Henry 1980; see also Särkkä 2012 in this volume).

In the 1850s, machines were still the exception in papermaking, and the industry was fundamentally based on handwork excluding the process of rag beating (Kaufhold 1976). A stream of innovations was soon to change this. In 1859, Heinrich Voelter introduced mechanical wood pulp (invented by F. Gottfried Keller in 1844) to large-scale production. This for a while solved the problem of scarcity of raw material. The first wood pulp mills were founded in 1853. In 1880, there were 276 mills, and in 1908, 714 wood pulp mills with 2,063 pulp grinders (Krawany 1910).

In addition to the ongoing shift from proto-industrial to industrial production, the regulatory framework saw also important changes as the new unified exchange regulations were accepted in 1850 and the new code of commerce for the most of the German states came into force in the 1860s (Günter 1987). When the industrial revolution reached Germany from the boom years at the beginning of the 1850s, direct investment of merchant capital was no longer an adequate way to finance industries. The building of new factories, expansion of the railway network, steam-driven production and concentration of production in the new factories required such sums of capital that only few companies survived by means of self-finance. The joint-stock company was the answer. Between 1850 and 1857, 85 joint-stock companies were formed in Prussia and 61 in Saxony. This was a notable increase from the first half of the

nineteenth century, but the real heyday of joint-stock companies started after the changes in the legislation at the beginning of the 1870s (Kitchen 1978).

4.4 From Intensive Industrialisation Until the First World War

The pace of growth and industrialisation seen in Germany during the period from 1870 to 1913 was surpassed only in the United States. With minor qualifications this also concerns the pulp and paper industry. In 1875, Germany produced 29.4% of the total European production (approximately 0.4 million tons), whereas in 1908 it produced 30% of the total European production of paper (about 2.2 million tons) (Krawany 1910). The share of German production therefore did not change much, but the absolute production saw an almost six-fold increase. This was an unbeatable figure in Western Europe, but the relatively new entrants, Sweden and Finland, grew faster, which kept the German share relatively fixed. The German leap had occurred already in 1847–1875, when the increase was 2,000% (Salzmann 1911).

According to Joel Munsell, there were 243 paper mills in Germany against 408 in Great Britain and 276 in France in 1871, although Munsell mentions that sources disagree. This is indeed true since his figures for German factories are much lower than the figures in German sources. The overall production in Europe would have been 454,965 ton (Munsell and Henry 1980). For 1874, Munsell gives 423 paper mills with an annual production of 182,880 ton in Germany against 274 mills with the same amount of production in Great Britain and 404 mills and a production of 150,368 ton in the United States. According to these figures, Germany and Great Britain shared the top position and the United States, France and Austria followed (Munsell and Henry 1980). In terms of firms and their employees, however, probably the most reliable data comes from the *Statistisches Jahrbuch für das Deutsche Reich*. Although the relative growth of production during the nineteenth century industrialisation was considerable, the post WWII era saw growth on a different scale (Fig. 4.1). The figures in this statistical yearbook are much higher than in any previous accounts. The imports in paper and paperboard were 6,735 ton and exports were 30,115 ton in 1878 (Statistisches Amt 1880, pp. 78–79).

Although Germany was a latecomer in industrialisation compared to the United Kingdom, the catching up process was fast. During the latter half of the nineteenth century, Germany reformed its education system according to an international model. Education *per se* was not the objective, but the combination of emerging chemical and electric industries on the one hand and the university departments and research institutes on the other. This combination, which today would be called a national innovation system (Freeman 1995), provided an environment where researchers could move freely between the industries and research.

After the founding of the *Reich* in 1871, the economic policies were liberal. In wider sense, however, Chancellor Bismarck's struggle (*Kulturkampf*) against the influence of the Roman Catholic Church dominated the political agenda. Bismarck's economic policy concentrated on the liberalisation of the economy from conventional barriers. The new law on joint-stock companies and the lowering of the tariffs were

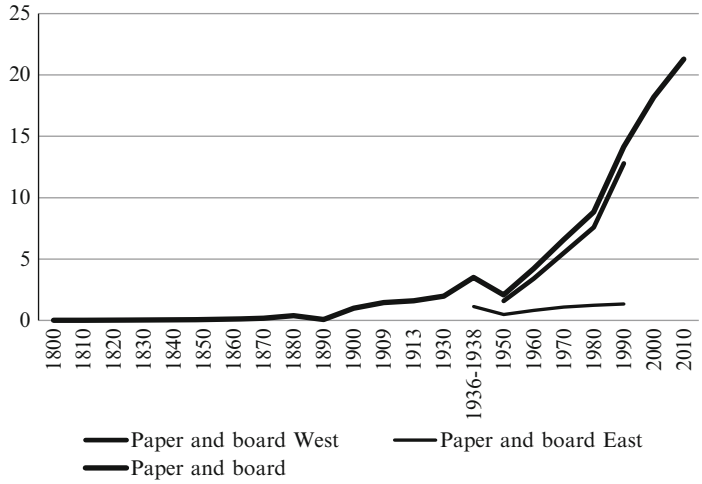

Fig. 4.1 Production of paper in Germany, 1800–2010 (million tons) (Sources: Kirchner 1897; Staatliche Zentralverwaltung für Statistik 1956; Statistisches Amt der DDR 1990; Thoma 1998)

to promote trade and industries. The founding of the *Reich* and the war indemnity paid by France raised a spirit of optimism, later called the *Gründerzeit*, (founder epoch) that was reflected not only in stock prices or growth rates but also in culture as the beginning of a new era (Dülffer 1997, p. 526). In a strictly economic sense, however, the unification of Germany was not a great change because, thanks to German customs union (*Zollverein*) and exclusion of Austria, the 'lesser Germany', later the *Reich*, had existed since the middle of the 1860s (Dülffer 1997).

Bismarck's liberalism was of the classical variety since it did not quite reach the workers. He was infuriated when a factory inspector criticised the conditions in a paper factory on his Varzin estate. Bismarck was against an extension of factory legislation because he claimed that such measures would damage competitiveness. Despite this, when the fight against socialism intensified, he saw the need to improve the living conditions of the workers. In speeches on the antisocialist laws of 1878, he emphasised that the fight against social democracy had to be complemented with measures to improve the situation of the workers (Feuchtwanger 2002). Characteristically for the Prussian military state, the first initiatives for labour protection had in fact come from the army to protect the military might of the state (Hallgarten and Radkau 1974). Furthermore, a study on the adherence to the child welfare law carried in 1874 in Germany concluded that the greatest number of violations was reported at paper mills (Günter 1987).

At the beginning of the period, the Franco-Prussian war caused a stimulus to the German paper industry since the invasion of France complicated paper production there, and German firms could win market shares in Switzerland, Italy, Spain, Belgium and Holland. Paper was also exported to America, India and Japan (Munsell and Henry 1980) (Fig. 4.1).

Cartelisation and concentration of industrial production increased rapidly during the last fourth of the century, especially in paper production. From 250 cartels in 1896, these arrangements increased to 385 in 1905 including more than 12,000 businesses. In paper production there were only six cartels, but they commanded 90% of the market share (Walter 2003).

From the founding of the *Reich* onwards, it is easier to analyse the development of the industry, since the *Kaiser's* statistical office (*Kaiserliches Statistisches Amt*) started to collect and publish relevant data for the whole country.

Although many of the major inventions in the paper industry were made before the 1870s, their diffusion and improvement continued. The sulfite process in pulp making was developed in 1872, and the transition from manual to machine production was completed (Salzmann 1911). One of the main development trends was the production process of the relatively new raw material cellulose. The shift to machine production during the nineteenth century meant that production increased approximately 50-fold from 1800 to 1900. From 1900 to 2010, it increased approximately 21-fold. Therefore, relative growth was faster during the nineteenth century, although the production was still far from modern figures.

The paper industry in Saxony secured a dominant position during this dynamic phase. In 1890 alone, 232 factories were founded (Barth and Rüther 2005, p. 1450). In 1908, Saxony produced 24%, 3.2 million quintals (162,000 ton), of the overall German production (Krawany 1910).

4.5 The Weimar Republic and the Third Reich

After the exceptional period of growth and increasing welfare between 1870 and 1913, history had an equally exceptional period of chaos in store. During the First World War, the change in pulp and paper industry employment was relatively moderate. The decrease in employees was 20% in 1918 compared to 1913 in firms with more than ten employees (Braun 1990). After the war, however, the German economy was a shambles. The hyperinflation was a shock for many contemporaries and had a bizarre twist to it from the viewpoint of the paper industry. Towards the end of 1923, more than 300 paper mills provided paper for 2,000 printing presses to supply the public with *Reichsbank* notes (Braun 1990). After the hyperinflation, a relative stabilisation took place. Growth of output per hour (in constant prices) in the paper and printing industries was 10% from 1926 to 1930, whereas the growth in all industries was 17% (Fischer 1976, p. 805). The value of paper industry production in 1927–1928 was 3.5 billion (5.7%) out of a total 61 billion *Reichsmark* (Levy 1935).

The economic crisis caused by hyperinflation and later the Great Depression intensified and gave new impetus to cartels, which had already dominated the industry before the war. Next to the general associations of paper and paperboard producers, many cartels and syndicates of different niche branches like print paper or cigarette paper came into being (Twerdochleboff 1934).

According to the cartel commission of 1905, the number of cartels, a producer organisation to fix prices and production at mutually agreeable level, was 353. In papermaking their market share was then about 90%. Twenty years later the number of cartels had increased enormously. In a survey by the Federation of German Industries (*Reichsverband der Deutschen Industrie*) in 1923, they were estimated to be 1,500 and 2 years later, in 1925, the government stated that there were 3,000 cartels with 2,500 belonging to the sphere of industry. In the survey by the federation, the number of cartels in the paper industry was 107 and in the iron and steel industry 307 (Levy 1935).

Such figures, according to Levy (1935), do not give a true picture of German cartelisation since they comprise organisations such as 'Konditionen-Kartelle', which were in fact agreements concerning certain trade usages (cf. trade associations in the USA), not agreements to regulate output or fix prices. In addition to cartels, there were supranational agreements, which were largely the result of post-war political decisions and affected trade in various industries. Some of the arrangements were designed to avoid the trade barriers between economic territories; some of them were designed to limit competition. For example, there was an arrangement in the paper trade (*Rotationspapier-Abkommen*), by which German manufacturers renounced their liberty to sell to the Balkan States and markets were left to Austrian and Czechoslovakian exporters (Levy 1935). Furthermore, there were bodies which tried to promote the pulp and paper industry on a European level. For example, in 1930 the European pulp producers agreed on a 20–30% production reduction to keep the prices up during the depression. This, however, caused pricing pressure from the North American producers (Reinhold 1932).

During the interwar period, the industry became increasingly dependent on forest and water resources. Canada overtook Germany in second place in production. The shares of many old paper-producing countries in Southern and Western Europe diminished (Twerdochleboff 1934).

The effects of the First World War and of the following hyperinflation are seen in paper consumption and per capita income. In 1924, German paper consumption (20 kg/capita) was notably lower than in the United States or Great Britain (50 and 33 kg/capita) and had declined in relative and absolute terms from the prewar figures (24 kg/capita). This is understandable given the hyperinflation of the previous years and the fact that per capita income was only 8.7 and 26.5% compared to that of the United States and Great Britain. Before the Great Depression, the consumption figure reached 27.7 kg per capita, but then fell to 22.7 in 1929. In the United States, the drop was from 100 kg per capita to 70.7 (Twerdochleboff 1934).

In 1925, due to the increase in paper production, Germany had to import 66% of its pulpwood. Imports had topped at 68% in 1924. From 1927 to 1930 the share of imports then decreased to an average 55.5%. The most important import countries were Poland and Finland (Reinhold 1932, pp. 119–120). This dependence on pulpwood and pulp imports led the German pulp and paper firms to invest in the east and north, for example, in Finland. Waldhof founded a big pulp factory in Käkisalmi, on the shores of Lake Ladoga, and other German firms established companies to take care of the pulpwood exports from Finland to Germany. This infuriated the Finnish paper producers, since the German hunger for pulpwood raised prices in Finland.

Furthermore, papermaking was domestic manufacturing in Germany protected by tariff wall, but the industry was large enough so that the small share of exports could shake the markets in Western Europe, which was the main market for the Scandinavian pulp and paper producers (Kuisma 1990).

The Second World War changed Germany's position in pulp and paper production significantly. In 1938, the Third Reich had a 12.4% share of world paper production and the share of imports in raw materials was only 3.3%. This was partly due to the Nazi regime's autarchic mindset. During the war almost the entire paper production capacity was directed to produce specialised paper products used in the war industry, from gas masks to submarines (Overy 1994, p. 290). After the war, the Federal Republic of Germany transformed into a pulp- and paper-importing country, since from the 1936 production capacity in pulp and mechanical wood pulp 57% was now in German Democratic Republic. In paper and paperboard production, the figure was 53%. This halving of the production meant bottlenecks in shipments, especially in grades formerly produced in the east. Before the industry could adjust its production to the new situation, the foreign competitors won considerable market shares. Furthermore, the shrunken industry had problems in producing the volumes due to the changed structure of demand for different paper types (Supthut 1973).

4.6 Papermaking in the German Democratic Republic and the Federal Republic of Germany

The Golden Age of 1950 to 1973 was the second period after 1870–1913 when the average Federal Republic of Germany GDP per capita growth was the highest in Europe (Maddison 2006). However, things were different for the German Democratic Republic. The problem of 'two Germanies' with different political and economic systems complicates the post-war picture of Germany as do the social and economic repercussions of the reunification.

4.6.1 Federal Republic of Germany

Although Federal Republic of Germany was a notable producer of pulp and paper, the share of the whole forest sector's production costs in 1954 was only 1% of GDP (Speer 1958, p. 155). During the period 1960–1980, the pulp and paper industry had declining shares in total gross value added, whereas the chemical, mineral, oil and plastics industries increased their shares fastest (Braun 1990).

In 1950, Federal Republic of Germany produced 1,144,207 ton of paper, 420,834 ton of paperboard and 497,672 ton of chemical pulp. Mechanical pulp produced amounted to 354,964 ton (Statistisches Bundesamt 1952). Despite all the problems, the value of exports against imports was still higher in paper and paperboard production. Mechanical and chemical pulp and pulpwood, however, were different stories. The worth of imports in pulp was four times higher than the value of exported

goods (Statistisches Bundesamt 1952). After the war, the share of imports grew for more than 20 years in West Germany. In 1971, 63.3% of demand was supplied with domestic production. Of the production costs, material costs were 48%. This underlines the problem of imported raw materials (Supthut 1973).

Before German reunification in 1989, Federal Republic of Germany with its 11 million tons of paper and paperboard was producing more paper than any other country in the EEC and EFTA. Globally, however, it was in the fifth place after the USA, Canada, Japan and the Soviet Union. Federal Republic of Germany's production was 31% of the total production in European community and 50% of the production in EFTA countries (Thoma 1990, p. 251). Papermaking was still a growth industry: production capacity had doubled from 5.5 million tons in 1970 to 11.1 million tons in 1989. During the same period the actual annual production increase was 5%, which was notably higher than the annual 2.6% growth rate of GNP. Future scenarios were also optimistic, since planned investments for the coming 5 years were eight billion *Deutschmark*. Investments in 1989 alone were two billion *Deutschmark*, which was 11% of turnover. This was twice as much as in other industries; the investments-employee ratio had tripled from 1984. The paper industry accounted for 93% of the whole pulp and paper branch; only 850,000 ton of pulp was produced (Thoma 1990).

The European common market exposed German industry to heavy competition abroad but above all in domestic markets. In 1989, the share of exports was 37% of production. Imports accounted for 46% of consumption. Destinations and the sources of exports and imports describe how internal market inside the EEC had already formed. Approximately 70% of the exports went to the EEC countries and more than 30% was imported from them (Thoma 1990).

4.6.2 German Democratic Republic

Before the Second World War, 35% of the German paper production had come from the Germany east of the Harz Mountains. Approximately 50% of this capacity, 105 paper machines, was dismantled by the Soviets in 1945–1946 and transported to the Soviet Union as war indemnity. In the Soviet-occupied zone, and compared to the prewar production levels, this loss in capacity was 55% in paper, 30% in paperboard, 48% in wood pulp and 24% in cellulose (Barth and Rüther 2005).

In Fockendorf, modern Saxony, this meant that on 11 July 1945, two high-ranking Soviet officers came to prepare a report on the Papierfabrik Fockendorf AG. On 23 March 1946, the dismantling of the facilities began. An authority of the district court in Altenburg wrote '[…] Our company is totally dismantled. We have an assignment to build it again. Our company is still a joint-stock company, but it will be soon owned by the state […]'. The machines were transported to the Soviet Union; only the empty buildings were left behind (Heinzig and Richter 2005).

In addition, forests were put under heavy stress in the Soviet-occupied zone. Felling of timber had already doubled during the Nazi regime. From 1946 to 1958, felling exceeded forest growth on average by a third. This meant that the regime

and its central planning commission had to devise schemes to improve forest use. One method was to use fast-growing trees (poplar), and the potential of making pulp from peat was considered (Wick 1970). When considering the loss in capacity and forest resources of the German Democratic Republic after the war, one should remember that Germany lost one fourth of its territory to Poland and the USSR.

The drop in production in the German Democratic Republic led to a drop in consumption. The prewar level in 1936 was 41.6 kg per capita. Five years after the war, in 1950, it was only 25.7 kg, a drop of 32%. Annual production of paper and paperboard was 430,000 metric tons. The pulp and paper industry was subordinated to serve the branches of industry considered more important. This led to the harmonising of innovation processes and common goal setting of cooperation partners. A centralised bureaucracy, *die Vereinigung volkseigener Betriebe* (later *Kombinat Zellstoff und Papier*), was established in Heidenau to manage production and investments (Barth and Rüther 2005).

In 1989, before the fall of the Berlin Wall, the German Democratic Republic produced 1.3 million tons of paper, paperboard and board (Fig. 4.1) and 400,000 ton of cellulose with net worth of 6.5 billion East German marks (DDM). The share of the pulp and paper industry was 1.4% of industrial production, and the branch employed 31,250 people. Productivity per worker was less than one fourth of the West German figure, 50 ton versus 220 ton. The consumption of paper was 85 kg per capita. Pulp and paper was produced in 122 facilities in 22 companies, which were subordinated to *Kombinat Zellstoff und Papier*.[1]

Along with the turning point (*die Wende 1989/1990*), the centrally planned economy of the German Democratic Republic started to crumble. This meant difficult times for the pulp and paper industry. Neither the firms nor their clientele or suppliers had any experience of an open market economy. Distribution networks collapsed overnight. The circulation of the economy ceased, which complicated debt servicing, which compromised the liquidity of the firms. With dwindling opportunities on the market, many firms struggled to survive (Barth and Rüther 2005).

The change, with its currency reform, was so rapid that the companies had no time to grasp or apply the principles of western markets, finance or accounting. The 126 production sites of the *Kombinat Zellstoff und Papier* were reassembled into 35 joint-stock companies. The companies acted according to the reorganisation instructions given by the *Treuhandanstalt,* an agency established to privatise the East German enterprises (Volkseigener Betrieb, VEBs), which led to break-ups, outsourcings and closures (Barth and Rüther 2005).

The government in Bonn took two decisions with grave implications for privatisation. First, the decision to set the exchange rate between German Democratic Republic and the Federal Republic of Germany currencies DM and DDM at 1:1 until 2000 placed a heavy burden on the economy of the former Federal Republic of

[1] Figures from (Barth and Rüther 2005, p. 1451). Official statistics of the GDR give 50,406 employed, 2.0% of the industrial production and only 77 companies, see Statistisches Amt der DDR 1990 (p. 158).

Germany and on the other hand quadrupled the liabilities of the former German Democratic Republic because the real external value of the eastern currency against that of the former Federal Republic of Germany had slumped to 1:4. Second, the *Treuhandanstalt* was guided by a policy of fast privatisation (privatisation before reorganisation) because the government believed that the private sector would restore the profitability of the industry faster (Schröter 2000).

These measures opened the way for foreign and domestic investors, for the restitution of some former family businesses to their owners and for management to learn the ways required by the market economy. Some of the factories were bought and reorganised by the western firms, many were bought back by their former owners, and the rest were managed and streamlined by the *Treuhandanstalt* for possible investors or were liquidated. In 1992, two thirds of the industry was privatised. The same trend continued for some years. The drama of the measures is apparent in the figures. The number of manufacturing facilities dropped by 47% from 1989 to 1992, the number of people employed by 80%, the number of paper and paperboard machines by 51% and the number of pulp digesters by 98%. Production plummeted by 53% (Barth and Rüther 2005, p. 1450).

4.7 The Pulp and Paper Industries in a Reunified Germany

If the rate between the two currencies (DM and DDM) had been set according to real exchange rate, it would have given the eastern economy a considerable advantage in production costs. In 1992, total manufacturing productivity in the east was only 27.1% compared to the west. From this level it rose to 42.6% in 1994. Lower hourly labour costs, 63.7% in the paper industry in 1995, and longer weekly hours could not therefore offset this productivity gap (Lange and Shackleton 1998, pp. 100–103).

As in the Nordic countries (Fellman et al. 2008), globalisation has put considerable strain on the German model of advanced capitalism (*soziale Marktwirtschaft*) that was widely implemented also in Nordic countries. The system, a result of a long and slow process with socially instituted and circumscribed markets, negotiated firms, facilitating state, associational self-governance, and tradition of long-term commitment and continuity, was considered to be in crisis. During the 1990s, the shock of reunification and the possible 'secular exhaustion' of the model caused further strain on the system (Streeck 1995, pp. 2, 17).

Furthermore, although proven especially efficient in a national setting, the German model has been sidelined in the internationalising process of capitalist economies. What has been adopted is limited to institutions that make or accommodate markets to the exclusion of others. Institutions that socially embed and correct such markets are equally central to German capitalism but did not, or *were* not, at least in the 1990s, diffuse to the international economy (Streeck 1995, p. 25).

Wolfgang Streeck has listed the institutions that facilitated the 'German way' (*deutsche Sonderweg*) in the Federal Republic of Germany after the Second World War and why they seem to fail in an international, borderless, economy. First, *Soziale Marktwirtschaft* was based on a complex domestic class policy, whereas international

Table 4.4 Turnover and employees of the pulp- and paper-producing firms in the former East Germany

		1989	1990	1992	1996	2004
Firms/plants	qty	21/122	27/102	21/65	37/44	40/42
Employees	qty	31,250	19,400	6,200	4,400	6,500
Paper and cardboard machines	qty	121	100	59	44	40
Pulp digesters	qty	42	37	1	1	2
Turnover	million	N/A	235[a]	353	783	1,450
Production	1,000 t	1,260	900	587	1,192	1,965
Privatisation rate	%	0	9.8	58.5	100	100

Source: Barth and Rüther (2005)
[a]2. half-year investments, 1990–2004 4,276 million

markets are constituted through diplomacy and relatively open markets. Second, instead of the individual firm and its competitive interests, the German firm was based in the broader German political and institutional context. Third, international state-like forms of public economic governance are weak and fragmented compared to the nation state, for example, in Germany. Fourth, German associations have prospered because of their close relationship with the facilitating state, which is not present in the international economy. Finally, German traditionalist economic culture thrives on long-term incremental improvements and requires stable commitments and the suppression of opportunism (Streeck 1995, pp. 25–26).

At the turn of the millennium, the German pulp and paper industry consisted of 170 firms, of which only six were producing mechanical pulp or cellulose. The production of paper, paperboard and cardboard employed 46,900 people with a turnover of 14.4 billion, whereas the production of mechanical pulp and cellulose employed 1,410 people with a turnover of 386 million. Investments were respectively 7.2 and 7.6% of turnover, while the average for all German industries was 4%. The whole pulp and paper trade, with the paper-processing and paper-packaging industry included, employed 148,810 people in 849 firms with a total turnover of 31.4 billion. Investments for the whole branch were 6.4% of the turnover. The paper branch as a whole accounted for 2.3% of the German production industry. Investments in the branch were 3.8% of total investments in the production industry, even though there was a drop of 12.4% from the previous year (Statistisches Bundesamt 2002, pp. 12, 25 and 57). Table 4.4 illustrates the fate of the German Democratic Republic paper industry after reunification. The 79% drop in employees and big drops in machines and factories against the increased production and turnover show how the industry has been streamlined.

Such were the effects of the Second World War, war indemnities, socialisation, central planning and finally privatisation and market forces that what was once the most dynamic area of pulp and paper branch producing more than half of the German production before the Second World War shrunk to a (marginal) periphery of the branch with an 8.2% share of turnover (2001). Of the former German Democratic Republic states, only in Thüringen did any domestic wood using pulp or paper industry survive in 1997 (For further information, see Thoma 1998).

International concentration of production in the pulp and paper industry has changed the industry in Germany, although there are still a considerable number of small niche producers. Many traditional companies and family companies have been sold to big Nordic firms such as UPM-Kymmene, Stora Enso and Norske Skog. For example, the Finnish Enso bought a controlling interest in the German E. Holtzmann and Cie AG in 1997 (Anonymous 1997) and Haindl, founded in 1849, was sold to UPM-Kymmene after five generations as a family business (Iivonen 2002). Before the deal was closed in 2001, Haindl had a production capacity of 2.7 million tons per annum with a turnover of 3.2 billion DM. UPM sold two of the six Haindl mills directly to Norske Skog (Anonymous 2001).

During the 1980s and especially during the 1990s, public concern for the environment brought new kinds of challenges to the pulp and paper industry. The strong environmentalist movement in Germany has challenged both domestic and foreign pulp and paper producers. At the beginning of the 1990s, Greenpeace launched a frontal attack against paper producers and print media. It was based on exaggerated threats to forest nature but on the other hand forced the industry to react seriously to the demands presented by the environmentalists and to participate in eco-labelling and forest certificate projects (Erskine and Collins 1997; FAZ 1993). In Germany, this environmental trend was so strong that from 1986 to 1991 the willingness to pay more for environmentally compatible products increased from 30 to 45% of the adult population (Becker 1993).

4.8 The German Pulp and Paper Industry in Retrospect

Despite fundamental changes in technology and constraints in production for over 200 hundred years, Germany has managed to retain its leading position in European paper manufacturing from the early nineteenth century onwards. This state of affairs is largely due to the fact that Germany is also the biggest market in Europe. Nevertheless, the German pulp and paper industries lost its dominant position in globally after the Second World War.

The industry that enabled the rise of a bureaucratic state, literacy, newspapers and to some extent western culture in general now faces challenges as the internet and personal computing threaten to take away its core customers. Furthermore, the paper industry in Germany has faced many challenges in recent years as national boundaries have quickly lost their significance and national industries have become part of international decision-making within a local context.

As to why Germany does not have its own global pulp or paper giants, even though it is the biggest producer and market in Europe, we can only present broad answers. One possible explanation is that Germany, or the territory it covered at reunification, has a long tradition of monopolies, guilds, protective tariffs and cartels. The old structure of privileges, corporatism and state guidance was embedded in the structure of emergent industrialism in an effective way. The old-landed aristocracy, the *Junkers*, already held the reins of society and the economy. To illustrate this situation, the story of Bismarck's rage in the case of the inspection of his paper factory

on his estate is a case in point, as is the story of paper manufacturer Diederich Hessling, the protagonist of the Heinrich Mann's novel *Der Untertan* (1918).

Some of the privileges and monopolies in papermaking and collecting rags extended to the 1870s, and thereafter cartelisation shielded the companies from the fiercest foreign competition. In many ways, the trade unions and associations continued from where the institutions of the mercantile era left off.

The fact that Germany has a large and significant domestic market has lessened the need for consolidation in the industry. Since the domestic market is large enough, it has not been indispensable for paper producers to look for export markets and thereby create the corporate structure of an international company. Many of the German producers have been small and local, supplying, for example, the newspapers in the surrounding localities. Recycled fibre is an important raw material for these small-scale local producers.

It is also worthwhile to consider the structure of the industry before the Second World War. Most of the production and of the largest producers were situated in the east, for example, in Saxony. The eastern part of the *Reich* had also better forest resources. Therefore, the division of Germany and the moving of the border to the west probably had a profound impact to the future prospects of the German pulp and paper industry. One should not forget to mention perhaps the most obvious reason: Germany's relative advantage just was not in papermaking. Compared to the steel, coal, electric, chemicals and machinery industries, the role and value of papermaking among the larger industries in Germany was modest.

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Chapter 5
An Accomplished History, An Uncertain Future: Canada's Pulp and Paper Industry Since the Early 1800s

Mark Kuhlberg

5.1 Introduction

Canada's status as a 'New World' country with a relatively small population and abundant natural resources dictated that the pulp and paper industry arrived late, enjoyed rapid growth that propelled it into a prolonged period of international ascendancy, and then suffered a steep downturn in its fortunes, one from which its escape is hardly assured. This chapter will trace the industry's development from the early 1800s until today, focusing in particular on corporate strategy, industry structure and the role of the government. While these three areas saw numerous trends come and go, several became defining features. In terms of corporate strategy, there was a consistent drive to rely on the strengths accruing from the country's natural resource bounty instead of investing heavily in research and development; firms also demonstrated a tendency to grow through domestic mergers and acquisitions. As for corporate structure, the industry witnessed a gradual shift away from tiny operations that were owned by and produced for local communities towards international corporations which remained Canadian-centric and relatively small in terms of their production facilities and capital invested. Finally, various levels of government aimed either to foster the industry's development or support its activities, although there were a few glaring exceptions to this generalization.

Several groups and persons should be recognized for the valuable contributions they made to realize this project. These include my home institution, Laurentian University (LU), which supported my research through a grant from its research fund (LURF). Sylvie Lafortune, LU's Government Information and Data Librarian, was extremely helpful in responding to my requests for statistics. The Pulp and Paper Products Council in Montreal graciously made its historical records available to me. Several researchers, namely Eric Harding, Cody Cacciotti, and Aaron St. Pierre, helped me collect and interpret the relevant data. To all of them, I owe a debt of gratitude.

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J.-A. Lamberg et al. (eds.), *The Evolution of Global Paper Industry 1800–2050: A Comparative Analysis*, World Forests 17, DOI 10.1007/978-94-007-5431-7_5,

The development of the industry can be subdivided into four major periods. The first, running from roughly 1800 to 1900, saw the industry establish itself as a relatively tiny, diversified, community-based concern. By the late 1800s, its shift to using wood instead of rags as its raw material recast its focus on groundwood pulp-based products and imbued the provincial governments, which controlled the bulk of natural resources in Canada, with enormous power over the industry. The next period, 1900–1945, was marked by exponential growth – overwhelmingly in newsprint – that was driven by the practically irresistible allure of the country's prodigious supplies of pulpwood and water powers. The industry became a world leader and largely American-owned and controlled and demonstrated an unrelenting drive to collude. The third stage, 1946–1972, witnessed the industry's greatest growth ever, in no small part due to favourable provincial policies. The final period, 1973–2010, was dominated by an ever-increasing array of difficulties that caused the industry to be mired in a morass from which it had not yet emerged 10 years into the twenty-first century.

5.2 Founding an Industry, 1800–1900

5.2.1 The Nascent Years, 1800–1850

As a frontier society at the turn of the nineteenth century, British North America (BNA), as Canada was then known, was hardly ripe for the development of a pulp and paper industry. Its non-native population of under 500,000 was spread over thousands of square miles and was intensely focused on carving farms from the local woodlands. Nevertheless, many of the immigrants who came from Europe had a long tradition of both political engagement and literacy, and these forces created a modest demand for paper. The government of the day endeavoured to promote the growth of the small-scale mills that were eventually constructed to supply this limited demand and other parochial paper needs, although together they hardly constituted an 'industry'.

While the colony's relatively tiny need for newsprint just after the turn of the nineteenth century was satisfied by imports from the United States, gradually mills sprang up to supply local newsprint requirements, and naturally they were located in the colony's most densely peopled region. BNA expanded rapidly during the 1800–1850 period, with the population of the largest 'province', Upper Canada[1] (today Ontario), reaching nearly 1,000,000 by mid-century. The demand for newsprint grew instep, particularly because this burgeoning population was highly politicized and the period's newspapers were partisan. As a result, practical factors

[1] Upper Canada was renamed Canada West in 1840, but for simplicity, it will be referred to as Upper Canada for the period preceding Canada's creation in 1867.

(e.g. high transportation costs, the scarcity of foreign currency and high-quality linen rags, and the long wait for delivery) and political ones (e.g. a lobby by businessmen keen to foster the development of home industry in general and newspaper publishers supportive of establishing a domestic paper industry in particular) made it expedient to create domestic papermaking capacity. In the early 1820s, the government in Upper Canada began offering a bounty to anyone who would do so. The British government also implemented a general tariff on most imports in 1825, and although it was eliminated in the 1840s, the tariff on paper imported from the USA remained and actually increased in the 1850s. These incentives succeeded in facilitating the construction of numerous mills in southern Ontario, with the first ones located in what are now Toronto and Hamilton, respectively. Because demand for newsprint still outstripped supply, another force arose – one that would remain a feature of the industry until recently – that pushed capital to invest in new newsprint capacity; newspaper proprietors backed ventures to guarantee that their paper needs would be met. In the main, the mills from this period were located in urban centres in order to be close to their market and source of raw material (i.e. rags), and most were relatively puny, often supplying only one major newspaper and sundry others (Blyth 1970; Carruthers 1947).

The same factors were also collectively the impetus behind the industry's birth and early development elsewhere in BNA, specifically its urban centres. Lower Canada[2] (today the province of Quebec) boasted a population of roughly 250,000 in the early 1800s, and within 50 years, it had grown to just under 900,000. Not only had this precipitated the construction of a number of pulp and paper plants, most of which produced newsprint, but Lower Canada had also been the site of the first paper mill in BNA. Over the course of 1803–1805, James Brown, a newspaper publisher, had established the Argenteuil Paper Manufactory in St. Andrews East (near present-day Montreal); the newspaper associated with this mill eventually became known as *The Montreal Gazette*, which still survives. Farther east, in the colony of Nova Scotia, Anthony Holland, a German immigrant and newspaper publisher, built a paper mill near Sackville in 1819. This was 4 years prior to the local government offering a bounty to encourage the construction of such facilities (Carruthers 1947).

The first half of the nineteenth century thus established a few trends for the production of pulp and paper in Canada. In terms of corporate strategy, mill proprietors had located their enterprises largely in the country's heartland (i.e. what would become the provinces of Ontario and Quebec), the area in which most of the colony's citizens lived. Second, many newspaper owners had invested in mill ventures in an effort to assure their paper supply. The industry's structure was defined by a smattering of relatively small producers which were mostly owned within the communities in which they both operated and sold their products; most also turned

[2] Lower Canada was renamed Canada East in 1840, but for simplicity, it will be referred to as Lower Canada for the period preceding Canada's creation in 1867.

out newsprint. Finally, practically from the time that the first facility was built in BNA, government – in this instance colonial – used its power to encourage the industry's development, a theme that would become more pronounced in the years to come.

5.2.2 The Adolescent Years, 1850–1900

This period saw both Canada's formation as a country in 1867 and the sowing of the seeds for its 'modern' pulp and paper industry. In terms of corporate strategy, this era was paradoxically marked by growth through both diversification and specialization. The industry as a whole saw a shift from strictly locally owned to domestically owned firms, the rise of several dominant family enterprises, a continued focus on domestic markets but the increasing importance of foreign ones, and the loosening of but continued ties between newspaper publishers and paper mills. Finally, government continued to play various roles in the industry's development during these years.

Around the middle of the nineteenth century, the colony's pulp and paper industry underwent a major transition. Mill owners began making much greater volumes of new products such as printing, wall and wrapping paper, and the rapidly rising literacy rate and expanding education system spurred the growth of the domestic book paper industry. In addition, newspapers continued to enjoy robust growth during the 1850s, and the newsprint industry both expanded its capacity and consolidated its ownership during the same period. Because demand outstripped supply and despite another increase in the tariff, significant volumes of newsprint (£18,000 worth in 1856) were still imported. The American Civil War (1860–1864) cut off the supply of this type of paper, however, thereby creating a vacuum into which domestic producers aggressively moved (Blyth 1970).

John Riordon led the charge and is often credited as being 'the father of the Canadian newsprint industry'. Over the course of 1862–1863, he built the country's largest mill at Merritton along the Welland Canal in southern Ontario, both to tap the waterway's hydraulic energy and minimize shipping costs to his most important customer, *The Toronto Globe*. In the latter part of the decade, Riordon's eponymous firm became arguably the first in Canada to convert to using wood instead of rags as its raw material (i.e. making and using groundwood pulp), allowing the enterprise to produce at the then unprecedented rate of 10 ton/day (Kuhlberg forthcoming).

The Riordon Company's evolution during the rest of the century was, in many ways, a template for the rest of the industry over this period, particularly in terms of corporate structure and strategy. Most notably, it was common for pulp and paper enterprises to be family-owned and operated during this epoch. Senator J.B. Rolland, for example, founded the Rolland Paper Company Limited, in Valleyfield, Quebec, in 1882, a firm whose brand name still survives. Moreover, Riordon initially turned out a wide array of paper products, as did most of his rivals, including the Dominion Paper Company, which was established in Kingsey Falls, Quebec, in 1872 (this site is now home to Cascades, which is discussed in Sect. 5.4). But for Riordon and an

ever-growing number of his peers, the trend was towards specializing in specific grades of both pulps and papers despite the numerous obstacles to doing so. Because Canadian firms were relative latecomers to and very small-scale players in this industry, they lacked the technological expertise to develop domestically the machinery needed to accomplish this aim and were forced to import it from Europe and the USA. In the late 1880s, for instance, Charles Riordon partnered with John R. Barber, another pulp and papermaker to bring the Ritter-Kellner (i.e. direct-cook) method from Europe and install it in a new, large mill they built in Cornwall, Ontario. Around the same time, E.B. Eddy, another eponymous firm, introduced the Mitscherlich process for making sulphite pulp on an unprecedented scale in Canada when he installed it in his mill in Hull, Quebec. Concomitantly, a number of other firms, of which the first was Alexander Buntin and Company in Valleyfield, Quebec, established large groundwood mills. Practically all processed softwood fibre and exported to the USA the surplus pulp they could not market domestically, but Buntin's operation was unique. It had imported the mechanical pulp process perfected in Germany by Heinrich Voelter to break down hardwood logs, and he was soon selling his production in England (Blyth 1970; Carruthers 1947; Hamelin and Paquin 1990).

Over the last decade of the nineteenth century, the Canadian industry expanded in ways that foreshadowed the explosive growth it would soon enjoy. One of the major trends was the creation of much larger, fully integrated mills, a movement sparked largely by groundwood producers realizing that they could generate much higher profits by adding paper (nearly always newsprint) mills alongside their pulp-producing lines. When they did so, they often installed the most modern equipment, thereby allowing the Canadian industry to begin achieving the economies of scale that would power its increasing importance in the international arena. Whereas the country's pulp and paper mills had typically been capable of producing but a few tons per day in the 1870s, two decades later new operations boasted a capacity of over 50 tons and often much more. The Laurentide Paper Company exemplified these developments. Organized in 1882 as the Canada Pulp Company in Grand'Mère, Quebec, to tap the hydroelectric potential of the Maurice River, it went through several owners (including iconic pulp and paper industrialists Albrecht Pagenstecher and Warren Curtis from the USA). By the end of the century, it was a fully integrated newsprint mill whose 75-tons capacity made it the largest operation of its kind in Canada (Carruthers 1947; Niosi 1975).

The conversion to processing wood instead of rags (which required relatively large amounts of power), operating dramatically expanded mills, and specializing in groundwood pulp and newsprint thrust the provincial governments into playing central roles in the future of the pulp and paper industry. Beginning in the late 1800s, existing and potential pulp and papermakers gazed longingly upon Canada's vast timber (specifically its spruce and, to a lesser degree, its balsam fir and hemlock) and hydropower resources. The provinces in central Canada (i.e. Ontario and Quebec) were particularly well endowed with both, while other provinces, such as British Columbia on the Pacific coast and New Brunswick and Newfoundland on the Atlantic, less so. Furthermore, Canada's colonial legacy left the 'public domain'

in the hands of the state or 'Crown', and it had a tradition of leasing – and not selling – the right to access these particular resources to business interests; nearly all the country's timber tracts and water powers thus remained under public – instead of private – control. Moreover, the country's constitution gave its provinces, not the national government, control over these Crown resources. The upshot was a situation in which politicians who held power in Quebec and Ontario – and to a lesser extent in the other aforementioned provinces – could essentially dictate the terms under which the pulp and paper industry would develop and operate.

Several factors made the potential of establishing mills in Canada at this time particularly appealing to investors. In the late 1800s, the American pulp and papermakers were rightfully expressing grave concerns over their future fibre supplies, a realization that had spurred many of them to begin exporting pulpwood from Canada. Problems arose with this strategy, however, when both the Canadian and provincial governments began either threatening to implement or implementing nationalist policies that were ostensibly intended to foster the development of a domestic pulp and paper industry by prohibiting the export of unprocessed logs. At the same time, the American newspaper industry was enjoying dramatic growth. In addition, a railway-building frenzy in Canada at and just after the turn of the twentieth century opened up previously inaccessible pulpwood and water power resources in northern Ontario and Quebec and made it feasible to transport pulps and papers made in these hinterland areas to distant markets (United States 1908).

The 1890s thus signalled the beginning of successive mill-building waves, usually in relatively remote sections of central Canada, by entrepreneurs who entered into contracts with various provincial governments to lease pulpwood limits and/or water powers; these agreements dictated the conditions under which the enterprise would develop. The deal Francis H. Clergue signed to erect a mill at Sault Ste. Marie, Ontario, was typical. As an American industrialist looking for an investment opportunity in the natural resource sector, he acquired the rights to the Canadian portion of the water powers on the St. Mary's River (which empties Lake Superior into Lake Huron) and created a host of industries to use the energy, one of which was a pulp and paper mill. To provide it with timber, he entered into a contract with the Ontario government in 1894 that bestowed on him the privilege of cutting pulpwood from an area north of the city for 21 years. In exchange, he was obliged to spend a certain amount of money on constructing the pulp and paper plant and employ a specified number of workers each year of the contract's duration. By the end of 1895, he had incorporated the Sault Ste. Marie Pulp and Paper Company and begun producing from its 150-tons groundwood pulp mill, and 4 years later, the company manufactured its first paper. During this same period, the Ontario government signed a series of similar contracts that would lead to the construction of a few additional mills in the province's northern reaches (Kuhlberg 2002).[3]

[3] These years also saw a fleeting attempt to establish the industry in British Columbia, specifically in Alberni on Vancouver Island (Carruthers 1947; PPC 2004).

The industry's growth and development fuelled a drive to maximize profits by using several schemes to cooperate instead of compete, a tendency that would become – for various reasons – a trademark feature of the Canadian pulp and paper industry for much of the twentieth century. Occasionally, this involved sharing ownership of mills. The manner in which ostensible rivals Riordon and Barber jointly built their new sulphite mill in the 1880s was a classic example of this practice. More common was the formation of combines that attempted to control the marketing of paper products. The first known scheme was launched in the late 1870s by the country's largest newsprint makers, a lead the wrapping papermakers followed a few years later. When renewed attempts by newsprint makers to collude failed in the mid-1880s and early 1890s, they successfully lobbied the Canadian government in 1897 to impose a 25% *ad valorem* duty on imported newsprint, thereby practically reserving the domestic market for themselves. Three years later, Laurentide led them into a formal association that achieved their goal of raising prices. The Canadian government acquiesced to the newspaper publishers' vociferous campaign for an investigation, which uncovered the scheme. In an attempt to restore competition, the government lowered the tariff on imported newsprint (Carruthers 1947; Canada 1902; Niosi 1975).

By the dawn of the twentieth century, the Canadian pulp and paper industry was therefore on the verge of a major breakthrough. It was quickly acquiring the scope of operation needed to compete on the world's stage, and it had barely tapped the country's seemingly infinite natural resources in doing so. This left tremendous room for the industry to expand in the future, a process over which the provincial governments would loom large.

5.3 Extraordinary Growth, 1900–1945

As the world's second largest country in terms of land mass and with its population growing at breakneck speed in the early 1900s, Canada's prime minister had good reason to trumpet at the time that 'the twentieth century shall be the century of Canada'. The *Pulp and Paper Magazine of Canada*, established in the spring of 1903, was caught up in this *Zeitgeist*. It boldly declared in its inaugural issue that its existence had been inevitable because the nascent nation was 'destined to be the greatest pulp and paper manufacturing country in the world' (PPMC 1903). Laurier's prognostication would prove to be off the mark, but the magazine's prediction turned out to be remarkably prophetic.

The Canadian pulp and paper industry enjoyed truly explosive growth from 1900 to 1945, and despite facing major challenges during the Great Depression, it established itself as a powerhouse in the international arena by becoming the world's dominant newsprint producer. The firms pursued a corporate strategy that fractured the industry into two grossly uneven and practically exclusive parts. The preponderant one was shaped by the activities of a few relatively large corporations (roughly half American owned) in the newsprint sector which sold largely to the US market.

The other was driven by a handful of relatively small, largely domestically owned firms that specialized in manufacturing pulps and non-newsprint grades of papers, almost exclusively for sale in the domestic market. Firms in both spheres repeatedly aimed at, and ultimately succeeded in, controlling their businesses by colluding. Finally, the industry's meteoric growth in Canada during this period reflected the influence of both internal (i.e. domestic) and external (i.e. international) factors.

5.3.1 Internal Factors for Growth

The leading internal factor for growth was the irresistible allure to entrepreneurs of Canada's prodigious supplies of potential hydroelectric sites located either amidst or very near huge tracts of pulpwood. The seemingly limitless supply of these resources, which could be readily processed into groundwood pulp and newsprint, predictably relegated the production of other types of pulp and paper to positions of ancillary importance until after the Second World War and pushed the Canadian industry to focus its efforts on building fully integrated newsprint plants largely in Ontario and Quebec. This process was facilitated by another flurry of railway construction during the first decade and a half of the twentieth century (Carruthers 1947).

Naturally, the provincial governments that controlled these Crown resources could exercise a fundamental influence over their exploitation, and although facilitating development was logically a priority in these polities, it did not always translate into them demonstrating a favourable attitude towards pulp and paper industrialists. In the main, provinces with economies that were heavily dependent upon the commercial development of forest resources – such as New Brunswick and British Columbia, for example – were highly receptive to requests from pulp and paper entrepreneurs for guaranteed access to a perpetual supply of government-controlled water powers and pulpwood on terms that were advantageous to the business interests (Parenteau 1994; Rajala 1998). In stark contrast, however, a province such as Ontario had long boasted a highly successful and well-diversified economy, one in which the forest industry had been important but certainly not the buttress upon which its prosperity rested. As a result, the political interests controlling its Crown pulpwood and water powers did not feel the need to acquiesce to the requests made by pulp and paper entrepreneurs (Kuhlberg 2002).

Another significant internal factor that influenced the Canadian pulp and paper industry's extensive development during this period was the country's tariff policy. Producers of non-newsprint grades of paper, for instance, had traditionally enjoyed significant protection from foreign competition. The years between 1900 and 1945 also saw Britain extend tariff protections to all 'home producers', such as Canada, within its empire. This created conditions conducive to Canadian pulp and non-newsprint papermakers holding sway over what was essentially a greatly enlarged 'domestic' market that extended literally around the world. In contrast, although newsprint makers had periodically benefited from favourable tariffs, the political weight carried by Canada's newspaper publishers had generally caused elected officials to ensure that imports could compete with domestic production.

This tariff structure is what led to the division of the Canadian industry into two disparate parts. The first, about which much more will be said below, was relatively gigantic and consisted of newsprint production for international – largely American – markets. The second, which is the focus here, consisted of a small number of firms that specialized in producing non-newsprint grades of pulps and papers for the domestic market. The existence of prohibitive tariffs in Canada (and the British Empire), which protected these companies, and similarly high American duties that prevented them from selling in the USA, left them with a market that was relatively small yet stable. While these factors could have fostered intense competition among the producers, and occasionally they did so, the overwhelming trend among these firms was to seek means of mitigating it in an effort to maximize their profits.

The development of the Canadian fine paper industry (which encompassed numerous products, such as writing paper and book paper) during the 1900–1945 period exemplifies how this corporate strategy was implemented. With roughly 65% of Canada's population concentrated in the provinces of Ontario and Quebec, it was logical that the fine paper mills would be located in this region to serve these markets. Beginning in the 1910s, the dominant firms that had been the pioneers in the industry began a drive to consolidate production by acquiring their smaller competitors. This left the industry's productive capacity under the control of a few dominant players, namely, E.B. Eddy and Rolland (in Quebec), Howard Smith (in both Quebec and Ontario), and Provincial Paper (in Ontario). Notwithstanding this convergence of ownership, the firms continued to produce a relatively broad range of papers, often using relatively small and inefficient operations. By at least the mid-1930s if not one decade earlier, these firms had formally begun to collude to control prices, and the effectiveness of this arrangement was apparently responsible for creating a practically impenetrable barrier to entry for new producers. Not only did production only creep above 100,000 tons for the first time in 1941, per capita consumption of fine paper had generally risen after 1920 at the same time as the number of fine paper manufacturers decreased (Canada 1952).

A similar scenario played out in the Canadian kraft (or sulphate) pulp and paper sector between 1900 and 1945 largely because of the protectionist domestic policy. The Brompton Pulp and Paper Company built the country's first mill in 1907 in East Angus, Quebec. Reflecting the growing demand for packaging emanating from a maturing consumer society, four more mills were constructed prior to the First World War, two more during it and three more between 1928 and 1932. These facilities, unlike the fine paper producers, were spread across Canada (i.e. in British Columbia, Ontario, Quebec and New Brunswick). Concomitantly, a scattering of smaller, converting facilities arose to manufacture finished products – such as cardboard boxes – from the raw kraft pulp or paper they received from the larger firms (Carruthers 1947; Canada 1939).

Both types of producers, however, strove to capitalize on operating safely behind a relatively high tariff wall to exercise monopolistic influence over their industry, and they largely succeeded. Canadian kraft pulp mills, for example, allegedly cooperated with the Scandinavian cartel during the 1930s to carve out their respective spheres of influence. The resulting agreement granted Canadian producers practically exclusive control over their 'extended' domestic market – the British Empire – in

exchange for limiting the tonnage they shipped abroad and meeting the cartel's price (Canada 1945). Similarly, the manufacturers of paperboard shipping containers cooperated informally on prices prior to the mid-1920s. When that failed to eliminate competition because of new entrants into the field, they agreed to a legally binding arrangement that achieved the aim through a carefully monitored and rigidly enforced quota system that was reinforced by the amalgamation in 1936 of a half-dozen firms into Gair Company, Canada (a subsidiary of American paperboard giant, Robert Gair Company). The upshot was the maintenance of high prices even though the industry was burdened with significant overcapacity (Canada 1939).

5.3.2 External Factors for Growth

Foreign tariffs were the most important of several external factors that fuelled the dramatic growth of the Canadian pulp and paper industry between 1900 and 1945. Of particular consequence was the decision by the United States government to eliminate duties on newsprint in 1913.[4] Canadian newsprint producers had been able to compete in the US market prior to this time; the total capital invested in Canada's newsprint capacity shot up from roughly $8 million in 1900 to just over $23 million 10 years later (CPPA 1918; United States 1908). Nevertheless, the elimination of the tariff in 1913 dangled a tempting carrot in front of business interests that had been contemplating establishing new mills in Canada. Making this allure practically irresistible was the aforementioned threat by provincial governments and the national government to prohibit the export of unprocessed pulpwood in an effort to foster the growth of the domestic pulp and paper industry. While together these forces sounded a clarion call to all present and potential producers, the message had a particularly clear resonance for newsprint makers in the USA. They could see that the future manufacture of an energy and wood-intensive product such as newsprint was destined to be moved to Canada, and the continued presence of substantial American tariffs on other grades of papers provided them with another compelling incentive to convert their mills to producing these higher valued products. The benchmark event in this process was the decision taken in 1925 by International Paper Company to shift its newsprint production north of the border. Within a few years, it was one of the largest newsprint makers in Canada, with its capacity concentrated in a few relatively monstrous, ultraefficient plants (Heinrich 2001; IPC 1948; United States 1930, 1951). By the eve of the Second World War, Canada was supplying newsprint to two-thirds of the American market, which consumed roughly

[4] Canadian economic historians disagree over the significance that should be attached to the elimination of the American tariff on newsprint in terms of propelling the explosive expansion of the Canadian industry during the early 1900s. The evidence indicates that the end to the duty in the USA was not *the* crucial factor in driving the industry's growth (Bladen 1958; Dick 1982; Fell 1934; Guthrie 1941), although a handful of academics argue that it was (Nelles 1974; Reich 1926).

half of the world's production, and generally favourable tariffs for newsprint within the British Empire provided secondary export markets (NAC 1937; Reader 1981).

Advantageous location relative to the market was another immensely important external factor, and it operated on several levels. The burgeoning population in the midwestern United States around and after the turn of the twentieth century caused capacity to be built in parts of Canada, such as northern Ontario, which were much closer to rapidly expanding urban centres like Chicago and Minneapolis than were the existing producers farther east. The result was a competitive edge in terms of lower shipping costs, especially if the mill were built directly on the shores of the upper Great Lakes and thus allowed for transportation to the USA by water instead of rail. A string of new newsprint plants sprang up across northern Ontario, for instance, including three in present-day Thunder Bay and one in Iroquois Falls, which was built by Abitibi Power and Paper just prior to the First World War. Cheaper shipping costs also attracted newsprint makers to tidewater regions of Canada. Some of these, such as the Mersey Paper Company in Liverpool, Nova Scotia, which was built in the late 1920s by the luminary Canadian industrialist I.W. Killam, offered the opportunity to ship their product by water year-round to both Europe and the northeastern seaboard of the USA (How 1986; PPMC 1928). Newfoundland's decidedly British orientation (it was both the closest part of Canada to the UK and a colony until 1949) drew major newspaper interests from that country to invest in two newsprint projects (Gray 1981; Hiller 1982, 1990; Newfoundland 1955; Reader 1981). Similarly, the new mills that were built in British Columbia during this period benefited from their access to relatively cheap, waterborne transportation to ports primarily along the American Pacific coast but also farther afield in Asia and Australia. The most important operations were Pacific Mills, Limited, at Ocean Falls and the Powell River Company, Limited, at Powell River, which were constructed during the 1910s (PPC 2004). The result was an industry in which most production facilities were located in central Canada and a handful of others either on or near the country's Atlantic or Pacific coasts.[5]

5.3.3 The Scope of the Industry's Growth

The combination of these internal and external factors drove a period of spectacular growth in the Canadian pulp and paper industry, with most of it occurring in the newsprint subsector. The meagre data that exists from the period prior to the First

[5] A few, propitiously located firms circumvented American duties on non-newsprint grades of paper by establishing capacity in the USA. Fraser Companies Limited was a Canadian-controlled firm with operations based in New Brunswick, and by the end of the First World War, it was one of North America's largest sulphite pulp manufacturers. In the mid-1920s, it constructed a fine paper mill in Madawaska, Maine (USA), just across the Saint John River from its largest pulp mill in Edmundston, New Brunswick (Canada). Thereafter, it evaded the tariff in the United States on fine paper by feeding its Madawaska mill with pulp produced at its plant in Edmundston (Parenteau 1994).

Table 5.1 Number of pulp and paper mills and capital invested, 1870–1915

	Paper		Pulp	
Year	Number of mills	Capital invested	Number of mills	Capital invested
1870	21	–	–	–
1880	36	–	9	–
1890	34	$4,673,211	24	$2,900,907
1900	28	$8,507,829	25	$11,558,560
1905	31	$21,260,157	22	$11,164,678
1910	35	$23,104,560	37	$30,782,373
1915	48	$84,110,366	32	$47,626,237

Source: Canadian Pulp and Paper Association (1918), graphs opposite pages 13 and 15

World War indicates rapid expansion for the entire industry between 1900 and 1915 (Table 5.1). Thereafter, all sectors of the industry grew, but it was newsprint that expanded exponentially. The country's newsprint capacity zoomed from under 1,000,000 tons in the late 1910s to 4,600,000 tons by 1945 (data include Newfoundland). Not only did this robust expansion establish Canada as the world's leading newsprint exporter by 1913, it made the pulp and paper industry by far and away the country's most important manufacturing sector and newsprint the nation's second most valuable export behind wheat by the onset of the Great Depression (Burley 1970; Canada 1945; Fell 1934).

The industry's extraordinary growth also precipitated its maturation, specifically during the 1910s and 1920s. By 1913, its size and scope were sufficiently large and diverse to warrant the founding of the Canadian Pulp and Paper Association (headquartered in Montreal, Quebec) and the subsequent creation of sections devoted to specific aspects of the business (i.e. sulphite pulp, newsprint, woodlands, etc.). Two years later, the industry signalled its desire to end its previous dependence upon imported technology when it helped found the Forest Products Laboratory at Montreal's McGill University. While this organization began by operating its own pulp and paper division, in June 1926 the industry raised this unit's profile by joining with McGill to rename it the Pulp and Paper Research Institute of Canada (later Paprican) (Hull 1986).

Concomitantly, some of the industry's most progressive firms invested heavily in research. The iconic Riordon Company was on the vanguard of this movement. Having built its sulphite pulp mill in Temiscaming, Quebec, just after the First World War, thereafter it developed the technology to produce rayon cellulose; by the late 1920s, it was making roughly half the world's supply of this product. Likewise, Spanish River Pulp and Paper Company, with three pulp and paper plants in Ontario and presided over by legendary American papermaker George H. Mead, employed a team of scientists and technicians who were dedicated to improving the performance of the firm's mills and the quality of its product. Finally, several companies also began managing their wood supplies according to modern forestry principles (Hull 1986; Kuhlberg 2001; Niosi 1975).

5.3.4 Corporate Strategy and Structure

In terms of corporate strategy and structure, this growth did not disturb one trend whose origins dated from the time of the industry's birth in the early 1800s. Major newspapers, now mostly American-owned, endeavoured to secure their long-term newsprint supplies by investing directly in Canadian capacity. *The Chicago Tribune*, for example, built a mill in 1912 in Thorold, Ontario, and another in Baie Comeau, Quebec, some 25 years later (Wiegman 1953). Likewise, *The New York Times* partnered with Kimberly-Clark of Neenah, Wisconsin, to build and operate an enormous new mill in Kapuskasing, Ontario, in the late 1920s (Tifft and Jones 1999). Furthermore, Lord Rothermere and other British newspaper interests had established a newsprint mill in Grand Falls, Newfoundland, in the early 1900s. Two decades later, they built another one in Quebec City, and in 1937, they secured control over Price Brothers, which owned several mills in Quebec (Reader 1981).

The industry's dramatic expansion between 1900 and 1945 effected a fundamental shift in both its ownership and corporate structure. The rapid increase in the capital requirements for building and operating a modern mill (and the often attendant hydroelectric projects) in the years after 1900 pushed firms to raise funds in money markets, largely in the USA.[6] Undeniably, many of the country's newsprint companies were overcapitalized from the outset, but during the 1920s this problem was exacerbated when a handful of American financiers, whose primary interest often lay in maximizing profits not by supporting the most efficient newsprint producers but manipulating the sale and value of their securities, exerted an ever-increasing control over the industry (United States 1951). They engineered most of the mergers and acquisitions that marked this decade. Not only did they succeed in attaching hyperinflated values to the new megacorporate entities, but they were able to ensure that the largest subsector of the industry – newsprint – was dominated by four behemoths: Canadian International Paper, Canada Power and Paper, Abitibi Power & Paper and Minnesota and Ontario. This also left roughly 40% of the Canadian industry directly owned in the United States; Americans – largely the Crown-Zellerbach interests – controlled practically all newsprint production in British Columbia by the eve of the Depression (Marshall et al. 1936). The percentage of foreign control rose during the early 1930s, when most of the newsprint firms that were grossly overcapitalized fell into receivership after being unable to meet their bond-interest payments and landed in the hands of their American financiers, who were their largest secured creditors. The degree of direct foreign control over the industry began waning in the late 1930s, a trend that accelerated thereafter (Canada 1945; Guthrie 1941; Marshall et al. 1936).

[6] One notable exception was the Belgo-Canadian Paper Company, which was organized in the early 1900s by the former Belgian Consul-General for Canada and a group of Belgian banks on whose behalf he acted and built a newsprint and pulp mill in Shawinigan Falls, Quebec (Carruthers 1947).

5.3.5 Drive to Collude

The first few decades of the twentieth century also saw the pulp and paper industry reinvigorate its efforts to collude. While it has already been described how makers of non-newsprint grades of pulp and paper endeavoured to achieve this goal, the newsprint makers' experience in this realm was unique. While it is axiomatic that they would be drawn to cooperate instead of compete, many other factors also played a role in this process.

No sooner had the Canadian government taken steps to break up the newsprint makers' monopoly in the eastern part of the country around the turn of the twentieth century than they had renewed their efforts (in British Columbia, newsprint cartels were much more effective because the industry traditionally consisted of only a few firms, and their relative isolation from other producers was conducive to monopolistic behaviour). During the early 1900s, Canadian producers who sold in the USA had agreed not to disturb the American market by selling their paper there to interests controlled by the American newsprint makers (United States 1908). While the duration of this arrangement is unclear, in the early 1910s the largest Canadian newsprint makers formed a new combination with their American counterparts. It, too, entailed agreeing to market jointly their paper in the United States through an American sales agency, but this time, a formal organization was created to oversee the cartel's operation. Moreover, this arrangement fixed the price of newsprint and allotted customers (particularly to new mills to prevent their production from operating as a competitive factor). Another American investigation uncovered this scheme in 1917, resulting in an indictment of the monopoly's principals, who paid fines after pleading nolo contendere to the charges (United States 1917).[7]

Several factors caused the nature of the Canadian newsprint industry's cartelization efforts to take an abrupt turn during the 1920s. One has already been addressed. The industry's egregious overcapitalization during this decade made it essential to generate massive profits to cover its inflated indebtedness, and cooperating instead of competing often seemed the only means of achieving this aim. Moreover, nearly all the country's mills relied upon provincial governments granting them Crown (i.e. government-controlled) resources, specifically pulpwood and water powers, which they accessed through long-term leases. This landlord-tenant dynamic opened the door for politicians to manipulate the lessees, particularly in provinces like Ontario whose prosperity did not depend on the forest industry. Beginning in the late 1920s, these governments – specifically those in Ontario and Quebec, where the bulk of the newsprint industry's capacity was located – demonstrated an unabashed commitment to the interests that sought to have newsprint makers collude. Furthermore, the Canadian industry strove to create a monopoly in order to

[7] Also during the First World War, the Canadian government seized control of the domestic marketing of newsprint and fixed the price at which it could be sold. These measures severely limited the producers' ability to sell in the USA, a fetter against which the industry railed (Canada – SPHC 1919).

strengthen its position vis-à-vis its primary customer, American newspapers. They had traditionally insisted on 'the interlocking contract', which dictated that the price at which newsprint would be sold for the entire year was set by the largest buyer, namely the Hearst interests. This gave newsprint purchasers potentially monopsonistic power and newsprint producers a compelling reason to counter with like force (Burley 1970; Safarian 1959).

The upshot was a renewed series of monopolistic endeavours in eastern Canada that began during a period, the 1920s, that was marked by International Paper and its subsidiary, Canadian International Paper (CIP), cutting prices in an effort to increase its market share. The early 1920s witnessed abortive voluntary sales agreements, while the late 1920s saw a series of attempts to exercise control over the market by selling newsprint through a central agency. The second, the Newsprint Institute of Canada (NIC), lasted the longest.[8] It was formed in 1928, when the governments of Ontario and Quebec insisted that nearly all companies holding leases to Crown resources participate in the scheme. It compelled all the NIC's members to contribute to a pool of funds that subsidized remote mills at the expense of those located nearer their markets and spread the total tonnage controlled by the pool to all its members' mills. Its demise was sealed when the two provincial governments enforced the plan unevenly. They exempted the period's renowned price-cutter, CIP, and granted mills owned by American newspaper publishers the same privilege (Canada 1945; Guthrie 1941; Kuhlberg 2002; Marshall et al. 1936). Not surprisingly, the other major producers were left operating far below their capacities because of the period's dramatic decline in demand for newsprint, thereby rendering them unable to meet their bond-interest payments. A series of receiverships ensued (roughly 50% of Canadian capacity went under). Some of the largest enterprises – most notably Abitibi Power & Paper Company – landed in the hands of interests that wished to see a cartel enforced, but the NIC dissolved amidst the chaos. Notably, CIP and the newspaper-affiliated firms escaped receivership during this period, and some emerged with far stronger balance sheets than they had ever had (United States 1930).

The 1930s saw new attempts to cartelize production in eastern Canada, and they eventually succeeded. During the early part of the decade, the governments of Ontario and Quebec insisted most of the industry cooperate through the Newsprint Export Manufacturers of Canada, but it foundered in the mid-1930s after one renegade firm refused to abide by its rules. This prompted the Quebec and Ontario governments to execute legislation that significantly expanded their power over the newsprint companies that leased Crown resources. They used it to enforce a plan to prorate the mills' tonnage and fix prices through the newly formed Newsprint Association of Canada (NAC), an organization that endured. Its success was partly attributable to its enforcement of a zone pricing system, which eliminated the competitive advantage of mills located nearer their markets. Moreover, by insisting that American publishers sign contracts within Canada providing for the shipment

[8] Two historians hold diametric views on the first attempt, named the Canadian Newsprint Company and formed in 1927 (Ellis 1948; Kuhlberg 2002).

of paper to the United States (with the mills absorbing the freight costs), it ensured that title to the product passed to the publishers when delivered on board common carrier cars at the mills (United States 1952). The transaction thus occurred entirely within Canada and thereby evaded American antitrust laws (Guthrie 1941; United States 1947; Vining 1940; Whitney 1958).

The Second World War strengthened the NAC's monopoly over Canadian newsprint production in the east and the ability of western producers to rule their marketplace. The national government managed literally all facets of the economy during the conflict, and achieving this end often involved cooperating with industry's leaders to an unprecedented extent. This left the American government clamouring in the background for the prosecution of Canadian newsprint producers for their monopolistic behaviour (the US Department of Justice indicted, for example, the firms in British Columbia in 1939 for violation of American antitrust laws) while the Canadian government granted legal recognition to and enforced the NAC's rules. Newsprint supplies in the USA tightened during the war due to the Canadian government's restrictions, labour and shipping shortages and the cutting off of shipments from Scandinavia. Canadian production fell from roughly 3.8 million tons in 1940 to 3.3 million in 1944, leaving American customers little choice but to reduce the size of their editions and use up all their existing inventories (Guthrie 1941; United States 1947; Wiegman 1953).

So by the end of the Second World War, the Canadian pulp and paper industry was a dominant player on the world's stage. Remarkably, there was still immense potential for the industry to expand.

5.4 The Golden Years, 1945–1972

For over one-quarter century after the Second World War, the entire Canadian pulp and paper industry enjoyed an unprecedented boom that was marked by several pronounced trends. Corporate strategy focused on maximizing short-term growth and profitability. For newsprint makers, this entailed increasing capacity as quickly as possible and maintaining what was arguably monopolistic control over their subsector. The effectiveness of this latter strategy practically closed the door to the establishment of new capacity, thereby pushing capital into other types of pulp and paper ventures. While many of these latter producers still focused on the domestic market, kraft pulp makers aimed to sell globally.[9] This period also saw both the

[9] The Canadian pulp and paper industry used several strategies to increase its supply of raw fibre during this period. First, many vertically integrated with lumber producers, either formally (i.e. by diversifying their operations) or informally (i.e. by entering into contracts with nearby saw mills). Both approaches secured wood chips, which gradually began to replace roundwood as the industry's raw material. Second, pulp and paper producers responded to the lack of interest in working in the forest after the Second World War by adopting the latest timber-harvesting technology in their woodlands. Doing so greatly enhanced their ability to access – and the efficiency with which – they procured raw fibre. The shift to transporting the wood from the bush to the mills by truck (and sometimes rail) instead of water also opened the door to year-round operations (Radforth 1987; Silversides 1997).

continuation of existing tendencies and the evolution of new ones in terms of the industry's structure. This involved a reassertion of Canadian ownership immediately after the war in the newsprint subsector, for example, and the increasing presence in other subsectors – particularly kraft pulp – of both American and other new foreign interests. Finally, these years witnessed provincial governments offering even greater support for the pulp and paper industry. These factors contributed to this remarkably long period of prosperity for Canada's pulp and papermakers, but they – and a few other forces – also sowed the seeds for problems that would later grow in magnitude for the industry.

5.4.1 Newsprint

At the end of the Second World War, Canada's newsprint producers operated roughly 35 mills (ranging in size from well under 200 tons/day to roughly 600) in seven out of the nation's ten provinces; 80% of the country's newsprint capacity was in Ontario and Quebec and 50% in the latter province (NAC 1947). The acute, wartime newsprint shortage was exacerbated in 1946 when restrictions on its use were lifted. The crisis became so severe that it precipitated annual meetings between newspaper publishers from the United States and newsprint producers in Canada (represented by the NAC). The publishers felt that these tête-à-têtes resolved little and thus demanded the American government launch inquiries into the NAC's monopolistic behaviour. The latter defended its behaviour by arguing that it was both operating at practically 100% capacity and hitting unprecedented production levels as a result and that the American government's insistence upon suppressing the price of Canadian newsprint (it remained well below the US commodity index and the price at which newsprint was being sold elsewhere in the world) dampened the industry's motivation for investing in increasing its capacity. With Canada supplying over 80% of the newsprint used in the United States in the late 1940s and that market representing over 60% of the world's demand for this type of paper, this battle between these two groups defined a large part of the pulp and paper industry's development in Canada during the immediate post-war years (NAC 1945, 1946, 1947; Wiegman 1953).

The newsprint shortage reflected the NAC's effectiveness in controlling its industry. It succeeded in achieving this goal only because the Ontario and Quebec governments wholeheartedly supported its agenda by refusing to grant pulpwood and water powers (of which many untapped supplies were still readily available) to interests wishing to produce newsprint.[10] Naturally, this meant that the traditional handful of heavyweights, namely, Abitibi, Consolidated Paper, CIP and Minnesota and Ontario

[10] The Ontario government even protected the NAC from prosecution by American authorities in 1947 when, immediately after the FBI had subpoenaed its members to produce their business records, it prohibited any firm in the province from responding to such requests (Ontario – SO 1947).

Paper, continued to dominate the industry. Immediately after the war, there began a general reassertion of direct Canadian ownership, with firms such as Abitibi and Great Lakes Paper firmly redefining themselves as domestic corporations. Nevertheless, in 1950 roughly one-third of the country's newsprint capacity was still directly owned by Americans and approximately half through stock ownership (United States 1951). The rules governing the NAC's cartel also shaped its members' corporate strategy, specifically in terms of maximizing short-term growth largely by speeding up or modernizing their mill operations; the NAC's regulations rewarded – after a number of years – companies that demonstrated their ability to produce at a capacity higher than that at which they had been rated. The industry thus operated at an average of well over 100% of capacity from 1945 to 1955, a period during which capacity climbed roughly 30% and production rose by over 70% (Table 5.2) (NAC 1949, 1956). Predictably, Canadian newsprint firms reaped ample profits during this 10-year span.[11]

The industry's growth quickened from the mid-1950s to the early 1970s. Nearly all companies continued to expand their productive capacities, mostly by improving existing machines. Capacity also soared with the amendment of laws in eastern Canada beginning in the mid-1960s that permitted mills to produce 7 days per week (traditionally all mills in Quebec and most in Ontario had been prohibited from operating on Sundays) (NAC 1960a). The bulk of the growth during these decades occurred in the newsprint industry's traditional base, Ontario and Quebec, and, to a lesser extent, British Columbia. Between 1955 and 1972, capacity rose by a total of 67% and production by 40% (Table 5.2), and newsprint makers remained highly profitable (Matthias 1976; NAC 1977).

But it had not all been smooth sailing for the Canadian newsprint industry during this latter (1955–1972) period. Its ups and downs certainly reflected those of the economy in the USA, in which most of Canada's newsprint was sold, but there were other forces at work as well. Two of them were inextricably linked. In the post-war era, the greatest growth in the Canadian newsprint industry's traditional market – the USA – occurred in its southern and western regions. These areas' newsprint needs were being increasingly met by producers in the American south, however, who had begun appearing in ever-growing numbers after 1945 (NAC 1956). Furthermore, these competitors boasted numerous advantages, including exploiting the latest technologies and economies of scale and enjoying lower labour, transportation and fibre costs. Moreover, the decision by western countries outside North America to de-peg their currencies from the US dollar in the late 1940s gave them a huge incentive to trade among themselves in order to conserve precious 'hard currency'. This drove nations such as Australia and Great Britain, markets to which Canada had heretofore supplied a considerable amount of newsprint, to turn to Scandinavia for supplies in increasing volumes, an initial stimulus that helped fuel both an enormous expansion in the size and rise in the productivity of that region's newsprint

[11] Abitibi, for instance, which obsessively directed much of its cash flow to paying down its debt after it emerged from receivership in 1946, generated dividends by the early 1950s that were never less than $.50/share (Matthias 1976).

Table 5.2 Newsprint capacity, production, operating ratio and exports, 1945–1972 (in tons)

Year	Capacity [A]	Production [B]	Operating ratio [B/A]	Exports		
				To USA	Total [C]	C as % of B
1945	4,672,080	3,591,901	76.9	2,665,947	3,351,416	93.3
1946	4,640,944	4,506,063	97.1	3,563,124	4,247,894	94.3
1947	4,728,724	4,820,164	101.9	3,897,300	4,598,139	95.4
1948	4,883,127	4,982,834	102.0	4,127,970	4,660,559	93.5
1949	5,113,108	5,176,327	101.2	4,380,250	4,828,947	93.3
1950	5,226,675	5,278,585	101.0	4,748,228	4,956,031	93.9
1951	5,359,816	5,516,279	102.9	4,783,549	5,143,616	93.2
1952	5,510,397	5,687,051	103.2	4,835,065	5,297,681	93.1
1953	5,722,640	5,721,296	100.0	4,861,372	5,334,287	93.2
1954	5,919,917	5,984,207	101.1	4,875,031	5,549,565	92.7
1955	6,064,000	6,191,000	102.1	5,070,000	5,805,000	93.8
1956	6,243,000	6,469,000	103.6	5,230,000	5,972,000	92.3
1957	6,756,000	6,397,000	94.7	5,055,000	5,907,000	92.3
1958	7,239,000	6,096,000	84.2	4,827,000	5,609,000	92.0
1959	7,521,000	6,394,000	85.0	5,118,000	5,953,000	93.1
1960	7,611,000	6,739,000	88.5	5,279,000	6,265,000	93.0
1961	7,734,000	6,735,000	87.1	5,227,000	6,216,000	92.3
1962	7,844,000	6,691,000	85.3	5,229,000	6,169,000	92.2
1963	8,055,000	6,630,000	82.3	5,180,000	6,100,000	92.0
1964	8,274,000	7,301,000	88.2	5,648,000	6,759,000	92.6
1965	8,421,000	7,720,000	91.7	6,093,000	7,157,000	92.7
1966	8,878,000	8,419,000	94.8	6,610,000	7,764,000	92.2
1967	9,294,000	8,051,000	86.6	6,263,000	7,330,000	91.0
1968	9,655,000	8,031,000	83.2	6,107,000	7,422,000	92.4
1969[a]	9,612,000	8,758,000	91.1	6,417,000	8,033,000	91.7
1970	9,719,000	8,607,000	88.6	6,144,000	7,876,000	91.5
1971	10,050,000	8,297,000	82.6	6,114,000	7,490,000	90.2
1972	10,151,000	8,661,000	85.3	6,403,000	7,960,000	91.9

Sources: Canadian Pulp and Paper Association (1955), Tables 42–43; ibid. (1972), Tables 31–34; ibid. (1973), Tables 31–34.

[a]After 1968 changes made were made in calculating capacity, and they are explained in CPPA (1971).

industry (NAC 1949, 1960b, 1967). Finally, even by the early 1950s newsprint capacity had begun appearing in new areas of the globe, particularly the 'developing world' (NAC 1953). Although Canadian mills were still competitive, their facilities were slowly becoming anachronisms (Clark 1984).

The years between the mid-1950s and the early 1970s thus saw the Canadian newsprint industry suffer on several fronts. Having operated at overcapacity for nearly one decade prior to 1955, the next 17 years saw its operating ratio hover around 88% (it dipped as low as 80% in the early 1960s); intermittent shutdowns and lay-offs became a regular part of the industry's cycle. Canada was also losing its previous international preponderance in this subsector. Whereas immediately

after the Second World War its capacity and production respectively represented roughly 50 and 62% of the world's total, by 1972 these figures had slipped to 40 and 38%. Moreover, the industry's productive capacity was widely dispersed, with roughly 75 companies operating mills that were relatively small by international standards (Matthias 1976; NAC 1973).

5.4.2 Pulps and Non-newsprint Papers

Myriad forces propelled the dramatic expansion of Canadian capacity in non-newsprint grades of papers and a variety of pulps during this period. These included the barriers to entry in the newsprint industry, the interest in exploiting previously underutilized pulpwood species such as jack pine in the east and lodgepole pine in the west, and the desire by foreign firms to seek guaranteed supplies of pulp for their domestic operations (NAC 1952).

The most important factor driving growth in the production of all pulps, however, was government policy. Provincial politicians continued to use their control over forests and water powers to entice capital into establishing mills, albeit almost always non-newsprint ones, within their jurisdictions. In Ontario in the early 1940s, for example, the government offered major American pulp and papermakers Kimberly-Clark and Marathon Pulp and Paper the privilege of exporting hundreds of thousands of cords of prime pulpwood to their mills south of the border in exchange for these firms agreeing to erect modest (app. 200 tons/day) bleached kraft pulp mills in the province (Lambert 1967). In Nova Scotia, the Swedish pulp and papermaker Stora Kopparberg (now Stora Enso) was induced to build a sulphite pulp mill by the practically irresistible terms on which the provincial politicians offered it access to pulpwood in the late 1950s. By 1962, the company had completed this facility, to which it soon added a large newsprint line (Sandberg 1991). Similarly, the government in British Columbia opened up its province's interior with railway and hydroelectric projects during the 1950s, paving the way for the construction of a half-dozen bleached and unbleached kraft mills in the region. During the next decade, the BC government offered pulp firms that agreed to establish operations in areas the government identified (i.e. locales in which sawmills were utilizing the larger diameter timber) guaranteed wood supplies (i.e. small diameter logs and wood chips from sawmills) at low, fixed prices. This precipitated the building of nine new bleached and unbleached kraft mills, most of which were integrated with local sawmilling operations, and these enterprises were backed by interests from other parts of Canada, Japan, Europe and the United States (Bernsohn 1981; Marchak 1983; PPC 2004). The pulp industry also arrived in Alberta during this period after the provincial government made available a supply of raw fibre under generous terms. North Western Pulp and Power (a joint venture by American pulp and paper giant St. Regis Paper Company and local firm North Canadian Oils Ltd.) built a 300-tons bleached kraft softwood mill in Hinton in the mid-1950s (Bott and Murphy 1997; Pratt and Urquhart 1994).

The result was a virtual explosion in the capacity of Canada's pulp industry, and it precipitated several shifts in terms of products and markets. Between 1945 and 1972, the pulp industry's overall capacity grew from a little over 6 million tons to roughly 23 million, which represented just under one-quarter of the world's capacity. During these years, the trend was strongly towards producing bleached paper grade pulps, particularly sulphate, and away from sulphite pulps. Canadian bleached (and semi-bleached) sulphate capacity represented about 4.6% of the country's total pulp capacity in the mid-1940s, whereas 20 years later the figure was 74%. In contrast, during the mid-1940s, bleached sulphite pulp capacity represented 8.7% and unbleached sulphite roughly 18.7% of total pulp capacity. Two decades later, the respective figures were 8 and 4.4%. The other major shift saw a move towards selling to mills other than those owned by the producer. When data began being kept on this aspect of the business in the late 1940s, about 18% of pulps produced in Canada were sold on the open market. By the early 1970s, this figure had risen to nearly 30%, and roughly 80% of this volume was bleached and semi-bleached sulphate (CPPA 1941, 1949, 1951, 1954, 1958, 1961, 1966, 1969, 1970).

The Canadian pulp industry's structure remained splintered throughout this period, both in terms of ownership and production facilities. Firms were controlled by numerous interests of various sizes from across Canada and around the world. Moreover, these facilities were relatively small and widely distributed, often because they were located where provincial governments – not economics – dictated. The upshot left Canadian pulp companies badly lagging behind their international competitors in terms of capitalization and scale of operation.

The production of non-newsprint grades of paper in Canada also grew during the 1945–1972 period but only modestly because the factors that had stunted expansion for decades prior to the war continued to do so long after it. These firms had typically been protected by tariffs on their products and pursued a corporate strategy that was bent on serving the domestic market and cooperating among themselves to eliminate competition. To achieve this goal between 1945 and 1972, they strove to integrate and consolidate their operations. Firms that had traditionally produced pulps acquired the converting facilities that turned them into products such as containerboard and paper bags. Periodically, these companies also grew through mergers and acquisitions in order to capture a greater share of their market. For example, Bathurst Power and Paper, a kraft pulp producer based in eastern Canada, acquired several containerboard and box-making mills from the mid-1940s until the early 1960s. During these years, Consolidated Paper, which produced a range of papers and pulps, had been cooperating with Bathurst in carving up the Canadian market for several of their products. Then in 1966, the two merged to form Consolidated-Bathurst, which thereafter dominated the packaging sector. Similarly, St. Lawrence Paper Corporation, another major producer of mostly non-newsprint grades of paper, formally absorbed the Brompton Pulp and Paper Company in the early 1950s and then merged in the 1960s with the Dominion Tar and Chemical Company Ltd., which already owned significant containerboard and fine paper assets; the new corporation was christened Domtar. As a result, a handful of firms, which were

overwhelmingly domestically owned, continued to rule the production of non-newsprint grades of paper in Canada (Canada 1956, 1960, 1962).[12]

Despite the buoyant times for virtually all subsectors of the Canadian industry in the quarter century or so after the Second World War, dark clouds were on the horizon. Little did its executives know that these challenges would only grow in number and strength in the next few decades.

5.5 The Brewing of a Perfect Storm, 1973–Present

While the Canadian pulp and paper industry enjoyed some success between 1973 and the present, this period witnessed a steady erosion of the foundation upon which its prosperity had been built. These years saw several major themes emerge in terms of corporate strategy, industry structure and role of government. The behaviour of the industry's leading firms reflected a remarkable degree of optimism about the future despite the host of serious and profound problems they were confronting. This translated into an ultraconservative approach to dealing with these issues, which was most often manifested in the industry's seemingly limitless faith in 'bigger is better' as its panacea. This mentality often created more challenges than it overcame, and it had significant implications for the industry's structure. The roughly four decades after 1973 saw a renewed thrust towards consolidation of ownership that resulted in the creation of fewer, larger players, one that resulted in a decided loss of Canadian control. At the provincial level, government policy towards the industry returned to a more uneven state, whereby forest-dependent jurisdictions remained strongly supportive and those that were not did not. At the national level, the government continued to be a fetter on the industry's efforts to build the critical mass needed to compete internationally because of its ostensible obligation to preserve a competitive domestic marketplace.

5.5.1 The Initial Big Bumps, 1973–1980

The mid- to late 1970s witnessed a series of dramatic shocks that created deep problems for all players in Canada's pulp and paper industry, although they still occasionally savoured good times. The two oil crises (1973 and 1979–1980), and the economic dislocation they precipitated, were central to this process. They drove costs up dramatically, and they had a devastating impact on the economies in the regions – the Northeastern and Midwestern United States – in which Canadian producers had traditionally sold the lion's share of their most important product

[12] Fine papermakers were also able to collude until they were prosecuted and found guilty in the early 1950s (Whitney 1958).

(i.e. newsprint) (CPPA 1982). In an effort to cut costs, newspapers implemented conservation measures, further reducing demand for newsprint. While the entire industry took significant downtime during the resultant periods of overcapacity, its mills also sat idle for extended stretches because of major labour unrest that repeatedly led to lengthy work stoppages (CPPA 1973a). Virulent inflation also drove up wages, thereby further burdening the industry with added costs that would become increasingly onerous in the future as competition intensified. Canadian newsprint makers reacted by first improving their efficiency (i.e. switching production from 30 to 32 lb sheets). They then benefited during the mid- to late 1970s from the rebounding demand attendant upon the economic recovery and the weakening of the Canadian dollar vis-à-vis the US dollar. The general upswing in conditions allowed for widespread investment in mill upgrades, but the decade saw Canada's newsprint industry lose more market share. By 1979, it represented only 33% of international production, an attrition that predictably signalled the end to the tight control it had formerly exercised over its market.

In the stressful economic climate of the 1970s, several firms again resorted to consolidation. One of Canada's largest and longest standing newsprint makers, Abitibi Paper Company, with operations across the country, acquired Price Brothers, a similarly esteemed firm whose plants were concentrated in Quebec. Although a joint investigation by the federal and provincial governments into the pulp and paper industry's woes in the early 1970s had suggested mergers as one means of addressing them, tellingly after the creation of Abitibi-Price, the federal governments in both Canada and the United States launched inquiries into whether the new corporate entity violated their countries' antitrust laws (Matthias 1976).

5.5.2 Continued Turbulence, 1980–2000

The challenges of the 1970s only increased in number and size over the next few decades, and although again these years were still marked by spurts of prosperity, the industry's trajectory during this period was decidedly downward. One of the most serious challenges was the strength of the 'environmental movement'. Although it had been active since at least the 1960s, over the next decade, it had gained significant political traction that only strengthened thereafter. The protesters targeted the Canadian forest industry's logging practices and the effluents its mills emitted into the air and water, and their ability to achieve their ends was evident in the increasingly stringent environmental laws that both federal and provincial governments implemented. While the industry was rightfully accused of having initially resisted the calls to amend its practices, by the turn of the millennium, it had largely addressed the numerous concerns that had been raised. Nevertheless, doing so – both in the woodlands and plants – had been costly and had undermined the entire industry's competitiveness.

For newsprint producers, these years brought even greater challenges. Although during the 1980s this subsector operated at or above 90% capacity and enjoyed

generally prosperous times, its international presence continued to shrink. By the end of the decade, it represented under 30% of world capacity (CPPA 1988). Competitors old (i.e. the southern United States and Scandinavia) and new (i.e. Asia, specifically Japan) were both bringing ever-more efficient capacity on line and enjoying the competitive advantages accruing from being located much closer to their markets, which coincidentally were enjoying significant growth (CPPA 1985, 1988). Canada's reliance on a relatively large number of small mills that had been established during the early 1900s was also a growing liability.[13] Moreover, the industry's traditional staid business ethos prevented it from either investing sufficiently in research and technology or responding effectively to analysts' recommendations to convert its least efficient capacity to producing higher valued papers (CFS 1988). Several new hurdles also appeared for the Canadian newsprint industry. First, its principal market – the United States – enacted new environmental regulations that insisted that newsprint contain a large component of recycled fibre. With many of the mills in Canada located in relatively remote sites far from urban centres, this new measure translated into higher production costs and undermined the traditional competitive advantage the country's mills had enjoyed because they had been able to tap high-quality virgin fibre (Canada 1994). Second, much of the Canadian industry had long benefited from cheap hydroelectricity, but during the 1990s, some parts of Canada deregulated prices for it, and practically all experienced rising costs for this type of energy.

While some of these problems obviously also deleteriously affected Canada's pulp and non-newsprint paper subsectors, the 1980s and 1990s also brought intermittent doses of good news for them. Pulp makers continued their shift away from sulphite towards bleached kraft, and beginning in the late 1980s, they increasingly converted to the more efficient production of thermomechanical and chemothermomechanical grades. Moreover, during the century's last two decades, some provincial governments again used their control over forest resources to support another round of expansion in the capacity of Canada's pulp subsector. This time the spotlight was on Alberta, a heretofore minor player in the industry but one that was oil-rich and anxious to diversify its economy in the mid-1980s in the face of free-falling energy prices. Offering $1.35 billion in loans and financing precipitated the construction of a half-dozen large mills that mostly produced chemothermomechanical kraft pulp. Two of the projects were undertaken by Japanese interests (i.e. Mitsubishi) and the others by American subsidiaries (i.e. Weyerhaeuser) and local Canadian firms (i.e. Millar Western and West Fraser) (Pratt and Urquhart 1994). This development, among others, made Canada by 1998 the world's largest supplier of paper grade market pulp (and second to the USA in the production of this commodity), representing 28% of total global capacity, nearly half of which was concentrated in British Columbia (CPPA 1998). The 1980s and 1990s also saw a few firms establish non-newsprint paper capacity in Canada. In the mid-1980s, American entrepreneur

[13] By 1990, the average Canadian newsprint machine represented only 57% of the capacity of an average Finnish machine and 79% of the average American machine (Roach 1994).

Dan Alexander teamed up with the employees at Abitibi's nearly century-old mill in Sault Ste. Marie, Ontario, to purchase it, convert it to supercalendered paper and rename it St. Marys Paper (PPC 2005). Roughly one decade later, Stora Enso added a 360,000 tons/year supercalendered line to its operation in Port Hawkesbury, Nova Scotia.

In terms of corporate strategy, the 1980s and 1990s witnessed various – and often conflicting – trends. Foreign firms, such as Mitsubishi, continued to buttress their supplies of raw pulp by investing in Canada. American giant Weyerhaeuser not only undertook the aforementioned new mill project in Alberta, but in 1999 it purchased the iconic Canadian firm MacMillan-Bloedel, which was a fully integrated forest products multinational, with operations concentrated in BC. In contrast, nearly two decades earlier, International Paper had begun divesting its Canadian assets. In 1980, it had sold a one-third share in its large newsprint mill in Dalhousie, New Brunswick, to the Oji Paper Company and Mitsui and Company of Japan. One year later, and in the wake of announcing a major campaign to upgrade its Canadian newsprint capacity, IP sold CIP (with 16 mills mostly in Ontario, Quebec and New Brunswick) to Canadian Pacific Enterprises for $1.1 billion (The Globe 1981).

5.5.3 The Biggest Bump of All, 2000–2010

While the robust international economic growth during the early 2000s brought reasonably good news to all subsectors of Canada's pulp and paper industry – the new millennium's first year saw Canadian mills produce record amounts of pulp and paperboard and newsprint consumption in the US approach an all-time high – its continued profitability masked both its fundamental weaknesses and a host of new ones. Newsprint producers were most deeply affected by these challenges and reacted most ineffectively to them. Nearly all firms in this subsector continued to single-mindedly believe both in their long-term prospects for profitability and the desirability of addressing present and future problems by resorting to their traditional solution of expanding through accretion. This latter faith had compelled Canada's largest newsprint maker, Abitibi-Price, to merge in 1997 with Stone-Consolidated, thereby making it the world's largest newsprint and uncoated groundwood producer. Only 3 years later, it paid $7.1 billion for Donohue Corporation, whose assets consisted primarily of the two mills and associated hydroelectric facilities that *The Chicago Tribune* had established prior to the Second World War, respectively, in Ontario and Quebec (CPPA 2000). Undeniably, this acquisition created a newsprint colossus. It owned 25 mills in Canada, the USA and United Kingdom, and a one-third share in four mills in South Korea, Thailand and China; it controlled 34% of the North American and 16% of the world's newsprint market. At the same time, however, achieving this end had cost Abitibi an extravagant sum that forced it to increase dramatically its debt load at the very time when the Canadian newsprint subsector in particular and the pulp and paper industry in general was about to face their most acute difficulties (PPC 2000).

These came in several forms. For newsprint makers, the first decade of the twenty-first century saw its primary market – the United States – experience a hyper-accelerated contraction, fuelled largely by the media's rapid shift in the western world to electronic formats. By 2009, the annual rate of decline for newsprint was over 20%, with February of that year peaking at an astronomical 33%; prices predictably plummeted (The Globe 2009). For Canadian pulp makers, who had grown increasingly reliant on selling in the international market, they were facing what seemed like wave upon wave of new competitors, particularly in South America. Not only had technological developments made lower quality virgin fibres from other countries such as Uruguay and Brazil more useable for more products, mills in these locations were producing on a relatively massive scale and tapping fibre sources that enjoyed an astonishingly quick rotation. This latter factor was especially troubling for all subsectors of Canada's pulp and paper industry. By the early 2000s, they had taken mammoth strides towards raising their forest stewardship practices to meet international certification standards. But doing so had caused them to incur significant expense and put them at a competitive disadvantage vis-à-vis their South American rivals for another reason as well. Producers there could simply ignore these regulations with impunity, as they were harvesting their crops from what were essentially intensively managed tree farms on reclaimed agricultural land and not woodlands that were deemed to be ecologically sensitive (CPPA 2000; CFS 2002).

Other factors compounded the difficulties facing the entire Canadian pulp and paper industry. The generally robust state of the country's economy during the period 2000–2010 was fuelled to a significant degree by the strength of its oil sector, which benefited from rapidly rising energy prices; Canada's currency thus became identified as a 'petrodollar'. Within a few years of reaching its all-time low of roughly $.61 US in early 2002, it was above par. This startling appreciation battered Canadian exporters, including pulp and papermakers, who had relied for at least the previous two decades on a relatively weak currency. Although the stronger dollar created an ideal opportunity to upgrade mills, few of the firms' balance sheets were healthy enough to allow for such investment. Around the same time, the American government imposed combined duties of over 27% on imports of Canadian lumber after negotiations to resolve a long-simmering trade dispute failed. This devastated Canada's lumber industry, which was a major supplier of chips to the country's pulp and papermakers. The resulting closure of a string of sawmills in Ontario and Quebec, the pulp and paper industry's traditional heartland, pushed up chip prices. The situation deteriorated in 2008 when the bottom fell out of the American housing market and the western world's economy (CFS 2002, 2006).

During this decade, government policy at both the provincial and federal levels was ambivalent at best and hostile at worst to the pulp and paper industry. Provincial governments continued to use their control over Crown resources for their own political objectives by insisting that firms continue operating their numerous, scattered and relatively small-scale pulp and paper mills, which often represented the local community's economic lifeblood, instead of allowing them to close their most inefficient ones and consolidate production in one large plant. Moreover, while the

forestry-dependent provincial governments extended aid to the distressed pulp and paper firms in their jurisdictions, the Ontario government offered relatively puny support to its mills at the same time as it announced billions in aid for the province's ailing auto industry. At the national level, the government's antitrust branch continued to oppose consolidations in the industry in the interest of maintaining competition. And while the Canadian government launched initiatives to support the industry's drive to develop and adopt 'green' technology, the sums it allocated to these efforts paled in comparison to those offered in other pulp and paper producing countries (FSAC 1992; CFS 2009).

These factors – essentially a 'perfect storm' of problems – combined to send the Canadian pulp and paper industry into a downward spiral that exceeded the perilous one it had experienced during the Depression. By 2006, Canadian newsprint production, for example, represented roughly 20% of world production; 60 years earlier, the figure had been roughly 60%. Once more, some firms endeavoured to address the situation by merging. Abitibi-Consolidated joined forces with Bowater, for example, to create the world's largest newsprint maker, but its magnitude was hardly a defence against its problems. By the early 2000s, companies in all subsectors were intermittently announcing the permanent shutdown of capacity, and by 2005 this news was arriving on what seemed like a weekly basis. By late 2010, only three of northwestern Ontario's original eight mills were still operating, and two of them – Domtar in Dryden and Abitibi-Bowater in Thunder Bay – had significantly reduced the scale of their activities. Even this substantial rationalization was insufficient, and many firms – including Abitibi-Bowater – slipped into either receivership or bankruptcy (CFS 2006, 2009).

It was not all doom and gloom for the Canadian industry, however, as some firms fought back by formulating innovative plans and aggressively implementing them. Cascades, which specializes in tissue and packaging, shut down its least efficient capacity, sold noncore assets and concentrated its operations in growth subsectors. It also expanded its recycling operations both to augment its supply of non-virgin fibre and distinguish itself as one of the country's most 'green' papermakers (www.cascades.com/profile/cascades-history/the-2000s). Likewise, Domtar focused on joining the ranks of the world's largest manufacturers and marketers of uncoated freesheet paper. It drastically expanded its presence in the United States (and rebranded itself as an American firm even though its corporate headquarters remained in Montreal) by acquiring a number of pulp and paper mills there, including Weyerhaeuser's fine paper operations, and concomitantly shedding its lumber business. By 2010, it was not only the largest player in its subsector in North America and the second largest in the world, it was profitable, flush with cash and on the prowl for new acquisitions. Finally, Fortress Paper was born out of the turmoil in the mid-2000s and learned to flourish amidst it. Organized by Canadian Chad Wasilenkoff, it purchased two specialty paper mills in Europe at fire-sale prices: the one in Landqart, Switzerland, makes banknotes and security paper (i.e. used in passports and visas), and the other in Dresden, Germany, is the world's largest producer of nonwoven wallpaper, controlling about half the market. In mid-2010, Fortress acquired a pulp mill in Thurso, Quebec, from insolvent Fraser Papers, for the measly sum of $1.2 million; its insured replacement cost had been $851

million. Fortress lined up support from the provincial government to convert the facility to producing high-quality speciality cellulose for the rayon textile industry, for which international demand – particularly from China and India – is increasing rapidly (The Globe 2010; PPC 2010).

5.6 Conclusion: Amidst the Darkness, There Is Faint Hope

As the first decade of the twenty-first century was drawing to a close, black clouds still enshrouded the Canadian pulp and paper industry, but a few rays of light were breaking through the darkness. Indisputably, the list of the industry's foibles was extensive. Canadian companies were relatively small – in terms of both their capitalization and scale of production – compared to their international rivals, they suffered from chronic underinvestment and had depended for far too long on their access to a seemingly inexhaustible supply of relatively cheap, high-quality, virgin fibre, an advantage that has all but disappeared. So, too, have the favourable domestic and/or imperial tariffs and the near-monopoly control many Canadian pulp and papermakers had exercised over their markets. Despite the growing global demand for pulp and paper products, the country's industry remained over-reliant on a commodity (i.e. newsprint) for which, and a market (i.e. the USA) in which, demand had been rapidly shrinking; Canada is also located far from Asia, which is experiencing the greatest growth in demand for pulp and paper products. And although Canada's production of wood pulp had grown exponentially since the mid-twentieth century, its position in the world market has been under siege from a rising tide of international rivals who enjoy numerous competitive advantages. Finally, the industry has shrunk significantly over the last century or so in terms of its domestic economic importance, thereby seriously undermining its political influence with elected officials at both provincial and national levels.

Although Canada's pulp and paper industry is but a mere shadow of its former self, there are grounds for believing that it will continue to be a dominant player on the international stage; the success of the abovementioned firms – such as Cascades, Domtar and Fortress – attests to the possibilities. The country remains the world's largest producer and exporter of newsprint, a product for which demand seems to have stabilized. Moreover, the profundity of the challenges that this subsector – and the entire industry – has recently faced has left them no choice but to shed their prevailing stand pat ethos and adapt to the new conditions. In addition, Canada still boasts arguably the world's largest supply of high-quality raw fibre, and the country's forest industry is a world leader in terms of environmental stewardship and reducing its carbon footprint. There is now every opportunity to exploit this renewable resource and capitalize on this 'green' niche by commanding higher prices for its products. Lastly, the country also lies adjacent to what remains the world's largest economy (CFS 2006, 2009).

Ultimately, Canada's pulp and paper industry faces a highly uncertain future, one that is rendered particularly dubious if one uses the country's economic 'staples'

history as a guide. Canada's past is littered with the remains of resource-extraction enterprises that suddenly appeared as a particular commodity's value rose, enjoyed a boom as the commodity was extracted and barely refined before being exported and suffered a decline – sometimes long, sometimes short – as the resource was either exhausted or lost the competitive advantages it had previously enjoyed. During this difficult latter phase, time and time again voices called for the particular industry in question to be more innovative in processing the resource. The clamour was most often for the manufacture of a higher value product in order to maximize the benefits accruing from the operation, but rarely did the industry take this advice. With most of the players in Canada's pulp and paper industry having hitherto ignored such counsel thus far, their past record does not augur well for their journey on the road that lies ahead.

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Chapter 6
From the Non-European Tradition to a Variation on the Japanese Competitiveness Model: The Modern Japanese Paper Industry Since the 1870s

Takafumi Kurosawa and Tomoko Hashino

6.1 Introduction: A Short History of Modern Paper Industry and the Long Tradition of Domestic Paper Culture

The first machine-made paper was produced in Japan in 1874. Japan's 130-year history of modern papermaking is shorter than Europe's. However, the Japanese paper industry grew rapidly in the twentieth century, and Japan remained the second largest paper producer in the world for three decades after 1970. Although it was afterward overtaken by others, Japan's paper and paperboard production was still ranked third in the world (31.22 million tons annually), its pulp production seventh (10.8 million tons), and its per capita paper consumption eighth (247.4 kg) in 2007, marking it as one of the top global paper producers and consumers.[1] Although a latecomer among major papermaking countries in the twentieth century, Japan experienced surprisingly rapid growth (see Figs. 6.1 and 6.2), supported by the rapid expansion of its domestic market. Unlike other transplanted industries, the import

This chapter was partially supported by a grant-in-aid for Scientific Research, (A) 23243055, (C) 17530266, (C) 19530308. The Japan Society for the Promotion of Science gave one of the authors the opportunity to present an earlier version of this study at the 15th International Economic History Congress at Utrecht University, August 2009. People in Nippon Paper Group, Inc., Daio Paper Corporation, Japan Paper Association, and Paper Museum (in Tokyo) gave helpful advice on promoting this study. We also thank Hisayuki Oshima for providing valuable data on intercontinental freight charges. We are also grateful to the participants of our session at Business History Society 2010 in Sapporo and especially Prof. Toshiyuki Shinamiya.

[1] http://www.jpa.gr.jp/en/ (Japan Paper Association).

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J.-A. Lamberg et al. (eds.), *The Evolution of Global Paper Industry 1800–2050: A Comparative Analysis*, World Forests 17, DOI 10.1007/978-94-007-5431-7_6,

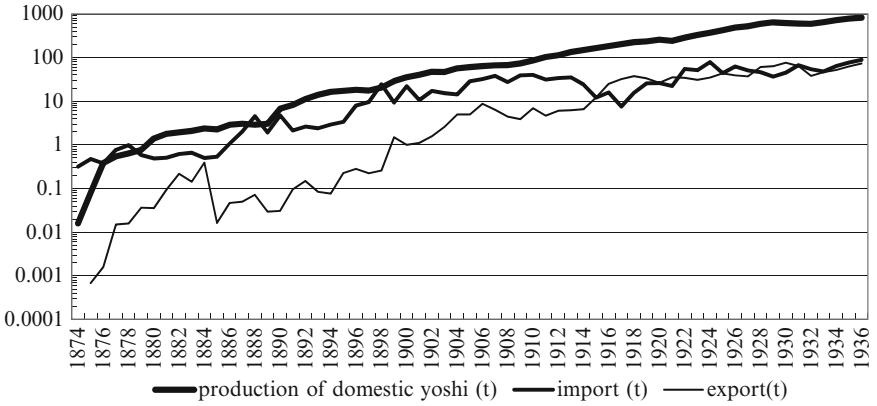

Fig. 6.1 Import and export of paper (all kinds) and the production of yoshi (Western paper) in Japan, 1872–1936 (1,000 ton, log. scale) (Source: The figures were computed using the data in Suzuki (1967), the appendix, and the *Yearbook of Pulp and Paper Statistics* (Ministry of International Trade and Industry and Minister Secretariat Office for Research and Statistics) for each year)

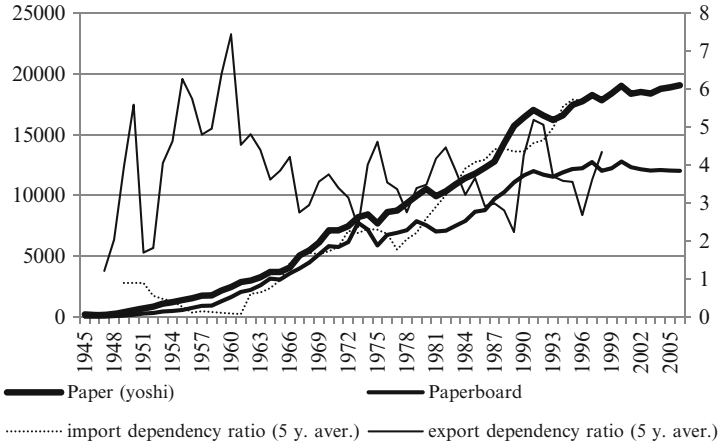

Fig. 6.2 Production paperboard and yoshi paper (1,000 ton, *left axis*) and degree of import-export dependency (5-year moving average %, *right axis*) of Yoshi (Western paper) and Paperboard in Japan, 1945–2005

dependency of papermaking was low from the start. Foreign manufacturers operating in Japan were virtually nonexistent. The system by which domestic manufacturers satisfied domestic demand had already been established during the industry's infancy and still exists today. This is a feature of Japan's paper industry.

How was such a fast catching-up process (i.e., the formation of a new market through technology transfer) realized, and what characterized the development of the non-European market? Government protection is certainly not the answer: Japan lacked tariff autonomy from the mid-1880s to the eve of the First World War, and direct government involvement was quite limited. The rapid development of the

modern paper industry must therefore be due to other factors. It can be said that an isolated geographical location, abundant natural resources, and market conditions (i.e., high self-sufficiency and low direct foreign investment) were specific to Japan, as distinct from the development of the European paper industry. Geographical conditions had a major impact on the development of the Japanese paper industry. Due to the cultural and physical distance from the West, the entry barrier for the Japanese *yoshi* industry was much higher than that of the latecomers on the periphery of Europe. A great distance from the major paper manufacturing countries can naturally serve as a certain protection if the materials and consumption markets coexist within the region. In the nineteenth century, Western paper manufacturers did not have any production base in East Asia. High transportation costs helped the Japanese paper industry be independent. In 1911, the transportation cost of a standard paper product from Europe accounted for about 35% of the selling price in Japan.[2] The rapid decline in import dependency (see Fig. 6.2) clearly shows that geographical isolation likely played a role in protecting this infant industry. On the other side of the coin, this distance provided the background for the domestic market orientation of the Japanese paper industry, which remains to this day. In addition, the Japanese paper industry was blessed with the natural resources critical for paper production—paper material and water. The rich water resources also supported hydropower generation, which served as a major energy source for the paper industry in the first half of the twentieth century. Changing from cotton rags to pulp was quite favorable to the development of the modern industry because Japan is forest-rich, with forest coverage of almost 70%.[3] The Japan-specific market conditions will be addressed in the next section.

The development of the Japanese paper industry in the twentieth century is interesting not only through international comparisons but also in comparison with other domestic industries. After the First World War, the paper industry was the first to have an oligopoly that lasted until its dissolution after Japan's defeat in the Second World War. The industry shrank significantly during the Second World War and saw its production capacity halved when Japan lost territory. The postwar period witnessed rapid growth. Domestic manufacturers retained their competitive edge over imports on the domestic market, but they never enjoyed a strong competitive advantage on the global market, unlike many of the other Japanese industries that flourished after the war, such as shipbuilding, steelmaking, electronics, and the automobile industry.

The Japanese paper industry is unique because it maintained the vertical integration of pulping and papermaking despite the limited forestry resources it faced during its development. The factors in this uniqueness were the ample supply of domestic resources, the presence of a world-renowned textile industry in its expansion period,

[2] The price of newsprint paper in 1911 was 113.9 yen per 2,000 lb (=907 kg), while the freight charge from Europe to Japan by secret cartel was 40 yen. For details, see the appendix in Nippon Yusen (1927) and Suzuki (1967), p. 125.

[3] In 1974, for example, Japan's forest accumulation was 2.1 billion square meters, comparable to Sweden's. Oji Paper (1987), p. 54.

and the development of a dissolved pulp (DP) industry. After the Second World War, this integration model was linked to the coastal location strategy based on free trade.

Before we outline the structure of this chapter, a short history of traditional Japanese papermaking is appropriate.[4] The *washi* was quite different from the *yoshi* in material, manufacturing process,[5] product characteristics, and use. Traditional *washi* papermaking dates back to the seventh century, when it was introduced from China through the Korean peninsula. Papermaking was closely connected to religion in Japan until the Middle Ages, and a major part of the demand was for Buddhist scriptures, the transcription of sutras, and political records (Miyamoto 1973, p. 58). People came to use *washi* for various purposes other than writing; it has been not only the paper used for Japanese calligraphy but also an important part of the culture—used, for example, as paper for sliding screens, tissue paper, fixtures, and living ware. Thus, *washi* and *yoshi* did not compete against each other in the same market. Even under the *shogunate* system (1603–1868), feudal loads often promoted *washi* production as a monopoly good as one of the good examples of proto-industrialization. Highly developed handmade *washi* wares contributed greatly to the expanding demand for paper in the country before the modern paper industry was launched. After the Meiji period (1868–1912), *washi* was used for the government-compiled school textbooks until 1903; therefore, its demand expanded along with the spread of education after the 1870s (Yagi 1940, pp. 45–47). Most *washi* manufacturers, who were spread out across the country, were microscale. They did not have enough capital to establish modern paper factories. When the production of "machine-made" *washi* began in the twentieth century, handmade and machine-made *washi* found new export markets.[6] It can be said that the *washi* industry experienced both process and product innovation.[7] The decline of the *washi* industry was more a result of the gradual change in the culture (in paper products and the ever-Westernizing lifestyle of the twentieth century)

[4] For detailed information on the long history of the domestic paper industry in premodern Japan, see Section 2 in Kurosawa and Hashino (2010).

[5] "Letting the pulp stock water settle on the mold and allowing drainage of water through the screen thus forming a sheet of paper." Paper Museum (1998), p. 8. See also Furuhata (2001), p. 72 and Sakamoto (2001), p. 50.

[6] *Washi* was introduced to other countries by Europeans who visited Japan in the Edo Period. After the mid-nineteenth century, *washi* was exhibited at World Expositions in Europe and in the US and was well received. For example, the Treaty of Versailles marking the end of WWI was signed with English ink on *washi*, accommodating a request for the world's best paper and ink. See Yagi (1940), p. 47.

[7] The papermaking division of the Printing Bureau of the Ministry of Finance produced *washi* using a combination of traditional paper mulberry and Western papermaking techniques. The paper was exhibited at the Paris Expo and was subsequently exported in large amounts. Later, an imitation of this product using wood pulp as material appeared in Austria under the name "Japanese Vellum" was imported into Japan under the trade name "Simili Japanese Vellum" in around 1900 and became popular. In 1913, Kyushu Seishi Co., Ltd., a Japanese *yoshi* manufacturer, made an imitation of Japanese Vellum with sulfite pulp that became popular in Japan as craft paper. See Paper Museum (2004), p. 17.

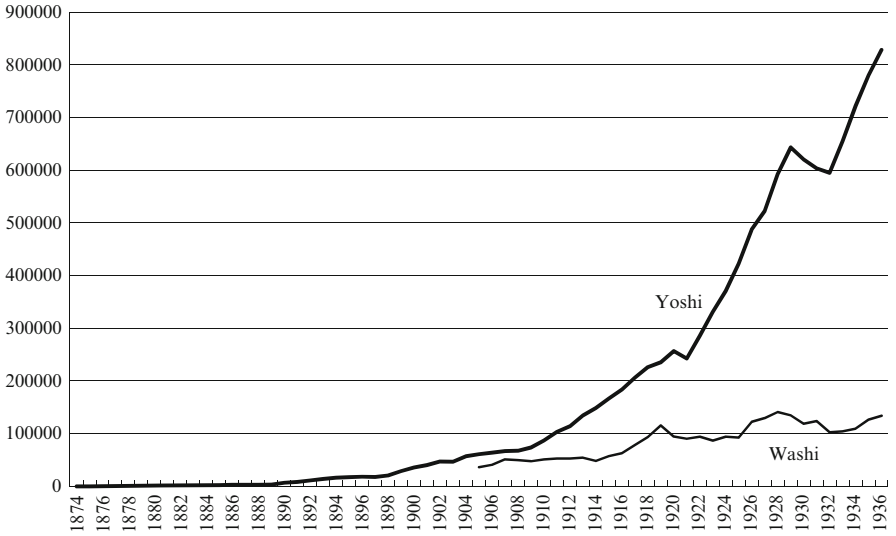

Fig. 6.3 Production of yoshi (Western paper) and washi (Japanese paper) in Japan, 1874–1936

and the arrival of non-paper material than a defeat in direct productivity and quality competition against *yoshi* (see Fig. 6.3).

The remainder of this chapter is arranged as follows. In the next section, we will outline the historical process of the establishment of Japan's modern papermaking industry, from its introduction during Westernization to the creation of its oligopolistic market structure (1870s–1945). The third section will explore its industrial development during the postwar period (1945–2000). In both sections, we will focus on the change in raw materials, technology and products, firms and industry structure, and the role of government. In the final section, we will consider the recent trends in the Japanese paper industry and conclude with some broader implications drawn from the 130-year history of the industry (Kurosawa and Hashino (2010)).

6.2 From the Introduction of the Modern Paper Industry Under Westernization to the Creation of the Oligopolistic Market Structure: 1870s to 1945

Between the mid-1870s and the end of the nineteenth century, the central government was crucial as the engine of Westernization and the developer of such requisites of modern industry as the judicial system and infrastructure. The government also played a crucial role in generating initial product demand, as the public sector required *yoshi* for banknotes, land title certificates, and other purposes. However, as it lacked tariff autonomy and took no protectionist measures, the government had no role to play as a direct protection entity. Despite contributing some direct involvement

by establishing public enterprises in the papermaking section of the Mint Bureau, the central government's role was confined to the initial stages of the technology transfer. The prosperity the Japanese paper industry has enjoyed since the 1880s was due to private enterprise, for the reasons explained below.

6.2.1 Transplantation of the New Industry: Changes in Raw Materials, Technology, and Products

6.2.1.1 Long-Term Trend of the Development of the Modern Paper Industry

The quarter of a century from 1875, when the paper machine was operated for the first time, to 1910, when the first large-scale integrated paper plant using wood pulp was established, can be viewed as the period of the transplantation and introduction of the modern paper industry to Japan. When modernization and modern industry were still in their infancy, the biggest challenge was not only to establish an industry but also a consumption market from scratch while overcoming tremendous cultural, technical, and social disparities and introducing new products and technologies.

The long-term trend in the industry's development is drawn in Fig. 6.1. Figure 6.2 shows *yoshi* production and its import and export dependency in Japan. In 1874, when *yoshi* production was launched, import was only 320 ton, as the *yoshi* consumption market was quite small. However, domestic production and consumption volumes showed an upward trend thereafter, reaching 2,388 ton after 10 years (1884) and then continued growth to 16,507 ton (1894), 35,552 ton (1900), 86,906 ton (1910), and 256,704 ton (1920). The increases in domestic production and consumption in the twentieth century were exponential due to the increases in the per capita consumption of *yoshi*. Per capita *yoshi* consumption was only 0.01 kg in 1874, far below that of *washi* but then started to increase to 0.13 (1890), then to 0.57 (1900), and exceeded 1 kg in 1910. It exceeded 5 kg in 1935, far more than the consumption level of southern European countries. Contrary to the surge in domestic production, the import trend was flat. The import dependency of *yoshi* (as a 5-year average) in Fig. 6.2 dropped to 30% during the 5 years after domestic production began, with a further decline to around 10% in the First World War period. The early transition to domestic production is a conspicuous characteristic of the paper industry, unlike the other transplanted industries in Japan. The *washi* industry sustained its competitiveness in its unique market even after the establishment of the *yoshi* industry through such efforts as the introduction of mechanized papermaking (see Fig. 6.3). According to a government survey in the first half of 1870, paper products (handicraft products) accounted for 4.6% of all industrial products (the paper at issue is obviously *washi*). This figure was not inferior to that of raw silk (5.5%) that supported the European silk textile industry or that of tea production (3.5%) (Hashimoto and Osugi 2000, p. 47). The production volume of *washi* was overtaken by that of *yoshi* by the beginning of the twentieth century, and its ratio declined to

30% by around 1910 and then to 20% by around 1920; it hit bottom and has been stagnant ever since.[8] Modern papermaking then assumed the main role in the industry, three decades after its introduction from the West.

6.2.1.2 The Introduction of the Modern Paper Industry

The transplantation process for *yoshi*, the modern paper industry, will be described with a focus on both the national and private projects, which played crucial roles in the earliest period. In contrast to other transplanted industries, the modern paper industry followed a privately led development from its earliest stage. In the 1870s, however, the papermaking section of the Mint also played a prominent role in introducing production engineering and developing engineers. The public papermaking plant invited a German engineer to support the start of production. The plant used a traditional material, *gampi*, in the beginning, and obtained pulp based on the *washi* papermaking technique. Then, paper mulberry was introduced to make *washi*, using both manual and mechanical techniques. In 1877, an imported paper machine was introduced to produce banknote paper. It also passed a pulping test with rice straw in 1878. In 1879, only 4 years after production began, the papermaking section of the Mint successfully reproduced an American cylinder paper machine (the vat machine). The private paper companies that were struggling to stabilize their management base petitioned the governmental paper factory to stop selling printing paper. Consequently, the national plant ceased production of printing paper products other than those for the exclusive use of the government.

6.2.1.3 Government Demand and the Establishment of Paper Manufacturing Companies

Private paper companies were helped by the bulk orders for land certificate paper placed by government offices. The Meiji administration established possessory titles to land and issued certificates of landownership to landlords. As the demand for this certificate was enormous, the paper section of the Mint sourced the *yoshi* used for this purpose to one of the newly established private paper companies, called Mita Seishijo (or Mita paper). Mita Seishijo sourced amounts beyond its production capacity to four other newly established private companies, such as Shoshi Gaisha (which later became Oji Paper Co., Ltd.). This high government demand sustained

[8] The market share of machine-made *washi* temporarily surged to 28%, in the midst of material scarcity immediately after WWII. It declined to a little more than 10% in the 1960s. As a result of the merging of the *yoshi* and *washi* product categories and the diversification of all paper products, the classification "machine-made *washi*" became less and less appropriate. Hence, after 1967, it was reclassified as either "paper" or "paperboard." See *Yearbook of Pulp and Paper Statistics* (Ministry of International Trade and Industry and Minister Secretariat Office for Research and Statistics) for each year.

private companies throughout the 1880s. Among the private paper companies, Shoshi Gaisha, Japan's first private paper manufacturer, was the most important. It was the direct predecessor of the two giants of today's paper industry, Oji Paper Co., Ltd. and Nippon Paper Industries Co., Ltd. Thus, 1873, the year of its establishment, marked the starting point of the modern paper industry in Japan. Shoshi Gaisha was formed on the initiative of Eiichi Shibusawa, a representative entrepreneur and businessperson of Meiji Japan. Shibusawa visited the Paris Expo in 1867 as a member of the Tokugawa *shogunate* delegation, where he was impressed by the commerce and industry of Europe and recognized the need to introduce modern papermaking into Japan, as a civilizing force, as soon as possible. The founders of the company comprised twelve key entrepreneurs, who also became its shareholders. Shoshi Gaisha was established as Japan's first manufacturing enterprise based on the modern limited liability company system, at a time when Japan did not even have a body of corporate law.

Importing paper machines, hiring foreign technical experts, funding, selecting, and procuring plant sites, constructing the plant, installing machinery, and recruiting and training the workers constituted a wide range of challenges that the newly established forerunner, Shoshi Gaisha, had to overcome. It purchased English paper machines (78-in. frontlinear paper machines from James Bertram) through Walsh, Hall & Co. The plant had originally planned also to engage in printing and bookbinding. In this period, other paper companies imported machinery from the UK, the USA, Germany, and other countries. Foreign experts working for machinery suppliers were invited to Japan and provided guidance not only on the installation and operation of the machinery supplied but also on plant management in general. After the foreign experts left, when stable production was established, the companies sent their engineers overseas to acquire the necessary skills.

6.2.1.4 Changes in Materials and Private Demand

Cotton rags were used as ingredients for machine-made paper in the earlier period, and the paper mills were located in cities like Osaka, Tokyo, Kobe, and Kyoto. As in Europe, the sourcing of rags soon became problematic; thus, rice straw pulp was tried out as a substitute and was successfully commercialized in 1883. Heizaburo Okawa (of Oji Paper Co., Ltd.) developed rice straw pulp, improving its quality and significantly cutting its production cost. Paper mills started to use rice straw either as the sole or main pulp material at the end of the 1880s. Meanwhile, wood pulp manufacturing technology was developed and applied in the West. In 1890, the use of mechanical and sulfite pulp began in Japan. The efforts to introduce new technologies were led by Heizaburo Ohkawa and Joichiro Mashima (of Fuji Paper Co., Ltd.). Oji Paper Co., Ltd. tried to adopt the sulfite process, while Fuji tried the ground wood process. Both paper manufacturers used American pulp digesters and managed to develop wood pulp. After the commercialization of wood pulp, Japan's major paper mills set up fully fledged wood pulp mills and relocated their plants to mountainous areas. In order to utilize the area's rich, almost untapped, coniferous

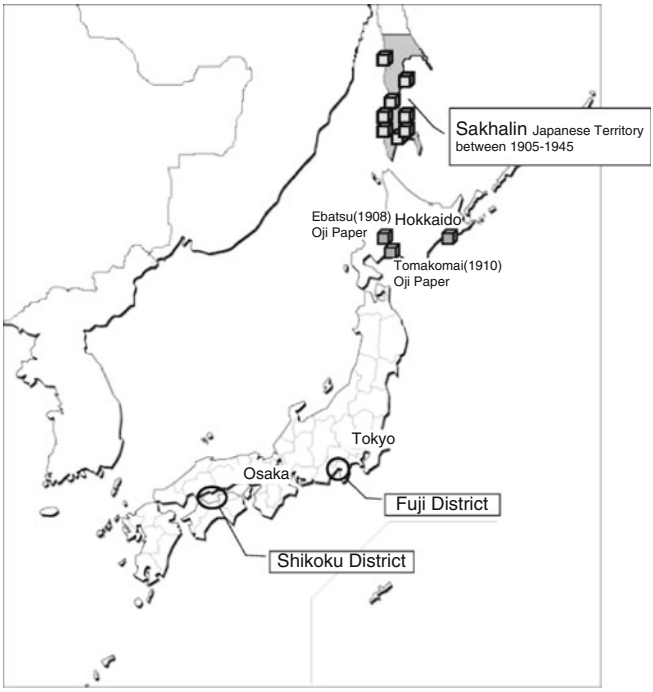

Fig. 6.4 Geographical distribution of the Japanese paper industry

forests, papermaking plants on Hokkaido Island began operating in 1900, with Sakhalin joining in as an important supplier of coniferous trees after the victory of Japan in the Russo-Japanese War (1904–1905), as shown in Fig. 6.4. Table 6.1 shows the changes in the materials used in the paper industry.

In the 1880s, private demand, especially for printing paper to be used in newspapers and books, sustained the industry after the decline in governmental demand.[9] The domestic production of *yoshi* was only 16 tons (compared to 320 ton of imports) in 1874, but it rose to 1,399 ton (492 ton of imports) in 1880 and then increased to 2,278 ton (538 ton of imports) in 1885, 6,527 ton (4,713 ton of imports) in 1890, and 17,260 ton (3,381 ton of imports) in 1895, along with the growing newspaper market.

The year 1912, 45 years after the Meiji Restoration began, marked the first year of the Taisho era (1912–1926), which was succeeded by the Showa era (1926–1989). Between the Taisho and early Showa eras, there occurred a period of dramatic Westernization in the nation's lifestyles. Many of the traditional customs developed

[9] The average daily circulation of the eight major newspapers in Tokyo was then about 72,300 copies (Miyamoto and Yui 1973, p. 93). In the 1880s, the publication of boys', women's literature, and other specialized magazines continued, and the publishing of fiction also gained momentum. Publishers began appearing one after the other (ibid., pp. 99–100).

Table 6.1 Comparison of paper materials between 1909 and 1922

	1909	1922	Growth rate (%)
Wood	53,609 (22.1%)	271,930 (53.6%)	407
Rice straw	126,870 (52.3%)	149,400 (29.5%)	18
Rag	34,117 (14.0%)	31,687 (6.3%)	−7.1
Others	28,260 (11.6%)	54,067 (10.7%)	91
Total	242,856 (100%)	507,084 (100%)	109

Note: Figures in this table were taken from the table in Suzuki (1967, p. 155). All figures were converted into metric tons

during the Edo period (1603–1868) perished, and modernism prevailed. The popular demand structure changed, and *yoshi*-specific demand expanded. Not only did the paper used for textbooks switch from *washi* to yoshi (Miyamoto and Yui 1973, p. 142), but journalism and publishing also flourished in an open atmosphere called the "Taisho Democracy." Magazines and literature collections were published one after the other, and picture postcards became popular. Products like candies, soap, and cosmetics pushed up the demand for containers and packages. As polychrome and offset printing developed, the consumption of paper expanded, resulting in a demand for a wider range of paper types and sophistications in quality (Miyamoto and Yui 1973, p. 123).

Fir (*Abies firma*) and hemlock fir (*Tsuga sieboldii*) were the earliest wood pulp materials used, but using coniferous resources, including the Yeddo spruce (*Picea jezoensis*) and Sakhalin fir (*Abies sachalinensis*) available in the northern territory, was also made possible; these were extensively used to obtain softwood pulp. These tree species occurred homogeneously and collectively, making lumbering costs cheaper. They were also distributed among the national forests, allowing papermakers to purchase material in bulk under advantageous conditions. The Fuji Paper Co., Ltd., one of the two giant paper companies at that time, completed its state-of-the-art newsprint factory in Ebetsu, Hokkaido in 1908. Two years later, its rival, Oji Paper Co., Ltd., started operating a pulping and papermaking plant. Both were large modern plants designed after observations made in Scandinavia and elsewhere. Among them, the Tomakomai plant was powered by electricity from a 25,000 hp hydropower generator and even traded its surplus power. It was equipped with 142-in. wide fourdrinier and two 100-in. types. Sakhalin became a main supply base for wood pulp after 1915 (with the joint sulfite pulp plant of Oji and Mitsui) and a manufacturing base for wood pulping and paper production processes (Karafuto Kogyo Co., Ltd.).[10] This utilization of northern softwood resources changed the competitive environment, especially when imported pulp became scarce during the First World War: Oji Paper Co., Ltd., Fuji Paper Co., Ltd., and Karafuto Kogyo Co., Ltd., all self-sufficient with their northern plants, enjoyed

[10] The survey on forest utilization commissioned by the Sakhalin Agency in 1911 proposed a plan to set up 11 pulping plants in Sakhalin to produce 143,000 ton of pulp annually, which formed the basis for a subsequent national forest utilization plan. See Suzuki (1967), p. 179.

significant growth; (Suzuki 1967, pp. 124–125) in 1913, on the eve of the First World War, their self-supply pulp ratio was merely 62% but grew to 87% by 1921 (Suzuki 1967, p. 155).

Just prior to the First World War, in 1911, the printing paper import duty was raised from 5 to 15%, producing a favorable environment for newsprint paper self-sufficiency. During the First World War, the Japanese paper industry established its footing in every sense of the word, not only materially. Imitation paper machines, with their auxiliary machinery (such as wire screening for paper manufacture and felt) were also being produced in Japan. When importing high-grade and special paper, which had been sourced entirely to foreign producers, became difficult during the war in Europe, Japanese companies began filling in with a wide variety of *yoshi*, including high-quality paper.

Moreover, in the early twentieth century and throughout the First World War, Japanese paper manufacturers ventured into paperboard production, causing the paperboard industry, following the *yoshi* industry, to take root in Japan.

6.2.2 Entries to the Market and the Formation of the Oligopoly: Firms and Industrial Structure

6.2.2.1 The Japan Paper Association: The First Cartel Organization in Japan

After the 1870s, a series of intermittent market entries occurred in Japan's paper industry, which had a limited number of players. Under these circumstances, an oligopoly emerged relatively early. Behind this surge in output was the start-up boom of the mid-1880s. Railways, spinning, and mining were the most active among the prosperous industries, but there were also new entries into the machine-made paper industry. The total number of paper industry corporations in 1890 was 7 (with 8 plants and 10 paper machines, with a total roll width of 721 in.), but this increased to 10 (11 plants and 11 machines, with 1,103 in.) in 1895, to 11 companies (15 plants and 26 machines, with 2,276 in.) in 1900, and to 12 companies (16 plants and 35 machines, with 3,104 in.) in 1905 (Suzuki 1967, p. 105).

After the main demands for paper shifted to private ones (such as newsprint), the major challenge to the industry was to compete against imported paper. Thus, *yoshi* manufacturers and traders formed the Seishisho Rengoukai (Japan Paper Mills Association) in 1880, emulating the Paper Makers' Association of the USA. This organization decided the highest price of the high-end printing paper and the lowest price for the low-end grades (Shinomiya 1997, pp. 140–177). As most imported papers were high quality, the organization attempted to set the highest price below the price of the imported paper to discourage demand for it, while also setting the lowest price to inhibit competition among the Association's member companies. This attempt was not very successful, but is still considered the earliest form of cartel organization in Japan (Japan Business History Institute 1999, pp. 5–10; Miyamoto and Yui 1973, pp. 97, 104–105).

Table 6.2 Market shares of major paper manufacturers in 1921 and 1932

	1921	1932
Oji Paper Co., Ltd.	38.0%	30.0%
Fuji Paper Co., Ltd.	32.0%	36.0%
Mitsubishi Paper Mills	12.0%	5.0%
Karafuto Kogyo Co., Ltd.	0.5%	21.0%
Others	17.5%	8.0%
Total domestic production	240,000 ton	595,000 ton

Source: Oji Paper (1937), appendix, pp. 8–17

6.2.2.2 Recession and Cartel Activities

In the spring of 1920, the Japanese economy plunged into the Great Depression of the postwar period. Curtailed operating hours, closures, and bankruptcies became rampant in many industries. Nevertheless, the paper industry doubled its production capacity by extensive investments in the boom during the First World War. When the import of pulp and paper resumed at the end of the war, paper manufacturers suffered from the decline in product prices and excessive production capacity. Under these circumstances, the market became more oligopolistic. Those who drove this oligopolistic system by staging corporate buyouts were Oji Paper Co., Ltd., Fuji Paper Co., Ltd., and Karafuto Kogyo Co., Ltd., which had established a self-sufficient pulp supply system and were highly profitable. Another measure against recession was cartel activity. Like Europe, interwar Japan went through the formation of organizational capitalism with the paper industry on its front line and the early formation of an oligopolistic system among the three giants. The market shares of the major paper manufacturers in 1921 and 1932 are presented in Table 6.2, which clearly shows the increasing share of the big three companies in the 1930s.

The Japan Paper Association reorganized from the Japan Paper Mills Association in 1906 and 1913 and pursued its cartel activity for 18 years, between 1921 and 1939. At the end of 1921, the association put "inventory adjustment" and price control on the agenda, resulting in an agreement on shorter operating hours and the encouragement of export signed by the 12 member companies, including all major papermakers. The companies that slashed their operations received a cash incentive, and those that promoted export received a grant from the Association. As a result, the industry overcame the problem of excessive finished goods inventories. These incentives were phased out by the end of 1922. In August 1926, nine members of the Japan Paper Association implemented an average 12% cut in operating hours and sustained it for 28 months; after a brief suspension, they resumed it in 1929 in the face of a prolonged recession. The Japan Paper Association also implemented a powerful sealing inventory measure (i.e., a mandatory suspension of shipment) to counter dumping by foreign papermakers.

The paperboard sector established industrial associations in each business category to maintain prices (the Yellow Paperboard Association with 17 members in 1925, the Brown Paperboard Association with nine members in 1931, and the

Cardboard Association with six members in 1934). Similarly, though they had somewhat weaker control, the machine-made *washi* sector also created cartel organizations in all product categories after the 1930s (Daishowa Paper 1991, pp. 35–38).

6.2.2.3 The Emergence of the "Grand" Oji Paper Co., Ltd.: Merger of Three Dominant Companies

The paper industry became one of the representative sectors of organized capitalism. The intensified trend toward oligopoly and the monopolization of resources peaked with the merger of the three dominant manufacturers in 1933. After the 1930s, the domestic production of pulp for rayon expanded, and the paper industry was incorporated into the wartime economy.

The intensified three-way competition during the recession drove Karafuto Kogyo Co., Ltd. into financial difficulties. Therefore, Oji Paper Co., Ltd. merged with Karafuto Kogyo Co., Ltd. and Fuji Paper Co., Ltd. in 1933, in an integration of the three giants. The "grand" Oji Paper Co., Ltd. was formed, with an annual output of 544,320 ton, paid-in capital of 150 million yen (£8.9 million, $37.8 million),[11] and control of more than 80% of Japan's *yoshi* production. It monopolized the newsprint paper business. It was comparable in size to the International Paper Company in the USA and was one of Japan's largest corporations. The merger of the three companies was a direct attempt to strengthen their market dominance, but it also enhanced productivity through product specialization by factory and saved production and indirect costs. In addition, the imported low-grade paper that had taken a 50% market share after 1931 with the help of yen devaluation quickly lost ground; the inventories were cleared, and the massive legacy debt from Karafuto Kogyo Co., Ltd. was steadily paid off.

Not only Oji Paper Co., Ltd. came out of a merger in the 1930s. In Fuji District, the biggest industrial cluster of the industry, Showa Paper Mfg. Co., Ltd. established during the First World War merged with some local firms to become Daishowa Paper Mfg. Co., Ltd., thus becoming Japan's second largest paper company after Oji Paper Co., Ltd. This was an attempt to counter the shortage of materials and pressure for factory conversion in effect during the Sino-Japanese War. In the 1930s, exports to the Asian region increased. Because of the expansion of both domestic demand and export, industrial paper output maintained an annual growth rate of more than 10%. Japanese products dominated the Chinese and Manchurian (current northeastern China) markets. In 1937, the size of exports had doubled over 1932.

[11] Even Tokyo Dento Kabushiki Kaisha (now TEPCO), then one of Japan's largest companies, had a paid-in capital of 400 million yen, and the largest spinning firms, such as Kanebo and Toyobo, were capitalized at around 30 million yen. See Miyamoto and Yui (1973), p. 149. The description below is based on pp.149–153 of Miyamoto and Yui (1973) unless otherwise specified.

6.2.3 The Role of the Government in Westernization and Modernization

6.2.3.1 Role of the Government in Changing Materials

As mentioned, the central government's Westernization policy stimulated demand for modern paper in the early days of the industry. Then, the first half of the twentieth century saw a stabilized private demand for *yoshi* and intensified international competitiveness, allowing private paper manufacturers to achieve import substitution. In this period, when extensive use of wood pulp was achieved, the most significant governmental support was the generous forest utilization concession for the northern national forests to domestic major paper mills at a bargain price. Tariff protection was also initiated, and the import duty on newsprint was drastically raised in 1911 from 5 to 15%. This worked to a certain degree. However, when compared to the peripheral European countries, the significance of Japan's tariff protection is considered to have been relatively small. An oligopolistic structure was formed during this time, but the government, lacking an antitrust policy, failed to react to it. In the 1930s, the government backed pulp self-sufficiency through a national policy but controlled the economy during the war.[12] The "grand" Oji Paper Co., Ltd., established in 1933, practically monopolized the northern softwood resources. Oji Paper consumed most of its own pulp material, so the other paper companies had no choice but to depend on imported pulp. Subsequently, pulp imports increased from 60,000 ton in 1932 to between 140,000 and 150,000 ton by around 1935 (Daishowa Paper 1991, pp. 34–35).

It must be emphasized that the rayon industry was also a key consumer of the imported pulp. In the early twentieth century, the textile industry was the main industry of Japan, unlike the more advanced paper producers in North America and Europe, where the main industry had been surpassed by the capital-intensive sector. In 1937, Japan was the world's largest rayon manufacturer, producing 270,000 ton that year. The import dependency of its raw material, dissolved pulp (DP), accounted for as much as 83% (Oji Paper 2001c, p. 53). However, when the Japanese government entered international isolation after the Manchurian Incident in 1931, it curtailed the use of imported pulp. In pursuit of autarchy, the government made a top priority of self-sufficiency in DP. The cotton industry, the main sector of the textile industry, had no choice but to depend on imported cotton, but the rayon industry managed to attain self-sufficiency in raw materials, as the woody resource in its *de facto* territory could support the expanded production of DP.

As a result of strong support from central government and investment by the rayon manufacturers, many pulp makers sprang up in the latter half of the 1930s, including Nippon Pulp Industries Co., Ltd. and Sanyo Pulp Co., Ltd. in 1937 and

[12] However, public support during the prewar period was not nonexistent. In 1937, a prefectural papermaking industrial research institute was founded in Shizuoka, one of the largest centers of the paper industry in Japan. Daishowa Paper (1991), p. 55.

Table 6.3 Annual output of pulp for rayon in Japan, 1935–1940 (tons)

	Total of domestic production and import	Mainland Japan	Foreign part (Sakhalin, Korea, Taiwan)	Manchuria
1935	160,283	0	33,964	N/A
1936	225,191	0	56,082	N/A
1937	348,723	0	58,220	N/A
1938	219,069	14,665	90,323	12,609
1939	300,230	49,866	109,690	30,338
1940	344,507	113,679(33.0%)	120,795(35.1%)	14,095(4.1%)

Source: Oji Paper (2001c), p. 53

Kokusaku Pulp Co., Ltd. and Tohoku Shinko Pulp Co., Ltd. in 1938. Most of them received technological assistance from Oji Paper Co., Ltd. Thus, the pulp self-sufficiency rate rose quickly. However, this did not improve the pulp sourcing difficulty faced by the other paper mills hard-hit by Oji's monopolization of pulp and the government's import restriction because the government had strategically prioritized DP for military purposes.[13]

Nevertheless, the existence of the rayon industry and the autarchy policy of the national government defined the structure of the Japanese paper industry for years to come; the non-Oji paper producers thus ventured into the pulp sector, and most of the newly established DP manufacturers started producing pulp for paper in the postwar period, eventually advancing into the papermaking sector, as mentioned below. For example, Daishowa Paper Mfg. Co., Ltd. first succeeded in making KP from red pine in 1939 and was becoming increasingly self-sufficient. In its neighborhood, Fuji District, 21 pulping factories were established during this period.[14] Mitsubishi Paper Mills Ltd., which had tried in vain to produce bamboo pulp in Taiwan around 1910, hence depended on imported pulp, initiated pulp production in the newly colonized Manchuria.[15] In 1940, Dainippon Recycled Paper Co., Ltd. was founded to use recycled paper as material (Tables 6.3 and 6.4).

[13] In 1937, eight imported pulp-dependent domestic paper firms (such as Mitsubishi Paper) jointly applied for permission to process virgin wood and operate a pulping business, but this was rejected by the government because of its policy of priority for rayon. Daishowa Paper (1991), pp. 62–67.

[14] The craft pulp production capacity in 1938 was 63,000 ton for Oji Paper Co., Ltd., 7,500 ton for Daishowa Paper Mfg. Co., Ltd., 7,500 ton for Takasaki Paperboard, and 2,000 ton for the others. Oji enjoyed a dominant position. Daishowa Paper (1991), p. 55 and pp. 62–67.

[15] Unlike Sakhalin (occupied since 1905), Taiwan, Korea, and Manchuria were of limited importance in the history of papermaking and pulping in Japan. Pulp production began in Korea and the Yalu River area of Manchuria via the Oji Paper, Co., Ltd. and others after 1918. Expectations for forest-rich Manchuria were high, but pulping and papermaking in other places had to wait until 1938 and even after. Five companies involved themselves in these projects. However, the lumbering and sourcing costs of pulp materials were high in Manchuria because of its lack of social infrastructure, and it never did achieve a key position as a sourcing base before being lost after Japan's defeat. Daishowa Paper (1991), p. 69.

Table 6.4 Annual import volume of paper by country (tons)

	Import total	USA	Canada	Sweden	Norway	Finland	Others
1935	126,319	54,676	6,742	3,958	48,186	12,574	183
1936	169,109	87,293	1,705	10,918	50,229	17,224	1,740
1937	290,523	138,212	20,468	39,277	55,509	32,588	4,469
1938	101,473	42,613	16,208	11,997	18,142	10,291	2,222
1939	110,336	43,804	8,393	13,165	26,724	18,250	N/A
1940	95,938(27.8%)	N/A	N/A	N/A	N/A	N/A	N/A

Source: Oji Paper (2001c), p. 53

6.2.3.2 The Paper Industry in the Wartime Economy

The Sino-Japanese War broke out in 1937.[16] The Japanese economy then intensified its militarization and control. As a nonmilitary industry, the paper industry was tossed around like a boat in a storm. In 1938, an official pricing system was introduced to curb soaring prices. It was also applicable to the paper industry, for which it set the highest price. In the following year, the market price was set on September 18. This price control lasted until May 1951. Following the importation of pulp, the rationing of raw materials, fuels, and other materials began in 1939. Supply to the paper industry was cut back drastically. With the prioritizing of military demand and restrictions on freedom of speech and news reports, the production of newsprint paper declined. In 1940, *yoshi* paperboard and *washi* products were sold through a sectoral sales control company. In 1944, these sectoral companies were dissolved and replaced by a single controlling company.

Under the wartime economy, a coercive streamlining of companies and plants throughout the whole manufacturing sector was promoted to enhance productivity and control. This was also applied to the paper industry in 1942; 380 small and medium-sized paper firms came under this program, to be ultimately reorganized into 143 companies with 319 plants by 1944. The establishment of the Daio Paper Corporation through the merger of 14 paper factories in Shikoku is a conspicuous example (Daio Paper Corporation 1995, pp. 1–11). In 1943, this was applied to the publishing industry, where companies ranking 200th or lower in paper consumption (22.6 ton or less) were forced to merge or close down. As a result, the number of publishers diminished to a third. The conversion of paper mills from civil to military use occurred by government decree. At Oji Paper Co., Ltd., eight of its plants were converted to make paper products for the military, with eight others subject to detachment, conveyance, and rent to serve in the war. Its Ebetsu plant, set up as the first fully fledged paper plant on Hokkaido, was also detached as a separate company for airplane assembly after its papermaking facility was transferred to Manchuria (Oji Paper 2001c, p. 13). By the end of the Second World War, paper production bottomed out due to shortages of materials, energy, human resources, and facilities, plus damage from air raids. Consequently, by 1946, paper output had diminished to 14% and pulp output to 16% of what had been 1.54 million tons for paper and 1.28 million tons for

[16] This description is based on Daishowa Paper (1991), pp. 57–91.

pulp in 1940 (Daishowa Paper 1991, p. 119; Suzuki 1967, p. 22 Appendix). The Japanese paper industry had made fleeting advances into the colonies under the government's expansionist policy but that project went down with the rest.

6.3 The Paper Industry in the Postwar Period: Development Toward the "Japanese Model" of Competitiveness

The paper industry in the postwar period started out with the division of the "grand" Oji Paper Co., Ltd. into many smaller firms. Japan's defeat also triggered the dissolution of the oligopolistic industry system. After 1945, the GHQ (General Headquarters) led a systematic divestiture of oligopolistic firms as part of its democratization policy for Japan. Such minor affiliated concerns as pulping companies and various factories were detached from the main entities (Oji Paper 2001c, p. 65), and Oji Paper Co., Ltd. was split into three companies with different mainstay products. The divestiture created Tomakomai Paper Co., Ltd. (producing newsprint paper by inheriting most of the corporate forests), Jujo Paper Co., Ltd. (inheriting seven factories, producing paper for printing), and Honshu Paper Co., Ltd. (producing paper for printing, tissue paper, special paper, and paperboard). In 1949, each company's respective share of output was 17.2, 16.8, and 8.5%, followed by Hokuetsu Paper Mills, Ltd. with 5.8, Mitsubishi Paper Mills Ltd. with 3.3, Daishowa Paper Mfg. Co., Ltd. with 2.5, and Kokusaku Pulp Co., Ltd. with 2.0% (Oji Paper 2001c, p. 341).

This quickly led to a drop in market concentration. At the same time, new firms entered the industry. The loss of Sakhalin, which Oji Paper Co., Ltd. had monopolized, increased dependence on the monopoly-free broad leaf (hardwood) forests on the mainland, while imported resources repainted the competitive landscape of the paper industry. Following the legacy of the prewar and wartime periods, the vertical integration model for pulping and papermaking processes prevailed. Together with the conversion of material, new technologies were introduced from abroad and were partially modified to help maintain a world-class technological level, bringing about a remarkable improvement in productivity. On the other hand, the many companies with homogenous resources competing for capital investment in response to an expected market growth ended up with cyclic overcapacity. As will be shown later, the central government issued one strong administrative directive after another in stark contrast to its prewar stance on the industry. In the midst of structural high prices for materials and low prices for products, the profitability of the paper industry continued to stumble across the board. Japan became the third largest paper producer in late 1959 after overtaking the UK and then went up a notch by surpassing Canada in 1970, its product range continuously diversifying.[17] After the 1990s,

[17] After the change from wooden to cardboard boxes, the shift to a mass consumption society, and the "packaging revolution," the percentage of paperboard of total paper products production jumped from 15% (1945), to 24% (1950), to 40% (1960), and eventually to 47% in 1966. However, it then started to decline due to the shift to other packaging materials such as plastic and the diversification of demand for *yoshi*, among other reasons. It has been hovering around 40%

some of the world's top ten paper companies were founded half a century after the grand merger of Oji Paper, in large-scale M&As.

However, the postwar business structure of the paper industry was a result not only of the division of the "grand" Oji Paper Co., Ltd. but also of the following changes: (1) the emergence of new leading companies due to the changed competitive conditions, (2) the vertical integration of pulping and papermaking processes, and (3) the creation of comprehensive manufacturers through diversified entries into the *yoshi*, *washi*, and paperboard sectors.

6.3.1 Changes in Raw Materials, Technology, and Products: Postwar Recovery and Growth

6.3.1.1 Recovery and Boom

Defeat in the Second World War deprived Japan of Manchuria, Korea, and Taiwan, as well as Sakhalin, which had been supplying 44% of the domestic woody pulp before the war (Daishowa Paper 1991, pp. 177–179). When the lumber from Sakhalin was growing in national forests, low-cost supply with high-volume transactions was guaranteed. However, it was the red pine and black pine and other trees in private hands on the mainland that became the main source of pulp in the postwar period, considered a problem because of the lack of price and transaction stability (Miyamoto and Yui 1973, p. 168). Since the ceded territory also had a number of paper plants besides the wood resources, the loss automatically reduced production capacity. Damage from air raids was limited, but the destruction of the economic infrastructure, the dire lack of resources and fuel, and the controlled economy throughout the 1940s made the recovery of production very difficult.

Under the controlled economy, low-grade *washi* products prospered because they were free from governmental control and could be made from recycled material using simple facilities. Hundreds of microenterprises entered the industry.[18] In 1949, controls on paper and coal were lifted. When the Korean War broke out in 1950, the paper pulp industry experienced part of the "Three White Products" (sugar, cement, and paper) boom, in which demand for craft paper, such as cement bags, surged. In 1953, paper output regained its highest prewar level, 1.76 million tons. It reached 1.92 million tons in 1954 (Suzuki 1967, "Statistics" in appendix, p. 14).

since the 1980s. See Suzuki (1967), appendix pp. 14–19 and the *Yearbook of Pulp and Paper Statistics* (Ministry of International Trade and Industry and Minister Secretariat Office for Research and Statistics) for each year.

[18] The main product was low-grade printing paper made from ground pulp and recycled paper. See Daishowa Paper (1991), p.124.

6.3.1.2 Material Conversion and Product Diversification

A GHQ-recommended amendment to the Forest Act in 1951 reinforced the restriction on tree-felling, causing a surge in the price of virgin wood (Oji Paper 2001c, p. 349). In the midst of a steep rise in coniferous tree prices after the 1950s, efforts were made to utilize broad-leaf resources. In 1954, for example, Kanzaki Paper Co., Ltd. was the first to produce semichemical pulp (SCP) from deciduous trees.

A major characteristic of the postwar Japanese paper industry is material conversion. Specifically, this included (1) conversion to pine tree among coniferous and to broad-leaf trees, (2) conversion from logs to wooden chips and from domestic wood to imported wood, (3) the start of outward FDI (foreign direct investments) to resource-producing countries and pulp sourcing through joint ventures, (4) increasing use of pulp from recycled paper, and (5) conversion to woody SCP in sectors still using rice straw, such as for corrugating media.[19] The use of new materials was achieved among the coniferous tree resources, namely red pine (*Pinus densiflora*) and Japanese black pine (*Pinus thunbergii*). The use of deciduous trees, such as beech, expanded. The relative proportions of coniferous to broad-leaf trees used as materials were 95 to 5% in 1952, changing to 42–58% in 1969. It was the fully fledged commercialization of the KP method in 1952 that brought about this change (Oji Paper 2001c, pp. 70–75). Each manufacturer pursued conversion to hardwood resources due to the lack of coniferous trees and a conversion from the SP to the KP method. Technological innovations such as semichemical pulp (SCP), semi-ground pulp (SGP), and chemical ground pulp (CGP) also contributed to the more extensive use of broad-leaf trees.

The use of imported wood commenced with imported logs in the 1950s (Oji Paper 2001c, pp. 97–98) and to be later replaced with wooden chips. Import from the west coast of the USA started in 1963. Toyo Pulp Co., Ltd. was the world's first company to develop exclusive berths for wooden chip carriers, with its competitors following suit (Oji Paper 2001c, pp. 163–169). The Ministry of International Trade and Industry (MITI, now METI—the Ministry of Economy, Trade and Industry) also subsidized this activity. In 1960, the ratio of logs to wooden chips was 76 to 24 but surprisingly became 30 to 70 by the end of the 1960s (Oji Paper 2001c, p. 239). This optimal overseas sourcing of virgin materials and domestic production of pulp and paper through vertical integration marked the foundation of the prototype for the coastal-style plant that characterized the postwar Japanese process industries, though it came somewhat later than in other sectors (such as the steel and chemicals).[20] Emerging companies like Daishowa Paper Mfg. Co., Ltd. and Daio Paper Corporation were especially systematic in their pursuit of this strategy. In 1973, 16 companies imported wooden chips from ten countries (including North America) using a total

[19] The share of rice straw among paper materials diminished from 11.2% in 1955 to 3.6% in 1965. See Toyo Keizai (1966), p. 266.

[20] Oji Paper (2001c), pp. 158–159, p. 359. The coastal location had already been determined but only for product shipment, and the materials were sourced domestically. In the chemical industry, 1958 marks the beginning of one of the coastal chemical complexes (in Iwakuni and Niihama).

of 51 chip carriers. Japan's dependence on imported raw material for pulping reached 35%, and wood was positioned as the second most imported resource next to oil (Daishowa Paper 1991, p. 282). From around 1970, the joint development of overseas virgin wood resources became noticeable. However, pulp imports did not cease. The Japanese outward FDIs were initiated in 1953 for the local production and import of pulp, which shifted into full gear around the end of the 1960s (Daishowa Paper 1991, pp. 344–351).

6.3.1.3 The Paper Industry During the Oil Crises and Changes in Economic Conditions

The first oil crisis of 1973 ended the Japanese postwar boom that had lasted for over 20 years beginning in 1955. Paper manufacturers benefited temporarily from the soaring prices, but the subsequent recession hurt their corporate earnings. After the oil crisis, the Japanese economy decelerated from a rapid 10% annual growth to a medium rate of around 4%. Unlike many other products, paper consumption and production expanded even in the era of slow growth. However, the position of the paper industry fell among manufacturing industries. In this period, its profit margin was extremely low, at 2% or less, only half of the manufacturing industry average. During the oil crisis and subsequently, soaring fuel and material prices and the wild fluctuations in commodity prices were a blow to the paper manufacturers. The response to pollution, which surfaced as a social issue in the latter half of the 1960s, also aggravated their low profitability. In 1970, the sludge in Fuji District became a symbol of environmental pollution. Fourteen antipollution laws were enacted in the same year, and the whole industry strove to improve the environment by investing 245 billion yen throughout the 1970s (Oji Paper 2001b, p. 173).

Like other industries, the paper industry was subject to drastic fluctuations in demand. After the Plaza Accord in 1985, the yen shot up dramatically from 240 to the dollar to 150 yen to the dollar. Japanese manufacturing industries coped with this change well, but a low interest rate policy and measures to generate more domestic demand to address the soaring yen generated an economic bubble. Demand for paper mushroomed after 1987. Domestic shipments registered 11 million tons in 1984, 13.95 in 1988, and 16.23 in 1991. Moreover, the special act that had included a new investment over a 5-year period expired in 1988. Paper producers fully responded to this situation by drumming up equipment investment. This collectively amounted to 1 trillion 890 million yen (about 15 billion dollars) over a 5-year period between 1987 and 1991. Forty-three paper machines were added to the industry, and production capacity rose by 5 million tons on an annual production basis, or 17% (Oji Paper 2001b, p. 302). This capacity became excessive in the recession phase and resulted in a bear market and price decline, weighing on management all the way into the mid-1990s.

6.3.1.4 Use of Foreign Resources, Integrated Production at Coastal Manufacturing Bases, and Use of Recycled Paper

The use of inland wood resources hit the ceiling, and the dependence on foreign resources that had begun in the 1960s took hold. The import dependence on materials for pulping accounted for 46.1% in 1979, declining to a low of 37.5% in 1985. It later recovered to 61.9% in 1994 due to the appreciation of the yen and a decline in the domestic forestry industry. Most of the initial resource supply came from North America; in 1979, 70% of it came from the west coast of North America, 17% from Oceania, and 13% from the USSR. Diversification of the source areas to Southeast Asia and Oceania had been tested in the 1960s,[21] but the so-called "chip crisis" of 1980 added impetus to this trend when the price of North American virgin wood skyrocketed by 2.5 times due to the local supply and demand situation, severely affecting Japanese paper manufacturers (Oji Paper 2001b, pp. 180–181). As a result of the diversification efforts, the percentages changed to 52.3% from North America, 25.7% from Oceania, and 11.8% from Chile in 1990. Sourcing from the southern US states and South Africa was now well under way. In addition, a shift occurred from natural and secondary forests to plantations (Oji Paper 2001b, p. 227, 279, and 320).

As mentioned, wood chip transport by specialized chip carriers and integrated pulping and papermaking along the coastal production bases began in the 1960s. The existing plants on the coast were located more for product shipment purposes than for material import. After the 1970s, the practice was changed to the use of raw materials from overseas, and new plant locations and mergers of existing coastal companies were promoted (Oji Paper 2001c, p. 201). Against this backdrop, fresh large-scale capital investments were commonly made in the coastal location projects, from the standpoint of the use of foreign resources. In the acquisition of Toyo Pulp Co., Ltd. by Oji Paper Co., Ltd., the decisive factor was Toyo Pulp's coastal location. The import of raw materials for pulping and the integration of domestic pulping and papermaking are peculiar features of the Japanese paper industry: Japanese paper manufacturers held the technical pulping know-how, which is why they also advanced pulp production abroad.[22] These activities increased at the beginning and end of the 1970s and during the period of the strong yen after 1985. Many of them were FDI-based joint ventures with the local forestry companies to which the Japanese provided pulping expertise. Such investment projects were underway

[21] In 1968, Daishowa Paper Mfg. Co., Ltd. established joint ventures in Malaysia and Australia to purchase rubber and eucalyptus chips on a long-term contract. Their competitors followed suit. See Daishowa Paper (1991), pp. 317–320; Oji Paper (2001b), p. 334.

[22] The first case of this type of FDI was Alaska Pulp, set up in 1953. That was followed by other plants, such as Honshu Seishi (N-BKP, Canada in 1967), Jujo Paper Co, Ltd. (RGP, Canada in 1968), Daishowa Paper Mfg. Co., Ltd. (N-BKP, Canada in 1970), and Sanyo-Kokusaku Pulp Co., Ltd. and Oji Paper Co., Ltd. (RGP, New Zealand in 1971).

in North America, Brazil, Southeastern Asia, and elsewhere, and most of the products there were exported to Japan.[23]

The first import of these finished goods made overseas occurred in 1976, when newsprint manufactured through a joint venture between Jujo Paper Co, Ltd. and Weyerhaeuser of the USA was exported to Japan. Oji Paper Co., Ltd. followed suit in 1980.[24] In both cases, the Japanese partner provided guidance on production control (Oji Paper 2001b, pp. 275–276). Such a development and import scheme occurred in response to the appreciation of the yen; the phasing out of the import duty promoted in the US-Japanese trade friction and GATT negotiations were also underlying factors.[25] The FDIs to the existing export markets commenced in the mid-1980s to provide product supply to the local market, the size of which rarely increases even today.[26]

Another important event after the oil crisis was the increased use of recycled paper. There is a long history of using recycled paper, especially for the paperboard and machine-made *washi* product areas. This trend was promoted by the technological innovation after the Second World War. It was in 1958 that the first DIP (deinked pulp) facility for newspaper appeared in Japan (Oji Paper 2001c, p. 357). The use of DIP spread after the oil crisis because of its excellent energy efficiency. In the midst of the second oil crisis and the "chip crisis," the use of recycled paper for *yoshi* was launched. The weight reduction demand for newsprint paper increased, lending an advantage to the low transparency of DIP.[27] The share of recycled paper of total paper output rose from 36.2% in 1970 to 51% in 1985 (Daishowa Paper 1991, pp. 430–431). The collection rate of newspaper was maintained at a high of 90.4% in 1989. Collection spread across Japanese society, including businesses whose collection rates used to be low (Oji Paper 2001b, p. 202). Today, Japan's collection rate and use of recycled paper are among the world's highest, along with Germany (see Table 6.5) and South Korea.

Higher dependence on recycled material also affected the location of plants and competitive conditions, by which companies strategically sought optimal locations for their plants in large urban areas, close to recycled paper collection sites.

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[23] The most representative one is Celulose Nipo Brasireira S.A. in 1970, a joint venture with the Brazilian national policy concern CVRD (Companhia Vale do Rio Doce). This project was financed by the Japanese government in the form of ODA. Nine major Japanese pulping firms and the Itochu Corporation invested in this project for the development of a eucalyptus plantation and the construction of the world's largest L-BKP plant based on Japanese technology. Japan procured 75% of the pulp produced there. Oji Paper (2001b), pp. 176–177.

[24] Oji Paper (2001b), p. 230.

[25] The import duty on newsprint paper was 5.5% in 1972, reduced in phases to 0% in 1990. The duty on coated paper was lowered from 10 to 4.1% and that for paperboard was reduced from 10 to 2.5%. In 2004, the tariffs on paper and paperboard were completely lifted. See Oji Paper (2001b), pp. 248–249.

[26] The first example of this was the thermosensitive paper plant of Kanzaki Speciality Papers, Inc. that opened in Massachusetts in 1986. Later, more such FDIs could be seen in Europe and China, though few. See Oji Paper (2001c), p. 376.

[27] Unlike in Europe, weight reduction in Japan was initiated at the request of newspaper companies. For this purpose, Oji Paper initiated Japan's first mass production of TMP (thermomechanical pulp) in 1976. See Oji Paper (2001c), pp. 166–168.

Table 6.5 Collection rate and usage rate of recycled paper (2007)

	Collection rate (collection volume/paper and paperboard consumption) (%)	Usage rate (recycled paper consumption/paper and paperboard output) (%)
Japan	73.7	61.6
Germany	72.8	68.3
USA	54.4	36.1
China	37.9	68.3
World average	53.1	52.7

Source: http://www.jpa.gr.jp/states/global-view/index.html#topic04 (Japan Paper Association)
Original data are from the *RISI Annual Review*

6.3.1.5 Changes in the Product Market and the Formation of Japan-Style Quality

Along with material sourcing, there was a big change in the material market after the mid 1980s. In 1978, per capita paper consumption grew to 142 kg, ranking eighth in the world, on par with major European countries such as Germany, though not as much as Scandinavia and the USA (Daishowa Paper 1991, p. 397). As the paper market matured, product quality and variety became important strategies for paper manufacturers. There were three important issues for them: (1) weight reduction, (2) penetration into the information-related product market, and (3) the diversification and expansion of sanitary products.

For weight reduction (e.g., of newsprint paper), replacement investments from SP facilities in sturdy craft pulp machinery was critical, including various environmental standards. These facilities were imported from Kamyr of Sweden and machinery manufacturers in Finland, partially modified for Japan. Information-related products were becoming increasingly significant given the demand for higher performance, lower costs, and the spread of office and automation equipment. Investments in coaters and other equipment were important for the sanitary market; new capital expenditures were required to respond to the soaring demand for paper diapers, which expanded in this period (Oji Paper 2001b, pp. 258–285). In the late 1980s, the demand for high-quality paper on the Japanese market reached the demand faced by the major advanced Western paper producers.

6.3.2 Changes in Firms and Industry Structure: Reorganization of the Competitive Structure

The relationship with the *zaibatsu* (family conglomerates) and postwar business groups was also restrictive. The biggest paper manufacturer, Oji Paper Company Limited, enjoyed strong financial and personal relationships with the Mitsui *zaibatsu*, especially in purchasing the forest resources, but did not have many business ties with its affiliates. The major *zaibatsu* made it a rule to run an affiliate in each major

industrial sector, but in the paper industry, the influence of *zaibatsu* (except for Mitsui and Mitsubishi) was kept to a minimum. Instead, the paper industry formed unique corporate groups, an example being Mr. Heizaburo Okawa, commonly known as the "Paper Tycoon," who doubled as president of Karafuto Industry Corporation and Fuji Paper Company. One of the factors in the industry's uniqueness may have been that the newspaper business, its biggest customer, was detached from the *zaibatsu*.

6.3.2.1 New Entrants After the Second World War

As the northern coniferous tree resources formerly monopolized by the key enterprises became relatively less significant, and smaller private and communal forests in other regions became more significant, the paper companies based on the local forestry resources in different regions also increased in relative significance. The demand for newspaper as a mass-produced product was relativized by greater product diversification, providing an opportunity for medium-sized companies. This allowed some SMEs (small and medium-size enterprises) in Fuji District (see Fig. 6.4), the supply base for the Tokyo Metropolitan area, and those in Shikoku, the supply base for western Japan, to distinguish themselves as postwar giants. Among them were Daishowa Paper Mfg. Co., Ltd. (in Fuji District, ranked third in 1958) and Daio Paper Co., Ltd. (from Shikoku, ranked third in the domestic newsprint paper market share in 1975). They achieved positions very close to the three offspring of the "grand" Oji Paper through an aggressive investment strategy, resulting in a lower production concentration ratio. In 1965, the top ten paper companies only had an approximate 45% market share. While the Japanese paper industry had grown into the world's third largest by 1962, its largest manufacturer was still ranked below 25th in the world (Daishowa Paper 1991, p. 227).

6.3.2.2 Vertical Integration of the Pulping and Papermaking Process

Vertical pulping and papermaking integration can be considered unique to Japan. This is because many twentieth century papermaking nations were forest-rich and either produced pulp and paper in an integrated way (as in Scandinavia and North America) or were dedicated to papermaking while depending on pulp importation (as in continental Europe and Korea). Japan has a sizeable population and paper production volume but is integrated, producing both pulp and paper. This system imports wood (logs or wooden chips) in lieu of pulp from a distance, after turning to foreign materials in the 1970s, when its own resource supply reached its limit, before which it had already established an integrated production of pulp and paper based on the domestic resources available.

This system is also an outcome of Japan's having been the biggest producer of rayon in the mid-twentieth century. This was because pulp manufacturers had been established in the course of pursuing the domestic production of rayon pulp. One other factor is the presence of a coastal-style development model with a dependence

on imported material, such as steel making. The import of pulp followed Japan's increasing dependence on foreign resources, but the domestic paper companies already had their own pulping departments; thus, pulp imports often took the form of "develop and import" through joint ventures with companies in forestry and resource-rich countries. This integral production of pulp and paper was retained despite the moves toward location in the place of consumption for more dependence on recycled material.

After the Second World War, the dominant manufacturers, who owned the pulping process, were all vertically integrated.[28] These entries into the pulping business were triggered by the lack of pulp caused by the collapse of the prewar material base and competition with rayon manufacturers in pulp sourcing. Between 1941 and 1946, 37.1% of the craft pulping facilities were lost, and the remaining facility output plunged to 7.6%, while the import of pulp was quite difficult due to the lack of foreign exchange. In those days, only five firms specialized in pulping—Kokusaku Pulp Industry Co., Ltd., Tohoku Pulp Co., Ltd., Sanyo Pulp Co., Ltd., Nippon Pulp Industries Co., Ltd., and Kokoku Rayon Pulp Co., Ltd. These five firms had far less production capacity than the domestic papermakers (Oji Paper 2001c, p. 231). Purchasing SP was extremely difficult for papermakers, especially during the boom of the rayon industry, which is why paper manufacturers had to start pulp production to secure material of their own.[29] On the other hand, specialized pulp makers advanced into the papermaking process due to factors such as the aggravated market price of pulp after the pulp boom, paper manufacturers' move toward pulping integration, and apprehension about instability and future demand for DP in the midst of the synthetic fiber recession.[30] Table 6.6 shows the top paper-producing countries in the world and their pulp and paper production ratios.

In 1965, the percentage of total sales of the papermaking by the former pulp manufacturers was quite similar to that of the papermakers: 78% for Kokusaku Pulp Industry Co., Ltd., 51 for Tohoku Pulp Industry Co., Ltd., 52 for Nippon Pulp Industries Co., Ltd., and 18 for Sanyo Pulp Industry Co., Ltd.[31] Thus, together with the existence of the world's largest rayon industry, an integral production system came into being which can be called the "Japanese model."

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[28] In 1999, eight of the top ten paper and paperboard manufacturers were integrated pulp and paper manufacturers. Among the 64 plants of these top 10 companies, 28 are integrated plants, including pulping and papermaking processes. On the other hand, paperboard companies tend to depend on recycled paper and use a very limited amount of virgin pulp. Out of 452 paper and pulp factories, only 54 are integrated, and those owned by SMEs use purchased pulp or recycled paper as material. See Oji Paper (2001a), pp. 78–79.

[29] In 1949, Mishima Industry (predecessor of Toyo Pulp) and Kanzaki Paper Co., Ltd. started pulp production. Daishowa Paper Mfg. Co., Ltd. became self-sufficient in pulp in 1952 and built a pulping plant. See Oji Paper (2001c), pp. 141–150.

[30] As a result of the cyclic recession in the synthetic textile industry and increased paper consumption after the mid-1950s, DP only accounted for 9% of all pulp output in 1964. See Toyo Keizai (1966), p. 151.

[31] Of the 1975 pulp output, 82% accounted for home consumption. 15 specialized pulping mills accounted for only 2.3%. See Toyo Keizai (1978), p. 151 and p.154.

Table 6.6 World's top 10 paper producers and their pulp and paper production ratios (ratio of pulp production, when paper and paperboard production is taken to be 100)

	1956		1965		1975		1985	
1	US	70	US	76	US	82	US	80
2	Canada	124	Canada	138	Japan	63	Japan	45
3	UK	n.a.	Japan	76	Canada	148	Canada	141
4	W. Ger.	50	USSR	97	USSR	90	USSR	84
5	USSR	101	U.K.	6	China	64	W. Ger.	24
6	Japan	86	W. Ger.	46	W. Ger.	29	China	70
7	France	41	Finland	174	Sweden	188	Finland	107
8	Sweden	260	France	46	France	43	Sweden	130
9	China	35	Sweden	209	Finland	130	France	36
10	Finland	186	China	61	UK	9	Italy	18

Note: This table is based on the statistics at the end of Toyo Keizai (1966), Toyo Keizai (1978), Oji Paper (1987), and Oji Paper (2001a). The original data are based on the *Pulp and Paper World Review*. The figures for the United Kingdom were calculated separately based on the data from *Forestat of FAOSTAT*, FAO (http://faostat.fao.org/site/291/default.aspx). The percentage in the United Kingdom for 1958 is 3.7 and presumed to be less than 5 for 1956

6.3.3 Changes in Regulation and Government Policies

After the Second World War, the private companies remained the main players in the paper industry, and the prime role of the government was to create a competitive market environment. During US occupation, the Oji Paper Company, formerly boasting a market share of close to 80%, was broken up into three, as mentioned; a strict anti-trust act was instituted, and holding companies were forbidden. It is worth noting that the merger of the three Oji Paper successor companies in 1968 fell through because of the judgment of the antimonopoly authority. If this merger had occurred, it would have produced a company with a market dominance of 37.5% in *yoshi*, 24.5% in *yoshi* and paperboard combined, and 60% in newsprint. The government took an affirmative stance in the beginning, but in the face of heated public discussion over the uncovered merger deal between the top two steel makers, it reversed its attitude. Hence, the paper merger deal was abandoned.[32] Later on, medium-sized mergers and acquisitions took place, but the market share of the top firms did not increase, and the so-called "dog eat dog" competition in the industry never changed very much.[33]

[32] However, the successors of Oji maintained various forms of affiliation. For instance, in 1972, five Oji successor companies jointly set up the Nippon Paper Pulp Research Institute. See Oji Paper (2001b), p. 147.

[33] In 1976, Oji Paper Co., Ltd., the biggest paper firm in Japan, had a paper market share of 14.9%. The top three companies jointly held a share of 37%, and the top five had 48.6%. However, the newsprint paper industry maintained the greatest degree of oligopoly, in which the market share of the top one, top three, and top five companies were 29.5, 66.6, and 83.7%, respectively. In this period, Tomakomai Plant for newsprint paper and Kushiro Plant of Honshu Seishi for paperboard were the world's largest in their respective business areas, but they are two of the very few exceptions. See Toyo Keizai (1978), p. 67.

Being a process industry, the paper pulp industry has very limited flexibility in adjusting to supply and demand. Japanese papermaking also faced cyclical overcapacity. In the absence of antimonopoly legislation until the Second World War, a paper industry recession cartel was maintained through the initiative of private firms on the basis of their strong market dominance. However, the postwar government shifted from a *laissez-faire* policy on the oligopoly to direct intervention to resolve the issue, as mentioned above. It was important for MITI to initiate its activities after the Second World War. When overproduction made prices plunge and worsened the business conditions of the paper companies, the MITI directed firms to curtail their operations in a coordinated manner. When this proved insufficient, it also banned new facilities investments and sometimes even mandated a reduction in production capacity. These measures were officially considered exceptions to the antimonopoly rules, which were principally managed on the basis of a strict anti-cartel policy. This type of intervention method was used repeatedly during recessions from the 1960s to the mid-1980s.

Government intervention occurred in the industry during the postwar period through to the 1980s, as with many countries in Europe. However, its function and purpose differed somewhat from period to period. In the postwar years of recovery (1945–1955), the goal was to develop conditions enabling the resumption of production and recovery to the prewar level through direct methods such as materials control. In the rapid economic growth period (1955–1973), the main task was to protect the domestic market from foreign companies, which were considered to be far more powerful than their domestic competitors. Import restrictions (until around 1962), tariffs (5–15% in the 1960s), and direct foreign investment regulations (until around 1969/1971) were imposed. Intervention in the competitiveness among domestic companies in the market was kept to a bare minimum. In the low growth period following the oil crisis (from 1973 to the 1980s), Japanese paper mills maintained their international competitive edge in the domestic market and faced the problem of overproduction or overcapacity during the recession, a more serious issue than protection against foreign capital. Unlike many other manufacturing industries that managed to eliminate these problems by developing overseas markets, the paper industry faced continuous government intervention, such as facility authorization, operation curtailment advice, restrictions on facility expansion, planned retirement of production capacity, and the endorsement of recession cartels.

In the 1990s, the MITI shifted its stance to deregulation and the promotion of competition, consistent with the global trend. Lifting the ban on holding companies and introducing new policies and laws to encourage business restructuring and divestiture facilitated M&As among domestic companies in the 1990s.

6.4 Conclusion: The Paper Industry in Globalization, Changing Policy, and the Tide of M&A

In 2001, Japan was overtaken by China in volume of paper production and lost its second global position that it had held for three decades as a result of the stagnant domestic demand after the 1990s and the rapid expansion of Chinese paper production.

In 2001, Japan's paper and paperboard production volume of 31.8 million tons marked a peak in its roughly 130-year history, but the decline in domestic paperboard production had already started in 1991. In spite of the lower economic growth rate, per capita paper consumption expanded for 20 years beginning in the early 1970s. The population growth rate also declined and became negative after 2006. Paper demand saturated for the first time in Japanese history, and after the 1990s, the stagnant paper demand hovered at a rate even lower than the growth of real GDP. This meant an aggravation of the management environment and a failure of the existing growth model for the highly domestic demand-oriented Japanese paper industry.

The emergence of China signaled the end of the era when a prominent world-class East Asian market automatically promised Japanese firms an international position. Of course, this is not the only external impact. Since 1990, large cross-border M&A deals have been carried out in the West. These Western enterprises penetrated into China and Southeastern Asian countries after the 1990s, as seen in the case of Pan Asia Paper. In addition, Asia Pulp & Paper (APP), Asia Pacific Resources International Holding (APRIL), Advanced Agro (AA), and other emerging paper companies in Southeastern Asia expanded and opened production bases in China, accelerating an export drive into the Japanese market. The Japanese paper industry came to think it was important for business management to gear itself toward global competition.

The policy environment also changed significantly in the 1990s. Recognizing the limitations of the conventional intervention-type method, MITI abandoned measures such as authorizing cartels during recessions and took measures to strengthen global competitiveness by encouraging competition and business restructuring under the slogan of "Selection and Concentration" (Kurosawa 2009, pp. 211–257). To promote the latter, legislation and the taxation system were reformed to facilitate intercompany M&A and the divestitures of business units. In 1997, the long-enforced ban on holding companies imposed to prevent industrial overconcentration was lifted. As a result of the financial crisis, the pervasive cross-holding of shares began to disappear in the public and private sectors after the mid-1990s. The Fair Trade Commission that had opposed the merger among the three former Oji companies in the 1960s relaxed its stance toward large-scale mergers for the sake of competition against foreign companies, pending detachment of the business area whose market share would be considered excessive. There were no hostile takeovers in Japan after the Second World War, and internal growth was the main growth strategy for many industries, including the paper industry. However, this situation changed after the 1990s. The number of friendly takeovers, in which the paper industry also took part, increased after the mid-1990s. There has yet not been a successful hostile takeover bid in Japan.

Before closing this chapter, the trend in the restructuring and concentration of paper manufacturers after 1990 leading to the formation of the two major groups should be mentioned. In July 1992, a merger of Jujo Paper Co, Ltd. and Sanyo-Kokusaku Pulp Co., Ltd. was announced, and the deal went through in April of the

following year to create the industry's largest company, Nippon Paper Industries Co., Ltd. (NPI). Jujo Paper Co., Ltd. was one of the three legacies of the former Oji Paper Co., Ltd., and Sanyo-Kokusaku Pulp Co., Ltd. was a product of the 1972 merger of two national policy concerns from the 1930s. In 1997, Jujo Paperboard in the NPI Group merged with Nippon Itagami and renamed itself "Nippon Paperboard." In March 2000, NPI, at that time the second largest in Japan, announced a business integration with the ailing Daishowa Paper Mfg. Co., Ltd., the then fourth largest paper manufacturer, and created Nippon Unipac Holding in March 2001, which became the top paper firm in Japan and the sixth in the world. The paperboard section of this group was restructured as Nippon Daishowa Paperboard Co., Ltd. This integration under a genuine holding company was the first of its kind in Japan. The group was renamed Nippon Paper Group Inc. in 2004. In 2006, it enjoyed a combined operating revenue of 8.5 billion yen (tenth in the world); its paper and paperboard production was 7.6 million tons in 2007; it employed 12,580 personnel, and its pulp and paper business dependency was 84.4% (Nippon Paper Group 2009).

This move heralded a countermovement from Oji Paper Co., Ltd. (as it was renamed from Tomakomai Paper Co., Ltd. in 1960), the largest among the three successors of the former "grand" Oji Paper and self-acclaimed industry leader. In October 1993, half a year after the merger of Jujo Paper Co., Ltd. and Sanyo-Kokusaku Pulp Co., Ltd., Oji Paper Co., Ltd. (with a market share of 9.8%) acquired another successor of the former Oji Paper, Kanzaki Paper Mgf. Co., Ltd. (2.5%) and formed New Oji Paper Co., Ltd. In 1996, New Oji Paper Co., Ltd. (12%) merged with yet another of the three offspring of "grand" Oji Paper and the largest paperboard manufacturer called Honshu Paper Co., Ltd. (7.5%) and resumed its traditional nomenclature, Oji Paper Co., Ltd. At the outset, it enjoyed the third largest sales in the world and acquired three other businesses, including a paperboard firm in 2002. In 2008, its sales registered 11.2 billion dollars (ranking sixth in the world), and its paper and paperboard output was 8.2 million tons (fifth in the world); it had 19,560 employees, and its pulp and paper business dependence was 89.1%. It is currently promoting the Nantong Project in China, one of the biggest FDIs in the paper industry (with a planned annual output of 1.2 million tons in 2015) in search of a conversion from management heavily dependent on the domestic market (Oji Paper 2009).

These two biggest groups own 25% of the market share. Following them are Daio Paper Corporation (22nd in the world) and the Rengo Group, both of which have approximately 10% of the domestic market share in sales. Daio Paper Corporation is a product of a merger among fourteen SMEs, including machine *washi* makers in the Shikoku area during the Second World War, and achieved rapid growth in the postwar period in successful consumer businesses, such as tissue paper. Its Mishima plant was completed in 1997 as one of the world's largest integrated plants for coastal pulping and papermaking, equipped with a berth for 100,000 ton-class carriers and boasting an annual output of 2.3 million tons. It is a company that maximized the advantage of material import while streamlining its business as a process industry and is one of few full-line paper manufacturers

in Japan.[34] On the other hand, Rengo Group came from a paperboard company established in 1909 and is now Japan's top manufacturer of paperboard, cardboard, and packing paper.[35]

Combined, the above four companies had an approximately 70% market share (on a revenue basis) and, together with Lintec Corporation (4.1%) and Hokuetsu Paper Mills, Ltd. or, since 2009, Hokuetsu and Kishu Paper Co., Ltd. (3.5%), reached 83% in 2006.[36] Even after the reorganization, the paper industry has yet to overcome the structural problems shared by many Japanese manufacturing industries, such as low profitability.[37] At any rate, it can be said that its 1990s restructuring left the Japanese paper industry with a new business structure that is aware of the maturing domestic market and of globalization.

Finally, the growth model of Japan's paper industry includes a unique and highly developed paper culture, natural and geographic conditions favorable to the paper industry, the technology introduction and investment strategies that can be used to exploit the latecomer's advantage to the full, and a readiness to cater to the severe quality demands of the Japanese market (Shinomiya 1995, pp. 59–75). In the post-war period, the expansion of domestic pulp production was partially due to the world's largest rayon industry that encouraged new entrants into the market. This resulted in a vertical integration model that combined pulping and papermaking processes inside Japan, using the wood chips imported from overseas joint ventures. This model has been changing in Japan, as dependence on recycled materials has increased. It seems to have been taken up by China, however, which has become the largest paper producer in the world. At any rate, the history of the development of the paper industry in Japan can be considered unique when compared to that in the Western countries that led the twentieth century.

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[37] According to the 2008 figures, the operating margin for Oji Paper Co., Ltd. was 3.2% and that for Nippon Paper Industries Co., Ltd. was 2.7%.

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Chapter 7
The British Paper Industry, 1800–2000

Timo Särkkä

7.1 Introduction

The focus of this investigation[1] is the history of the British paper industry and the environment in which it has operated since the birth of mechanical papermaking in the early years of the nineteenth century to the end of the twentieth century. By paper industry, we mean those establishments engaged primarily in the manufacture of paper and paperboard. Establishments engaged primarily in converting paper into paper products as well as allied trades, such as bookbinding and printing, are by and large excluded from consideration, although the distinction in not always feasible.

The case method illustrated here aims to show how the nature, the scale and the distribution of papermaking have changed in Britain from 1800 to 2000. Britain was the first country in the world to enter into the field of paper manufacturing industry. In retrospect, it is a matter of particular significance to analyse the consequences of coming first in a line of business. With this case method, it is hoped to provide information which will add to our understanding of British paper manufacturing history and possibly extend or clarify the paper manufacturing industry history as a whole.

The present investigation evolves from the realisation that the main aim of business history is to study and explain the behaviour of firms over long periods of time and to place the conclusions in a broader framework composed of markets and institutions in

[1] The investigation was conducted in the context of the Academy of Finland research project *The rise, fall and re-emergence of business organizations: retrospective and prospective views on forest-based industries* (2008–2011). I remain grateful for the Academy and the members of research project for the faith displayed in my research.

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J.-A. Lamberg et al. (eds.), *The Evolution of Global Paper Industry 1800–2050: A Comparative Analysis*, World Forests 17, DOI 10.1007/978-94-007-5431-7_7,

which that behaviour occurs. Business history can also provide a powerful insight into the evolution of capitalism. The cultural critique thesis expounded by many business historians has argued that the British economy was not industrial in nature but rather commercial and financial (Wilson 1995). Britain has been regarded as a country of personal capitalism, whereas the United States, Germany and, perhaps, Japan as countries of corporate capitalism. The thesis that personal capitalism is a major cultural characteristic of British businessmen has provided a benchmark against which British economic history has been evaluated (Chandler 1990). In this investigation of British paper manufacturing, we will be content to analyse some general tendencies behind organisational changes within the paper industry. The history of the British paper industry has been divided into several linear stories, which will concentrate on technological transformation, raw materials, trade policies, production capacity, employment and the major historical particulars affecting the industry.

In respect of the British paper industry, there is a notable lack of systematic research. In contrast to the detailed examination of the early history of the British paper industry by Spicer (1907) and Coleman (1958), the more recent developments have been less studied by modern paper industry historians. To the best of our knowledge, the most comprehensive investigations of papermaking in the British Isles are those by Shorter (1971) and Hills (1988). Magee (1997b) covers the years from 1860 to 1914, and Owen (2000) includes a chapter on the paper industry within a framework of a broader post-Second World War analysis of British manufacturing industry. In addition, there is an available extensive body of literature on British business history. In turning to the existing studies on various paper mills and papermakers, they tend to lack consistency of method in investigating the history of the British paper industry. However, company and business family histories are not entirely without value for the present purposes since they provide powerful insights into the lives of the manufacturers behind the development of the industry. The Wrigley (Tillmanns 1978) and Bowater (Reader 1981) family business histories can be mentioned as illustrative examples. The findings have been supplemented with statistics concerning this industry provided by paper trade journals and directories as well as trade and production returns. The most quoted in this investigation include the *Accounts Relating to Trade and Navigation of the United Kingdom* (1882–1964), which focus on import-export trade. The Census of Production Act was passed in 1906, and the *Final Report on the Census of Production of the United Kingdom* furnishes a basis for an analysis of production returns from 1907 onwards. The tables in the Appendix A furnish the particulars of the trade and production returns quoted below.

7.2 The Birth of Mechanised Papermaking

Britain was the first country in the world to possess the capital, the enterprise, and the skill necessary to develop industrial mechanisation. The transition from mercantile to industrial capitalism was made by concentrating production, providing a regular flow of raw materials, accounting the flow of funds and controlling a workforce.

These were new tasks for many businessmen. By the Great Exhibition of 1851 Britain had become the 'Workshop of the World', but the effects of industrial mechanisation were still confined to a narrow range of industries, particular regions, and agriculture and domestic manufacturing employment remained extremely important. Nevertheless, a steady transition from mercantile to industrial capitalism was already pervading British business life (Wilson 1995).

The history of the British paper industry, for the purposes of this investigation, begins in the early years of the nineteenth century. Before that period, paper was produced by fairly simple manual work, which fell into three distinct processes: the preparation of the pulp, the manufacture of a wet sheet of paper and the drying and finishing off of the paper. The earliest English mill is believed to be John Tate's mill on the River Lee, near Hertford, founded in 1488. By the middle of the seventeenth century, there were mills in the South of England, Buckinghamshire, Oxfordshire and Surrey, and in Scotland, near Edinburgh. Despite this early impetus, it was not until the late seventeenth century that papermaking started to flourish. The first effects of the Industrial Revolution were felt particularly in the cotton, wool and iron trades but also indirectly in the paper industry. The growth of the industry indirectly and increase in population directly increased the demand for papers of all kinds, both for the domestic and export trade (Hills 1988).

The industrial production of paper based on steam power got off to a slow start compared to the textile and iron industries. The reason for this comparative slowness in experimenting with steam power in papermaking lay in the smallness of eighteenth century vat mills (they typically employed from 6 to 17 people) and their remoteness from coal supplies and modern means of communication (Coleman 1958; Spicer 1907). Paper mills were typically established on good water power sites, which might first have made steam power unattractive to the paper manufacturers. An illustrative example is provided by Bridge Hall Mills, near Bury in Lancashire, which reveals that paper mills based on water power continued to be developed regardless of improvements made in steam engine technology (Tillmanns 1978). Falls of water required constant repair and were liable to cause heavy floods or to fail altogether in the driest seasons. With steam, the manufacture could be carried on regularly throughout the year, which made steam engines attractive to manufacturers willing to take risks in building new factories. One of the early examples of this business pattern was Springfield Mill, which was erected by William Balston in Maidstone in 1805. This pioneering mill was based on steam power, and it utilised spring water in papermaking (Balston 1954).

How then was the mechanised production of paper made a workable economic enterprise in Britain? Such a development would have been impossible without improvements in papermaking techniques. The story of the introduction of the first paper machine in Britain is connected to Henry Fourdrinier (1766–1854) and his brother Sealy Fourdrinier (1773–1847), who together with John Gamble bought the patent rights on a machine for making paper in 1801. In 1802, the Fourdrinier brothers came in contact with a British engineer called Bryan Donkin, whom they helped to set up in an engineering workshop at Bermondsey on the South Bank of the River Thames. For the next 5 years, Donkin worked on the machine financed by the

Fourdrinier brothers, who invested in the experiments the large sums they obtained from the wholesale stationery business in the City of London (McConnell 2004).

Experiments with the new technology made by the Fourdrinier brothers at Frogmore Mill on the River Gade, near Hemel Hempstead in Hertfordshire, and the adjoining Two Waters Mill, where their first papermaking machines were installed by Donkin in 1803 and 1804, started the slow emergence of the paper machine in Britain. The Fourdrinier machine experiment was made at the expense of craftsmen, who often opposed the introduction of machinery, and, indeed, financiers, who, like the Fourdrinier brothers, eventually went bankrupt (Shears 1967). It was not until the 1830s that mechanisation became truly widespread in the industry in Britain, owing to capital costs that were too heavy for many manufacturers. Ultimately, the mechanisation of the industry was financed by using the well-tried methods of partnership, mortgage and loan on bond. Through this network of loans and leases, mortgages, purchases and partnerships, the world of papermaking came into being (Coleman 1958).

The Fourdrinier machine represented a straightforward mechanisation of what was formerly done by hand. In principle, it performs an exactly similar sequence of actions as in handmade papermaking, only rather faster. Although the original idea of the paper machine technique was not Donkin's, the development work on the machine was due to him, and his work was rewarded at the Great Exhibition of 1851 in Hyde Park, London. It is perhaps enough to state that by this time the Fourdrinier was already a fairly complex and costly machine (Coleman 1958; Lloyd-Jones 2004; Clapperton 1967).

What is important to emphasise is the stimulus given by this initial mechanisation to the whole the process of paper manufacture. At the heart of the early British industrial success lay evolutionary change of technology, mechanical alterations and improvements in the preparation of raw materials for the production and the production of paper itself. Paper mills and paper machine manufacturers themselves were often important players in transmitting new technology through the industry. Improvements in technology allowed papermakers to concentrate on the quality of the final product and to organise the industry to be better able to meet the growing demand for paper of various kinds (Magee 1997b).

Who, then, were the entrepreneurs who built up the paper industry in the first decades of mechanisation? The pattern was not uniform throughout. New industrialists came in alongside the old established families. To the growth of an industrialist class, an important contribution was made by the lower middle class. Nepotism was the traditional route into management. Managers were brought into the firm because of their family or religious connections and learnt their jobs through practical training (Wilson 1995; Pollard 1965). The important papermakers during these early decades of mechanisation included John Dickinson, who had several mills in Hertfordshire. James Wrigley and Son, John and Thomas Bonsor Crompton as well as Chares and Henry Hilton manufactured in Lancashire. In Kent, there were William Jaynson and William Balston and, in Surrey, Sir William and James Magnay. Furthermore, there were papermakers working on a considerable scale in Oxfordshire, Berkshire, Buckinghamshire and Hampshire (Shorter 1971). While

Britain led the field of papermaking technology, the momentum of being the first nation successfully to mechanise the production of paper was gradually lost to the overseas competitors in the course of the nineteenth century (Magee 1997a, b), not least because of raw material shortage that threatened to cripple the British paper industry development by 1860.

7.2.1 *Economic Characteristics of the Early Papermaking Industry*

A number of economic determinants of the early papermaking industry flowed directly from technical needs. These include (1) location of the mills, (2) raw materials, (3) skilled labour and (4) capital. Prior to the introduction of the steam engine, the location of paper mills was conditioned by water supply, which was needed both as a source of power and for the paper manufacturing process. The distribution of paper mills was thus conditioned by existing water sources. At first, the industry grew up in river valleys in the north (Lancashire and Yorkshire), the southeast (Buckinghamshire and Kent) and Scotland (based around Edinburgh market), where both fast-running streams and clean water were available (Coleman 1958; Spicer 1907; Shorter 1971; Magee 1997b).

First, the paper mills based on water power had to be situated along rivers where a fall in level could be exploited by building dams, channels and waterwheels. The fast growth of the paper industry could not have been achieved in Britain without the existing water power resources. After the introduction of the steam engine to the paper mills, coal replaced water as a power supply, and the paper mills tended to be placed near coal mines. In principle, with steam power, manufacturing could be carried on regularly throughout the year if all the other production requirements could be met. The older mills were built to satisfy the local demand for paper, but improvements in technology made it possible to produce greater quantities for wider markets. This development forced manufacturers to consider the best options for the rail and canal transport of both raw materials and finished products. During the early period of the mechanised paper industry, a number of the older mills were shut down due to their location remote from the coal mines and the means of transport, canals, railways and ports. The newer mills were linked by the network of railways to the towns. The general tendency of change was towards the towns and towards the coal mines (Coleman 1958; Spicer 1907; Shorter 1971).

Second, an important economic determinant of papermaking was the raw materials for making paper. Traditionally, the most important raw materials were cotton, linen and hemp rags. The availability of rags in turn conditioned the location of the paper mills since rags were not typically available in abundance. Hence, the early paper mills tended to spring up at a fairly short distance from the major conurbations, especially London, which was the greatest market for paper and the centre of rag supplies. The expansion of overseas trade highlighted the importance of proximity to good harbours so that the raw materials and finished goods did not have to be transhipped far from ocean-going vessels (Coleman 1958; Spicer 1907; Shorter 1971).

Third, papermaking techniques did not allow setting up a vat mill on the basis of semi-skilled or unskilled labour. The presence of specialised labour in the productive process thus defined the industry. A major theme regarding skilled labour during the early period of the mechanised paper industry was the hostility of skilled workers and their organisations to changes that altered the existing customs and arrangements regarding employment in the paper industry. A strong craft tradition existed in handmade paper manufacture. The spread of the paper machine brought to the manufacturers a ready-made answer to the problem of labour relations since it allowed them to be free from the power of skilled and organised labour. This persuaded the manufacturers to mechanise the industry even further (Coleman 1958; Spicer 1907; Shorter 1971).

Finally, since papermaking is a mill industry, it requires a substantial amount of capital. Well into the twentieth century, the City of London was dominated by 'gentlemanly capitalism', where industrial interests were shunned as socially inferior to the more lucrative and prestigious business of exporting capital (Cain and Hopkins 1994). The poorly developed state of capital markets made it preferable to rely on internal sources for the investment requirements. This led to the creation of the 'web of credit' by which we mean the combination of merchants, industrialists, banks and acceptance houses (merchant bankers) (Wilson 1995) to invest in the paper industry.

7.2.2 Measuring the Early Industrial Change

During the early period of mechanisation, the scale of the British paper industry changed as well. Mechanisation affected the size, the number and the output capacity of the paper mills. The general impression of what statistics offer is that from 1800 to 1860 the paper industry grew steadily in Britain. The extent to which the production increased cannot be measured with precision; it varied from mill to mill and according to the grades of paper, and it changed over the years.

During the early period of mechanised papermaking from 1800 to 1860, the total output of machine-made paper in Britain increased from the lowest 557 ton[2] (1805) to the highest 95,971 ton (1860). In handmade paper manufacture, the total output decreased from the highest 16,502 ton (1805) to the lowest 3,839 ton (1860). Handmade paper thus constituted roughly 4% of the total production in 1860. The machine-made production exceeded that from the vats for the first time in 1824. The number of machines outnumbered vats for the first time in 1848. In 1860 there were 340 machines compared to 130 vats running in Britain. It is also noteworthy that small mills were disappearing, and that papermaking was concentrating into larger hands and into fewer districts. In 1851 Lancashire had the two largest mills in Britain, Bridge Hall and Farnworth. The leading counties in terms of the total number of mills were Lancashire and Kent. The total number of mills in England and Wales in 1860 was 306 (Shorter 1971; Lewis 1969).

[2] In Britain, 1 ton equals to 2,240 lb avoirdupois or 20 cwt (about 1,016 kg).

In Scotland, the change towards larger mills and the elimination of vats in favour of machines were also well under way by 1860 (Thomson 1974). The Edinburgh district was dominant in the Scottish paper industry. In 1851 it had 18 out of 48 working mills (Shorter 1971). The absence of old mills in remote areas, excellent port facilities, rapid industrialisation in both the linen and chemical industries and the rapid growth of towns are some reasons for the speedy change of the early Scottish paper industry (Coleman 1958). The Irish paper industry did not have a similarly positive outlook because of the lack of capital, a comparatively low standard of living, the lack of accessible coal resources in Ireland itself, the unstable political situation and the general decline in the population from 1840 onwards (Shorter 1971).

In the first part of the nineteenth century, Britain was the world's largest and lowest-cost producer of paper. The reasons behind increased production included improvements in technology and the effective supply of raw materials for paper. Furthermore, the manufacturers in Britain were operating with significant advantages on their side, including a supply of cheap and accessible coal, craftsmanship, a relatively orderly society and an efficient transport system (Mokyr 1990). However, what was more important was an increased effective demand for paper caused by the growing population. The census of 1801 showed that the population of the British Isles was 15 million in 1801. In 1861 it was nearly 29 million, the total having thus almost doubled since 1801 (Coleman 1958).

New patterns of social intercourse, increased literacy and heightened social consciousness are all included in the important reasons for the increased demand for paper. The numbers of literate people were rising rapidly after the introduction of national education in England and Wales under the Education Act of 1870. Hundreds of millions of letters went through the post office every year. Penny and halfpenny newspapers, journals, magazines, reviews and cheap editions of books came within the reach of the very poorest. In indirect ways, the mechanisation of industry gave people and institutions more reasons to need paper. The early growth of mass communication through new forms of cheap publications was made possible by mechanical printing and papermaking. Without the paper machine, many of these cheap publications would have been impossible to call into existence (Coleman 1958).

7.2.3 The Introduction of the Free Trade Principle

In overseas trade, Britain was committed to mercantilism between 1800 and 1860. The domestic industry was protected by tariffs, and the little that was exported went to Britain's overseas colonies. However, in the course of the nineteenth century, British industries had come to a greater extent to depend on exports to maintain their rate of growth. In an evolving business environment, mercantilist policies seemed not only unnecessary but even harmful to an export industry that needed to access a wider range of markets than the British colonies could offer. For the paper industry, the most important duties under the heading the 'Customs and Excise' included

duties on imported paper and raw materials, the Excise Duty on paper manufactured in Britain and the licences which had to be taken out by papermakers. The Customs and Excise duties in force influenced both the supply of exported foreign paper and the volume of domestic production (Coleman 1958; Owen 2000; Spicer 1907).

The introduction of the free trade principle in October 1861 caused the paper industry for the first time to become an object of general public discussion in Britain. The British manufacturers had traditionally supported import duties to compensate foreign export duties on rags and opposed the excise duty on paper. The influential campaigners for the abolition of excise included *The Times* (e.g. 17 February, 1860), connected with influential papermaking families, and *Economist*, which lamented that the industry had not grown to be a major national industry like that of cotton manufacturing due to the repressive 'Taxes on Knowledge' (e.g. 10 March, 1860; 12 May, 1860; 19 May, 1860; 2 June, 1860; 4 August, 1860). The papermakers saw themselves as being sacrificed to the dogma of free trade as they were forced into the ironic position of opposing the repeal of excise against which they had been campaigning 150 years. These questions brought the British papermakers' association into being in the 1860s (Coleman 1958). Its aim was to fix prices at a generally profitable level and to bring a greater degree of stability in times of falling prices and intensifying competition (Wilson 1995).

As it turned out, the British paper industry was not ruined by the removal of the protective tariff wall. However, foreign competition became a major feature of the paper trade after 1861. First, the biggest importer of paper and board as well as printing and packing paper was Germany. In the early twentieth century, the share of German imports fell due to growing competition from Canadian and Scandinavian producers, which could best utilise wood pulp as raw material (Spicer 1907; Bartlett 1980; Magee 1997b). The quantity of imports rose rapidly, being already 664,093 ton (12.9 million cwt[3]) in 1913 (Table 7.1). The removal of the tariff wall in Britain did not lead to similar decisions elsewhere in Europe. Quite the opposite. Protective tariffs continued to be enforced throughout western Europe. As a result, the British orientation to the empire in paper trade remained strong. In 1913 the exports were 174,976 ton (3.5 million cwt) (Table 7.1) of which over 70% went to the British colonies and dominions, countries like Australia, the Union of South Africa, British India and New Zealand (Magee 1997b).

7.2.4 The Introduction of New Raw Materials

One of the most pressing problems faced by British paper manufacturers was failure to supply raw materials for papermaking to keep up with the demand for paper, and this problem had recurred at various times up to the 1860s. There were two developments that helped to alleviate the raw material shortage: the continued expansion in the cotton textile industry in Britain and an early nineteenth century invention, the

[3] In Britain, one hundredweight (cwt) is equal to 112 lb avoirdupois (about 50.8 kg).

introduction of chlorine bleaching, which made coloured rags suitable for papermaking. Despite these developments in technology, imports of rags rose rapidly and reached 20,000 ton by 1863. Significantly, the repeal of customs duties on the export of rags led to an increase in exports of these raw materials as well, being only 1,000 ton in 1861 but already 24,000 ton in 1870. Due to this adverse situation Britain continued to need to import rags to meet its raw material requirements from 9 to 20% of its total rag needs. By the 1860s, rag was imported to Britain from various ports on the continent but also from Asia, Australia, South Africa and South America. This was not the most cost-efficient way to obtain raw materials, since many other papermaking nations had maintained or increased their existing export duties on rags. Owing to increased demand for paper and raw materials, the price of rags doubled between 1848 and 1855 (Hills 1988; Coleman 1958; Spicer 1907; Magee 1997b; Shorter 1971).

The more economical methods of manufacture and larger output to meet larger demand led to the quest for new raw materials. In the paper trade, over half of all running costs were accounted for by raw materials. It was thus regarded as essential for the successful introduction of a substitute for rags that the substance should be cheap and available in abundance. In addition, it should be rapidly cleansed and bleached and yield a strong, pliable fibre which would produce paper possessed of permanent whiteness. It was the introduction of esparto grass for papermaking that first offered a solution to the raw material shortage in Britain. Since the first and fundamental utilisation of esparto grass in the paper industry by Thomas Routledge, who took out a patent in 1861, esparto was used especially by the British mills for papermaking. Esparto grows on rocky and dry mountainous districts of southern Spain and North Africa, within the area known as the Esparto Zone (between 32° and 42° latitude north). After being dried like hay, sorted into different qualities and baled up, the grass was ready to be transported to the paper mills. Owing to cheap freight, it was possible to import esparto cheaply for the British paper mills. Except for the use of more chemicals, there was little cost difference in processing paper from esparto or from rag. Together these factors, especially the cost difference in favour of esparto over rags, led to increased export of esparto and to the opening up of new mills. The import of esparto reached its peak in 1888, with 249,000 ton compared to 41,000 ton of rags (Hills 1988; Spicer 1907; Magee 1997b; Shorter 1971).

One of the reasons for the success of esparto was that the British chemical and mining industries were able to produce the chemicals and minerals the use of esparto requires to make the process of pulping profitable. Of chemicals, one of the most important was caustic soda (Magee 1997b). Of clay minerals, kaolin (china clay), which was obtained from Cornwall, had come to be used in British papermaking at the turn of the eighteenth and nineteenth centuries. It was added in very small quantities to the pulp in order to give body and weight to the finished sheet. So long as the main raw material used was rags, a small amount of kaolin was needed. However, the introduction of esparto increased the consumption of kaolin. The discovery of bleaching and colouring further increased the demand for minerals and chemicals (Coleman 1958; Spicer 1907).

Despite these developments, the demand for raw materials was in no way satisfactorily met. In an elementary way, many modern processes for the isolation of cellulose from wood were tried out by several British papermakers. The first and the most important attempt in Britain was made by Matthias Koops as early as in 1800, but it proved fruitless. Nevertheless, by the early 1880s, international breakthroughs in the production of chemical wood pulp made the raw material available for the British manufacturers. Wood pulp began its steady rise to prominence in Britain at first at the expense of esparto but then later of both esparto and rag (Coleman 1958; Hills 1988; Shorter 1971). The imports of wood pulp to Britain increased accordingly. In 1913 British raw material imports totalled about 1.23 million tons. The share of wood pulp of the total import of raw materials was 79.6% (977,957 ton), while the imports of esparto constituted only 16.7% (204,932 ton) and rags 2.4% (29,538 ton) (Table 7.2).

Technological change related to the transformation of raw materials and the more scientific use of minerals and chemicals together with the adoption of factory methods of production and the improvement of machinery signified increased production (Magee 1997b; Spicer 1907). The increased production also meant enlarged diversity of output. The *Phillips' Paper Trade Directory of the World* listed in 1910 some 40 different products manufactured by the British paper mills. Lower costs of raw materials, chemicals, wages and fixed charges together with increased production led to a drop of 60% of the average price of paper between 1861 and 1902 (Spicer 1907). This combination of increased output and lower costs brought new businessmen and capital to the industry. More than 150 new firms were launched solely between 1870 and 1900 (Bartlett 1980). The number of mills dropped while production concentrated in larger establishments. Between 1860 and 1900 the number of mills operating in England and Wales decreased from 306 to 211, while the number of machines grew from 300 to 418. (Shorter 1971) The typical paper mill of the time was a single-machine mill employing between 20 and 70 workers. The development towards larger mills intensified in the latter part of the nineteenth century. For instance, Newbattle Mills near Dalkeith in Scotland is said to have employed some 300 people in 1870 when it operated with three machines (Robert Craig & Sons, Ltd. 1920).

7.3 Effects of Global Upheavals

The years from 1914 to1959 can be divided as follows in the British paper industry. The years from 1914 to 1919 were interrupted by the First World War. After the war, Britain failed to take part in the world boom of 1925–1929 and then sank, with the rest of the world, into the depression of the 1930s. The economic depression was at its worst in the third quarter of 1932, but thereafter, everything pointed towards a strong upward trend, leading up to the boom of 1937. The Second World War from 1939 to 1945 caused a violent disruption to the British production capacity, and it was not until 1950 that raw material rationing was repealed. The Korean War led to a continued boom in the paper market in the 1950s.

The nineteenth century beliefs in free trade and in an unlimited extension of markets parallel with the extension of productive capacity were shattered by the experience of the First World War. Before the war, Britain had been the world's chief free market, but in 1931 it was forced to abandon the free trade principle which had been close to a national ideology for 70 years (Trentmann 2008). During the interwar period tariffs, quotas and price-fixing agreements spread widely to the paper industry. As a consequence, free competition, which had hitherto characterised the paper trade, nearly disappeared from the British business scene (Pollard 1963).

Britain had been formally off the gold standard since March 1919 (*de facto* from the outbreak of the war), but by April 1925, the pound had reached its pre-war parity with the dollar, and it returned to gold. It has been estimated that the pre-war parity was over-valued to the extent of 10%. Such a significant price differential encouraged imports while it handicapped the export trade (Pollard 1963; Youngson 1967). The imports of paper and board increased 161.5% from 1919 (7.6 million cwt) to 1929 (19.9 million cwt) (Table 7.1). Canadian paper especially was increasingly exported to Britain. Another permanent threat came from the Nordic papermakers (Sweden, Finland and Norway), who were aggressively searching new markets.

Protection was first extended for wrapping and packing paper grades, on which import duties were imposed in 1926 under the Safeguarding of Industries (Customs Duties) Act. This was a defensive tariff intended to grant protection to British industries if imports compared with British products enjoyed unfair advantages such as subsidies or bounties or if imported goods were sold below the cost of production (HC Deb, December 5, 1927 vol. 211 cc956–7). Then, following the economic upheaval of 1931, the Abnormal Importations (Customs Duties) Act was passed to prevent an inrush of imports in anticipation of later duties, and in February 1932, the Import Duties Act inaugurated the protectionist era in the British paper and board industry (Pollard 1963). The only exception was newsprint, which was among the manufactured articles exempted from duty, subject to limits on quantity. Owing to the strong economic growth of the late 1930s, British paper consumption rose from 1.8 million tons in 1924 to 3.6 million tons in 1938. However, the share of imports dropped from 42% in 1930 to 29% in 1938 (Owen 2000).

The end of the free trade era signified the building up of the imperial preference system, aimed at expanding trade among the members of the British Commonwealth in a world of shrinking commerce and rising trade barriers. Imports from Empire countries were exempted from the original tariff of 1932, and in an Imperial Economic Conference, assembled in Ottawa in July–August 1932, it was hoped to expand trade among the members of the British Commonwealth. However, the pre-1861 mercantilist conception of an industrialised mother country linked with primary produce countries had become grossly anachronistic by 1932. The Dominions were determined to protect their industries even against Britain. The introduction of the imperial preference system did not increase trade volumes as such but rather directed trade to the Empire (Pollard 1963).

In spring 1940, the Germans conquered Norway and blocked all trade between Scandinavia and Britain. Wood pulp and newsprint imports ceased from that direction

until Germany was defeated, and all future imports of both commodities would have to make the long, hazardous passage across the North Atlantic. During the Second World War, the price and quality of raw materials, being under government control, were not open to negotiation. Above all, output was severely restricted. The British paper mills experienced a number of difficulties in the years during and following immediately after the war. A rising demand for paper was frustrated by the weakness of the economy. There was no adequate source of domestic raw materials, and lack of dollars prevented the import of either of raw materials or of newsprint. In the world market, there was a general shortage of pulp. There was also a general shortage of coal and labour. Paper control measurements continued until 1950 when the paper industry could determine its own selling price (Ahvenainen 1976; Reader 1981).

The Empire dominated the geographical horizons of British trade after the Second World War. Imports rose from 1949 (9.3 million cwt) to 1959 (24.1 million cwt) 159.5% (Table 7.1). The major importers were Canada along with the Nordic countries. In 1949 the share of the Nordic countries from the total imports of paper and board was 54.5% (5.1 million cwt), while the share of Canada was 24% (2.2 million cwt). In 1959 Canada and the Nordic countries had both a 36.3% (8.7 million cwt) share of the total imports of paper and board (Table 7.3). The main bulk of the paper and board exports went to the English-speaking world. In 1949 the major export countries were Australia (28% share of the total exports of paper and board), the United States (15%), the Union of South Africa (8%), New Zealand (6%), the Irish Republic (6%) and India (5%). In 1959 the major export countries were respectively Australia (33%), New Zealand (12%), the Union of South Africa (9%) and the Irish Republic (6%) (*TN* 1949, 1959).

Imports of raw materials rose also rapidly. In 1919 the total imports of raw materials were about one million tons but doubled in quantity by 1929. The share of wood pulp imports of the total imports of the raw materials were constantly over 80%. The biggest importers of wood pulp were the Nordic countries (Table 7.2). For instance, in 1929 1.3 million tons of wood pulp or 80% of the total raw material imports were imported from the Nordic countries (*TN* 1929). Domestic wood pulp production stood at 209,000 ton in the same year (*LN* 1938–1939). By 1959, the British papermaking industries imported over two million tons of raw materials (*TN* 1959). For instance, within the Bowater Organisation, the sources of supply were in Scandinavia for mechanical pulp and in Newfoundland for pulp wood and sulphite pulp (Reader 1981). The early esparto and wood pulp preparation plants established in Britain during the interwar period did not survive the post-war period but were closed down by the end of the 1950s as they could not operate economically (Hills 1988). By 1960, the paper mills in Britain depended for survival almost entirely on foreign imports of wood pulp.

7.3.1 The Paper Industry Growth

A dramatic increase of paper and board production (204.2%) took place between the census of production years 1907 (850,000 ton) and 1951 (2,586,500 ton) (Table 7.4). The growth is predominantly reflected in the production capacity while the number (Table 7.5), the size (Table 7.6) and the distribution (Table 7.7) of the

mills remained fairly constant. The number of mills decreased from 306 in 1924 to 267 in 1935, but after the war, the number of mills started to rise again, being 282 in 1951. From the analysis of the size of the mills by employment in the *Census of Production* returns for the years 1935, 1948 and 1951, we can determine that, in each of these years, the largest concentration of mills (over 50 mills) can be found in the groups between 50 and 99 persons employed and between 100 and 199 persons employed. At the biggest end, there were five mills which employed over 1,000 persons in 1935, three in 1948 and four in 1951. After the war, the size of the mills increased. In 1948 and 1951, there were four mills in both years that employed over 1,500 persons. The distribution of mills and workers is provided in the *Census of Production* returns for 1948 and 1951. The analysis by standard region reveals that the British paper industry was distributed in the southeast (based around London) and the northwest of England as well as in Scotland. In 1948, the southeastern region had 56 mills and 15,331 workers, the northwestern region had 67 mills and 13,274 workers and Scotland had 50 mills and 14,567 workers. In 1951, the number of mills in the southeastern region had increased to 61 and the number of persons employed to 18,584. In the northwestern region and Scotland, there were few changes in 1951 compared to 1948.

Newsprint manufacture was largely responsible for leading the industry with ever wider and faster machines and increased production. This was a logical development because newsprint was one of the cheapest paper grades made, and because it was required in large quantities. By the 1900s, London's halfpenny dailies had already reached publication figures previously unattainable. The *Daily Mail* alone built up a steady circulation of 750,000 copies. To reach their market, publishers had to find far more paper than any previous publisher had ever needed. Publishers were dependent on large, uninterrupted supplies of newsprint, and the terms on which they found it were crucial to the health of their enterprises. This encouraged publishers like Edward Lloyd, the owner of the *Daily Chronicle*, to build their own paper mills. By 1902, the *Daily Chronicle* mills had 11 machines outputting 1,000 ton every week of newsprint and other grades of paper. Interestingly, Lloyd determined to control raw material supplies as well. He bought esparto grass cutting rights from southern Spain and Algeria and the Norwegian Hønefoss Træsliberi in order to ensure a ready supply of wood. Eventually he had a stake in every stage of papermaking from making pulp to advertising and selling the finished paper (Reader 1981).

By the early twenties, British-owned mills independent from newspaper groups had become rarities, and the British paper industry was on the whole dominated by newspaper owners. Established papermakers like Albert E. Reed, along with newcomers like Eric Bowater, built large newsprint empires by the end of the 1930s. In Scotland, large producers included Inveresk Paper Company and Tullis Russell. In 1928, the total production capacity of newsprint mills in Britain had exceeded 650,000 ton, but only about 100,000 ton was produced by newsprint manufacturers independent of the publishers (Ahvenainen 1976).

After the slump of the 1930s, the living standards started to rise, and there were plenty of potential customers. Between 1930 and 1937, the *Daily Mail* was ousted from first place among the dailies both by the *Daily Express* and the *Daily Herald*. By 1937, each of these three papers reported circulation figures above two million.

Among the Sunday papers, the *News of the World* and *The People* reached over three million readers. The British acquired a reputation as the keenest newspaper readers in the world (Reader 1981). In 1935, British production of newsprint stood at 857,300 ton, which furnished 38.1% of the total production of paper and board (2,250,300 ton) in that year. The newsprint imports were, in 1935, 366,000 ton and exports 70,400 ton. The total of 1,152,900 ton of newsprint was available for use in the UK (*CP* 1935). With that figure, more newsprint was being consumed per head of the population in the British Isles than in any other country of the world (Clapperton and Henderson 1947). The war changed it all, and in 1950, the consumption of newsprint in Britain was 46% less than in 1939 (Reader 1981).

7.3.2 Organisation of Labour

Unions of workmen had been in existence in Britain since 1789, but the first serious craft organisation to represent the interests of the craftsmen of the vat mills was the Original Society of Papermakers founded in 1800. The progress of trade unions in the machine industry was very modest until the later decades of the nineteenth century, and an increasing number of machine workers found themselves without adequate representation. Into this vacuum stepped in 1854 a union of machine workers, calling themselves the United Brotherhood of Paper Makers. From 1869 to 1894, there existed two societies for the craftsmen of the machine mills, the United Brotherhood and the Modern Society of Paper Makers. In 1894 they reunited in the Amalgamated Society of Papermakers, but it continued to represent beatermen, machinemen and finishers only. The skilled union did not open its membership to unskilled or semi-skilled workers, even though the general union was weak and unstable. Instead, it was eager to merge its identity with that of the old craft union of handworkers. The National Union of Paper Mill Workers was founded in 1890 for unskilled mill workers but did not have a long existence as an independent union. In 1914, it amalgamated with the National Society of Printers' Warehousemen and Cutters (Bundock 1959; Coleman 1958; Spicer 1907; Harris 1994).

Divisions between vat and machine mill workers on the one hand and within machine production between skilled and unskilled workers on the other made the organisation of labour in the paper industry severely divided at a time when efforts for shortening the working week were under negotiation (Magee 1997b). Low wages and irregular employment characterised especially unskilled employment, which widened the gap between skilled and unskilled workers (Pollard 1963).

During the First World War, the trade unions within each industry had been forced to collaborate closely, and this encouraged a movement towards the amalgamation of the small societies into larger bodies. Ultimately, the Trade Union (Amalgamation) Act of 1917 made amalgamation easier and helped to create large national unions (Pollard 1963). The National Union of Printing, Bookbinding, Machine Ruling and Paper Workers (from 1928 onwards known as the N.U. of Printing, Bookbinding & Paper Workers) was founded in 1921 to represent workers

in paper and allied trades. At its height in the late 1950s, the union had over 160,000 members (Bundock 1959). Following mergers with several small unions, it joined with the National Society of Operative Printers and Assistants to form the Society of Graphical and Allied Trades (SOGAT) in 1966 (Gennard and Bain 1995).

What were the relationships between employers and employees like? The family-based management structure dominated the industry until the First World War. The typical Victorian employer was a highly personalised one. Paternalism best describes the employment relationship in the industry. With the advance of limited liability ownership before the First World War, personal employer paternalism diminished (Harris 1994). After the First World War, the strongly personal nature of the British paper business scene was replaced by a type of corporate paternalism, which saw company welfare schemes as an integral part of modern industrial management. Broadly speaking, histories of trade-unionism indicate that the stability of relationship was dependent on employers delivering a valuable set of welfare benefits (Pollard 1963; Harris 1994).

Although there is some evidence of worker's resistance from the late nineteenth century, all in all peaceful industrial relations prevailed in the industry. During the First World War and the interwar period, national trade unions were both strong enough and militant enough to challenge employers, both in narrow skirmishes and on a broad front, like that of the 1926 General Strike (Richardson 2006). The Trade Disputes and Trade Unions Act of 1927, which made general strikes illegal, illustrated that employers were still able to gain considerable victories over organised labour. It was not until the Trade Disputes and Trade Unions Act of 1946 that the 1927 Act was repealed (Pollard 1963).

How many people worked in the industry? It is difficult to find an adequate answer to this simple but important question. The most satisfactory estimates are largely based on the occupation tables of the *Census of Population* returns, which are available from 1831 onwards. In 1861 total employment in paper manufacture in Britain was 17,669, of whom 13,248 worked in mills in England and Wales and 4,421 in Scotland. Fifty years later, in 1911, the total employment had increased to 34,954, of whom 24,844 worked in England and Wales and 10,113 in Scotland (Shorter 1971). It should be noted, however, that these figures do not show the total employment which paper manufacture provided. According to the estimate made by Coleman (1958), total employment offered by paper mills in 1861 was twice that given by the census figures. This would bring employment in the Britain in 1861 to 35,000. Furthermore, the census figures do not take any account of a range of occupations also dependent of the paper industry. In 1861 these together added another 17,000 for England and Wales.

From 1907 onwards, we can base our estimates on the information provided by the *Census of Production* returns. The Censuses of 1907 and 1924 extended to all firms, however small, but in 1912 firms employing not more than five persons were required to state only the average number of persons employed by them in the year. The exemption of small firms in 1912 resulted in the exclusion of an important proportion of some of the paper trade and, both for that reason and because the First World War interrupted the task of dealing with incorrect returns, the information

available for that is not sufficiently complete to warrant its use for detailed comparisons. The Censuses of 1907 and 1912 covered Great Britain and the whole of Ireland, but that of 1924 applied only to Great Britain and northern Ireland. However, the exclusion of southern Ireland (the Irish Free State) in 1924 does not seriously affect the comparability of the figures. The 1948 and 1951 figures concern firms employing on average more than ten persons. The number of persons employed increased from 1907 (40,955) to 1951 (73,690) by 80% (Table 7.8). Peak employment in the paper trade was reached in 1959 when 100,000 persons were employed.

Compared with the numbers employed in other branches of trade, we can determine from the *Census of Production* returns that the relative importance of the paper, printing and stationery trades in 1924 was 4.7% and in 1930 5.3% of all trades (cf. Deane and Cole 1969). The order of importance in the larger industries in the UK in 1924 was 32nd and in 1930 34th. It should be noted, however, that for instance in 1924, the share of employment provided by firms engaged in the manufacture of paper, and board and coating paper was only 14.7% (51,390) of the total employment figure of the paper, printing and stationary trades (359,922).

In what conditions did they work? During the early period of papermaking, the most unattractive and unhealthy places were the rooms where the rags were sorted and cut. The work of the papermakers themselves in the vat mills was heavy and tiring. Yet both these workers and their successors in the machine mills were generally regarded as a healthy and long-lived section of the artisan class. The prevalence of accidents, however, was a common feature during the early period of mechanisation (Coleman 1958). The first important improvement in the state of labour in paper mills was the passing of the Act for the Extension of the Factory Acts in 1867, which restricted the employment of children and women in manufacturing work. The subsequent Acts, on the whole, meant better work (Spicer 1907; Shorter 1971; Industrial Information Series 1947).

What did they earn? There are two major problems in estimating wages paid. First, the data available for the nineteenth century is inadequate. It has been estimated by Coleman (1958) that English papermakers' wages increased by 38% between 1803 and 1865. Second, under the Census of Production Act of 1906, the Board of Trade was prohibited from enquiring the amount of wages paid in connection with a Census of Production. Voluntary enquiries on this subject were, however, conducted by the Ministry of Labour in respect of both 1930 and 1924. Comparison of wages paid to other industrial groups reveals that average annual earnings per operative in the paper trade in 1930 were between £121 and £140. With that salary, the paper trade workers belonged to the same relatively well paid category of workers such as, for instance, workers in iron and steel foundries. They earned more than workers in the textile trades (not exceeding £100 or between £101 and £120 p.a.) but less than workers in the printing and publishing sectors (over £160 p.a.).

7.4 From Empire to Europe

After the Second World War, the British paper industry oriented towards the changing world, and it became attached to the global market system. The government started to openly encourage the creation of large firms which would be more capable

of competing with the large North American and European firms. The ending of family control and the creation of a British corporate economy are among the most significant post-war business trends (Wilson 1995).

For most of the 1950s, the papermakers enjoyed seller's markets as standards of living were rising. Great hopes were placed on development of magazine paper because the marketing opportunities were attractive for periodicals like *Woman*, *Woman's Own* and *Woman's Realm*, as well as *Radio Times* and *TV Times*. The improved market situation benefitted most of all packaging and wrapping paper and board sectors of the industry. New products of all kinds and new versions of old ones were flooding into the shops, like tissues, paper towels, toilet paper and other products of that kind (Reader 1981).

British entry into the European Free Trade Association in 1960 subjected the British paper industry and its domestic markets to competition. In the Common Market system, domestic markets were left open to the Nordic importers, Sweden, Finland and Norway as tariff barriers were dismantled. Backed by natural advantages, the Nordics used price policy – relatively cheap newsprint, relatively dear pulp – to further their dominance in the British markets (*PTR* 19 October 1961). Compared to the removal of protective tariffs 100 years earlier in 1861, the situation was more serious for the British papermakers, because overseas producers were now in a much stronger competitive position compared to them.

British paper companies were under great price pressure due to the increased imports by the Nordic paper producers, working in a much more competitive environment than the British producers. Consequently, there was great deal of rationalisation and mill closure in Britain as producers lost their faith in their business environment. In the 1960s, pressure on profit margins forced the closure of some 35 mills all over Britain. There was no single reason for the closures; they were due to intensified competition, changes in equipment and in the organisation of the industry as well as factors arising from the overall market situation (Shorter 1971).

The abolition of tariff barriers and the advantages of vast forests, integrated pulp and paper production and cheap electricity enjoyed by overseas producers were some of the reasons for the quickly deteriorating market situation in Britain after 1960 (Jensen-Eriksen 2008), but not all. In an attempt to maintain its competitiveness against overseas producers, the British paper industry was forced to operate on low-profit margins. This prevented major investments in new plants and machinery suitable for reprocessing greater proportions of waste paper. The need to modernise the industry was delayed by the continuation of protection for the first 15 post-war years, and this proved too overwhelming for the survival of the British-owned paper industry.

British participation in the European Economic Community in 1973 once again worsened the prospects for the British paper industry. The domestic markets were under foreign competition, and there was little hope of expanding export trade in the Commonwealth countries. The only place British paper industry could hope for any real expansion was the booming economies in western Europe, but the Continent was a foreign territory to them. British firms were accustomed to establishing themselves as manufacturers in the English-speaking world, but on the Continent there were foreign languages and laws to contend with as well as different conceptions of business life and methods of doing business altogether.

There were several different strategies with which British papermakers tried to overcome their adverse market situation. The substitution of imported wood pulp by wastepaper became a necessity for the survival of that part of the industry which concentrated on commodity grades of paper. Producers of high-quality and specialised grades, like Tullis Russell in Scotland, concentrated on niche markets. International expansion strategy was chosen by large companies such as Reed and Bowater, who invested in new plants in North America while cutting back their domestic production. They also diversified into new products, which caused several large acquisitions and mergers. By the end of the 1970s, most of these strategies had failed with the exception of specialisation (Owen 2000).

Wiggins Teape tried to counter competition by building an integrated pulp and paper mill at Fort William, which exploited home-grown timber resources. The development of the wood-pulping industry, with some exceptions, was a relatively new idea in Britain. The timber did not exist in sufficient quantities and on a guaranteed scale for the necessary capital investments to be forthcoming. However, in the late 1960s, some British papermakers placed great expectations on the use of home-grown wood resources and the use of fertilisers in planting. The supply of British-grown coniferous wood was expected to rise from 2.3 million tons in 1970 to 7.8 million tons in 2000 (wet wood with bark) (Hummel and Grayson 1969). However, these expectations proved false. The bold experiment made by Wiggins Teape was never profitable, and the mill at Fort William was closed in 1980 (Owen 2000).

By the 1980s, British business culture had changed dramatically, and the paper firms developing a strong international dimension led the way breaking the old mould. The period of rationalisation and reorganisation lasted until the late 1980s. In 1991 there remained 71 national and multinational companies, which had 109 running mills. Only 40% of the total production capacity was British-owned. The industry was still concentrated in the southeast and the northwest of England and Scotland. Since 1960, the industry has been much more capital-intensive than previously. As a consequence, there was a steady decline in the numbers of persons employed along with the number of mills. In 1991 an average mill had some 300 employees (Gennard and Bain 1995).

In the 1990s, a remarkable modernisation took place in the British paper industry. Investments in recycling technology created new business opportunities for British companies. Modernisation of the industry meant changes of ownership structure as well, and new projects were more likely to be undertaken by foreign companies than British-owned. The surviving companies targeted their products at sectors of the market where a British-based producer could compete against imports. In 1997 there remained three British-owned companies, PBP Industries, API Industries and Inveresk Paper Company, who concentrated on waste-based grades and high-value-added grades. The total number of foreign-owned and British-owned companies was 62, the total production capacity being 6.5 million tons. The most important raw materials were wastepaper (59% of total pulp equivalent), imported wood pulp (29%) and British produced wood pulp (11%). The industry owned by multinationals was much more export oriented than previously. In 1997 it exported 22% (1.438 million tons) of its total output (Owen 2000).

7.5 The British Paper Industry in Retrospect

This investigation has provided insights into developments in the British paper industry and evaluated its peculiar problems from 1800 to 2000. What we can learn from it? Britain was the first country in the world to enter into mechanised papermaking. The first Fourdrinier papermaking machines were introduced in the early 1800s, but it was not until the 1830s that mechanisation became truly widespread in the paper industry in Britain. After a relatively slow start in the mechanisation process, the industry developed with some rapidity. By 1860 the world of mechanised papermaking had been born in Britain.

Britain continued to lead the field in the papermaking industry until the later decades of the nineteenth century, after which the momentum of being the first nation successfully to mechanise the production of paper was gradually lost to some of its major competitors in North America and Continental Europe. In retrospect, it is not difficult to demonstrate the weakness in the British paper industry structure if compared to its major competitors. The difficulty in obtaining esparto and wood pulp during the First World War forced mills to switch to wheat and oat straw and wastepaper instead, which revealed Britain's vulnerability in terms of supply of raw materials, and this dilemma recurred during and immediately after the Second World War, when there was a very severe shortage of all fibrous materials in general and of wood pulp in particular (Shorter 1971). As it turned out, after the First World War, the British papermakers lost their technological edge over the major overseas competitors. In other words, Britain started to pay the penalty for being the pioneer in the line of mechanised papermaking business.

While the impetus of early mechanisation was gradually lost in Britain, North American and Continental producers became major players in the field of papermaking at the close of the nineteenth century when the utilisation of wood as raw material for making paper revolutionised the whole paper industry. A remarkable expansion of the industry was witnessed in Canada and the Nordic countries (Reich 1927). Endowed with water power, raw material and networks of lakes and rivers, they became major importers to the British markets that operated under the free trade principle. The increased foreign competition led to the introduction of protective tariffs.

The English-speaking world dominated the geographical horizons of the British paper industry until 1960. The main bulk of exports went to the empire or Commonwealth countries, while Canadian and Nordic firms were major importers. The inherent weakness of the British paper industry had been masked in the 1930s by the low cost of pulp and in the 1940s and the early 1950s by the excess of demand over supply. In Britain, the paper industry prospered because the price of pulp in Canada and the Nordic countries was falling faster than the price of newsprint in Britain, and because British newspaper owners were able and willing to pay somewhat higher prices for British-made newsprint than for imports in order to keep British industry healthy (Reader 1981). After the Second World War, the negative consequences of being the first in the line of papermaking business were revealed.

British entry into EFTA in 1960 subjected the British paper industry and its domestic markets to competition. Finally, British entry into the EEC in 1973 oriented the British paper industry towards Europe.

Appendix A

Table 7.1 Imports and exports of paper and board 1913–1959 (cwt)

	1913	1919	1929	1939[a]	1949	1959
Imports	12,881,860	7,621,522	19,932,938	16,469,284	9,278,384	24,073,682
Exports	3,499,513	935,919	5,047,318	2,373,427	3,769,501	4,894,092

Source: *Accounts Relating to Trade and Navigation of the United Kingdom*
[a]Eight months ended 31st August

Table 7.2 Imports of raw materials 1913–1949 (tons)

	Rags	Esparto	Wood pulp	Other fibrous materials	Total
1913	29,538	204,932	977,957	16,927	1,229,354
1919	6,525	70,624	937,920	1,242	1,016,311
1929	19,699	312,711	1,638,247	9,584	1,980,241
1939[a]	15,232	221,409	1,129,873	15,485	1,381,999
1949	20,389	360,624	1,305,137	20,253	1,706,403
Total 1913–1949	91,383	1,170,300	5,989,134	63,491	7,314,308
% from total	1.2	16.0	81.9	0.9	100

Source: *Accounts Relating to Trade and Navigation of the United Kingdom*
[a]Eight months ended 31st August

Table 7.3 Imports of paper and board by country in 1949 and 1959 (cwt and %)

	1949	%	1959	%
Canada	2,224,384	24.0	8,736,846	36.3
Other Commonwealth countries and the Irish Republic	49,353	0.5	475,206	2.0
Finland	1,109,590	12.0	3,675,145	15.3
Sweden	2,895,648	31.2	3,609,334	15.0
Norway	1,050,922	11.3	1,445,781	6.0
Western Germany		0.0	193,204	0.8
Netherlands	1,400,621	15.1	2,338,025	9.7
Belgium	15,711	0.2	51,452	0.2
France	15,684	0.2	57,330	0.2
Austria	102,147	1.1	52,684	0.2
United States	350,098	3.8	3,274,843	13.6
Czechoslovakia	19,273	0.2		0.0
Other foreign countries	44,953	0.5	163,832	0.7
Total	9,278,384	100.0	24,073,682	100.0

Source: *Accounts Relating to Trade and Navigation of the United Kingdom*

Table 7.4 Total make of paper and board 1907–1951[a] (tons and %)

	Thousand tons	% share from selected years
1907	850.0	6.9
1912	1,018.2	8.3
1924	1,268.3	10.3
1935	2,250.3	18.3
1937	2,546.1	20.7
1948[b]	1,772.2	14.4
1951	2,586.5	21.0
Total	12,291.6	100.0

Source: *Final Report on the Census of Production of the United Kingdom*
[a]The manufacturers of paper were required to state the total weight of paper and board made by them in the year, whether sold or added to stock or used by them in their works for further manufacture. Similar information was not required in 1907, but an estimate of the total made in that year was made by the census office on the basis of the information furnished in the returns (*CP* 1924)
[b]Great Britain only

Table 7.5 Number of establishments 1924–1951[a]

	N
1924	306
1930	272
1935	267
1948[b]	275
1951	282

Source: *Final Report on the Census of Production of the United Kingdom*
[a]Firms engaged in the manufacture of paper and board and coating paper
[b]Great Britain only

Table 7.6 Size of establishments by employment 1935–1951

Average number employed	1935	1948[a]	1951
11–24	16	20	18
25–49	42	30	36
50–99	53	61	58
100–199	54	53	51
200–299	43	43	38
300–399	19	20	27
400–499	13	12	16
500–749	18	23	19
750–999	4	6	11
1,000–1,499	5[b]	3	4
1,500 over		4	4
Total	267	275	282

Source: *Final Report on the Census of Production of the United Kingdom*
[a]Great Britain only
[b]1,000 and over

Table 7.7 Distribution of mills and employment by standard region 1948 and 1951

	Establishments		Persons employed		Average number employed per establishment	
Region	1948 (GB)	1951 (UK)	1948 (GB)	1951 (UK)	1948 (GB)	1951(UK)
Northern	11	11	2,054	2,290	187	208
East and West Ridings of Yorkshire	16	16	2,342	2,764	146	178
North Midlands	11	14	834	1,090	76	79
Eastern	10	9	4,406	4,857	441	540
London and southeastern	56	61	15,331	18,584	274	305
Southern	15	14	3,641	4,181	243	299
South Western	25	25	6,259	6,774	250	271
Midlands	10	10	1,914	2,150	192	215
Northwestern (including northern Ireland in 1951)	67	66	13,274	13,833	198	210
England (and northern Ireland in 1951)	221	226	50,055	56,523	226	250
Wales	4	6	1,518	2,081	380	347
Scotland	50	50	14,567	15,086	291	302
UK	275	282	66,140	73,690	241	261

Source: *Final Report on the Census of Production of the United Kingdom*

Table 7.8 Number of persons employed in the paper trade[a] 1907–1951

	Number of persons employed[b] (thousands)
1907	41.0
1912	42.1
1924	51.4
1930	53.8
1935	59.9
1948	66.1
1951	73.7

Source: *Final Report on the Census of Production of the United Kingdom*
[a]Firms engaged in the manufacture of paper and board and coating paper
[b]Including operative (wage earners), administrative, technical and clerical staff (salaried persons). The figures are exclusively of outworkers

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Chapter 8
The Paper and Board Industry in the Netherlands, 1800–2000

Bram Bouwens

8.1 Introduction

The history of the Dutch paper and board industry goes back to the sixteenth century. Thanks to a combination of favourable circumstances – a good supply of rags, the availability of clean water and energy (wind and water), the rise of Amsterdam as a staple market and the technological evolution (the invention of the 'Hollander') – Dutch paper gained worldwide acclaim. Dutch watermarks guaranteed outstanding quality and a superior product. Foreign competitors even falsified the watermarks and copied dispensing 'recipes'. The Netherlands was one of the most important centres of paper production in Europe (de Vries 1957; de Vries and van der Woude 1997, pp. 311–314; Bouwens 2004, pp. 19–35). Nowadays, the pride of the Dutch producers of paper and board may still exist, but at the beginning of the twenty-first century, the members of the Dutch Association of Paper and Board Producers seriously ask themselves whether there is still a place for paper and board producers in the Netherlands on the global competitive scene (VNP Annual reports 2000–2008). Already in 2000, about 60% of all companies were no longer Dutch owned, and this development accelerated throughout the first decade of the new millennium. Corporations from Scandinavia, Finland, the United States and other countries, which were already benefitting from an ample supply of domestic raw materials, became dominant. They dominated the industry landscape not just because of their access to cheap and high-quality raw materials or their technological edge but because they had at their disposal capital to an extent which local competitors could not hope to match. They were well-established multinationals in a business environment where

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J.-A. Lamberg et al. (eds.), *The Evolution of Global Paper Industry 1800–2050: A Comparative Analysis*, World Forests 17, DOI 10.1007/978-94-007-5431-7_8,

national boundaries were quickly losing their significance. The Dutch paper and board industry went through a new process of transformation and became part of international decision-making within a local context. This development made the Dutch industry very vulnerable, which can be illustrated by the fact that during the first years of the new millennium, several multinational corporations closed down their plants in the Netherlands.

The contemporary history of the paper and board industry in the Netherlands is the narrative of an industry that had to cope with considerable competitive disadvantages. This chapter analyses the evolution of the paper and board industry in the Netherlands and the way businessmen formulated their strategies to increase the profitability of their activities and decrease the uncertainties of competition.[1] How did the industry cope with the challenges of the markets, the increasing international competition and the formal and informal institutional context? After a brief introduction of the pre-industrial era and the slow process of industrialization during the nineteenth century, this chapter will focus on the development of the industry and the corporate strategies that became apparent during the twentieth century.

8.2 The Birth of the Industry

Although the first paper mill in the Netherlands dates from 1428, it was the paper mills of the sixteenth and seventeenth centuries that were responsible for the worldwide acclaim of Dutch paper grades during these centuries. The mills were founded in many places in the Netherlands but geographically concentrated in two areas: 'de Zaanstreek' and 'de Veluwe'. Both areas continued to be important regions for paper producing activities until the mid-twentieth century. Several factors and circumstances contributed to the worldwide acclaim of Dutch paper grades. The rise of Amsterdam as an international port was of great importance for the supply of raw materials (mainly rags) and for the export of the paper itself to all parts of the world. Especially in this part of the country, the rags were of a high quality. The quality of the Dutch product was initially inferior to paper made in France, but the industry in that country – which was in many cases in the hands of Dutchmen – suffered greatly, among others, from the exodus of Protestant

[1] There is no universal definition of strategy, many definitions are available, each with numerous connotations. Strategy is – according a prescriptive definition of the concept – a (long-term) vision of what an organisation seeks to do, the markets and customers it wants to serve and the manner in which available resources are allocated. Mintzberg and others have pointed out that strategies may evolve through time and firms take advantage of unforeseen opportunities and try to anticipate and react to changes in competitive and institutional environments. In the case of the Dutch paper and board industry – where one would expect rational decision-making and careful strategic planning because of the immense scale of investments – this has proven to be an important factor. See, for example, Bouwens (2003).

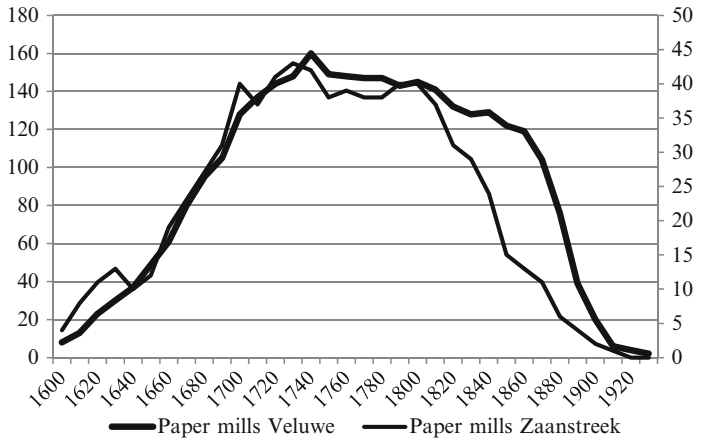

Fig. 8.1 Paper mills in the Netherlands, 1600–1930 (Veluwe *left axis*, Zaanstreek *right axis*)

papermakers to the Netherlands after the repeal of the Edict of Nantes (Voorn 1961, pp. 31–45; de Vries 1957, pp. 24–25). Furthermore, the invention of the so-called Hollander beater which, especially in the Zaanstreek, took the place of the old stamping mill was an important factor in improving the quality of the product which rapidly became world famous. The 'Hollander' stands as the most important innovation in papermaking between the Middle Ages and the nineteenth century introduction of mechanical paper production. The production rose rapidly in these years. For example, the production of grey and blue paper grades that were important as packaging material increased not more than 10,000 reams (unit of 500 sheets of paper) per year in 1650 to over 75,000 reams in 1740. A large part of this production was exported. In 1667, the paper mills exported 38,000 reams of different paper grades, 100 years later the export was tripled (Honig 1888; de Wit 1990, pp. 15–17; Bouwens 2004, pp. 29–35). The consequence was that a steady stream of mills came into existence (see Fig. 8.1). At the beginning of the eighteenth century, almost 200 wind and watermills produced 5,000 ton of paper annually. Foreign papermakers regarded this development with envy and oriented themselves to a large extent on Dutch production methods.

The two centres of papermaking differed in many respects. The sandy soil of the Veluwe possessed naturally pure water, whereas the Zaanstreek had the handicap of poor quality water and invested heavily in resolving this problem. The Veluwe mills were small mills driven by water power, usually run by only a few relatives who combined papermaking with other agricultural activities and who often rented the mill from a landlord. On the other hand, the Zaan region mills, driven by wind power, were among the most important industrial installations of these years, often employing 40–50 workers. The capital investment required for these mills caused investors to reduce their risks by organising themselves in 'partenrederijen', a form of limited partnership that was confined to shipbuilding and fisheries. Cooperation was the order of the day. The papermakers in the Netherlands, both in the Zaanstreek

and the Veluwe, had been familiar with cooperation since the early days of the industry. Innovation, adoption and adaption of new techniques were frequently undertaken as concerted operations, and they joined forces to attain protective trade arrangements from the Dutch government. Cartels played a crucial role in structuring the national paper industry.

During the eighteenth century, Dutch papermakers lost their dominant market position. Foreign competitors falsified the watermarks and copied dispensing recipes. Despite the protection of the Dutch government afforded by import duties on paper, the ban on the export of rags and by the introduction of differential duties in the Dutch East Indies, the paper industry fell behind. With the invention of the papermaking machine in the late 1790s and the increasing use of modern techniques in Britain, France and Germany, manual papermakers in the Netherlands lost ground (Voorn 1961, pp. 74–75, 1985, pp. 11–12; de Vries 1957, pp. 221–222; Bouwens 2004, pp. 35–40). Nevertheless, the manufacture of paper according to traditional methods maintained a prominent position throughout the eighteenth century. Due to clear differences in quality between handmade grades and paper produced on papermaking machines, the transformation of the Dutch industry was a gradual process. It proved difficult to abandon a tried-and-tested formula for success. Moreover, technological and financial obstacles as well as the necessity of using alternative non-domestic raw materials delayed the inevitable process of industrialisation. In this development, the Dutch paper industry was not a unique case in the Netherlands. Several industries had the same kind of problems with financing and adapting new technologies, whereas the Dutch government protected them only marginally (van Zanden and van Riel 2000).

After the 1850s, the number of papermakers that produced the so-called paper sans fin steadily increased, while at the same time, several experiments were carried out with regard to all kinds of new raw materials. In the northern part of the Netherlands, a whole new branch of industry successfully developed which produced paper and board out of straw. Both cooperatives and private companies performed well by adding value to the inevitable by-products of growing corn. The capital intensity of the industrialised companies annihilated differences between newcomers and the established producers of paper. During the second half of the nineteenth century, new producers entered the market, and new areas rapidly rose to importance. The leeway in the production of machine-made paper was steadily made up, the difficulties connected with raw materials diminished, and the economic situation, governed by liberalism, became more favourable. Commercial treaties rendered the competition from foreign paper, but gradually, the Dutch paper industry also grew stronger through progressive mechanisation. At the end of the nineteenth century, the Dutch paper industry was – with a few exceptions – totally industrialised and made use of wood pulp and celluloses that had to be imported in huge quantities. Only two big firms succeeded in building a cellulose factory (de Wit 1990, pp. 50–51; Visser 1954, p. 130; Bouwens 2004, pp. 47–51).

On the eve of the First World War, the Dutch paper and board industry included 22 factories producing a wide array of paper grades. Next to these firms, 19 relatively small production units that made paper and board out of straw operated in the northern

part of the country. These firms mainly exported their board to the United Kingdom and until the 1960s had their own institutions to organise business. They did not interfere with the other parts of the industry, the 22 firms that produced both bulk products and speciality products. Also with regard to ownership structures, the Dutch paper industry was a motley collection of companies. Companies listed on the stock exchange dominated the spectrum. Van Gelder Zonen (VGZ) and Koninklijke Nederlandse Papierfabrieken (KNP) produced many different grades of paper, employed thousands and were most active in expanding their business through internal expansion and after the Second World War also through mergers and acquisitions. Most firms were family firms, in which ownership and control were combined.

During the first half of the twentieth century, the Dutch paper and board industry already exported heavily, while imports were also important to serve the consumers in the Netherlands. On average, Dutch wholesalers imported about 90,000 ton of paper and board a year during the interwar period. At the same time, export amounted to 60,000 ton during the 1920s and 30,000 ton a decade later. This is not very strange and fits not only the characteristics of the international paper and board industry but also the way the small and open Dutch economy was organised and the way businessmen conducted their affairs. Businessmen not only had to cope with domestic competitors but were often in fierce competition with producers from outside the Netherlands. The liberal trade policy of the Dutch government promoted this. It also influenced the possibilities of businessmen for working together in business interest associations, creating cartel agreements and the process of concentration through mergers and acquisitions. On the whole, the Dutch business system was highly coordinated during most of the twentieth century. As the industrialisation of the paper and board increased, so did cooperation. In 1904, 16 producers of paper and board founded the 'Vereeniging van Nederlandsche Papierfabrieken' (Association of Paper Producers in the Netherlands). However, it was not until the 1930s that this institution became a flourishing organisation and focal point of the industry. Agreements on prices, sales and production reduced competition and provided stability for the members (Bouwens 2004, pp. 57–61).

It is an interesting feature that after adopting the papermaking machine, the scale of operations remained the same for a long time. During the second half of the nineteenth and the first half of the twentieth century, expansion was a matter of building new machines rather than increasing the width or length of existing units or of making any attempts to reduce production costs. This, however, was very important to remain competitive. While demand was rising, competition from Germany and the Scandinavian countries increased, and prices were under pressure during the first decades of the new century. On average, the prices of most grades halved between 1875 and 1905 (Visser 1954, p. 148; Sluyterman 1992, p. 36). Most companies now produced a wide array of qualities, and both short-term and long-term economies of scale seemed to be of little importance.

Before the Second World War, the growth of the industry was very marginal, and the scale of the production facilities made it possible for newcomers to enter the market. In 1945, the Dutch paper and board industry counted 50 companies producing 350,000 ton of paper and board. The second half of the twentieth century

would, however, force the industry to be more clear about their strategic intentions and the way they could and would expand, or not. This proved rather difficult because of the growing complexity of the competitive, institutional and economic environment.

8.3 Strategic Modes in the Paper Industry: Deliberant and Emergent

After the years of recovery from the Second World War, the paper and board industry prospered. Demand for paper and board increased, competition was not particularly fierce, and the output could be easily sold. Supply never quite caught up with demand, and internal expansion was attractive for all firms. Although the government still fixed prices during the first half of the 1950s, sheer company turnover made expansion possible. In 1953, for example, the whole paper and board industry had a turnover of 270 million guilders. After paying for the raw materials, energy and the employees, 113 million guilders was left for depreciation, paying interest and dividends. The ratio between profits and costs at 40:60 was remarkably stable during these years.[2] The number of machines in operation grew by about 35% during the first two decades after the Second World War. After 1955, this was coupled with an increase in average machine width (Table 8.1). Using 170 machines, the paper industry was producing almost 1.5 million tons of paper and board annually (Bouwens 2004, pp. 128–137). Formulating strategy in a prescriptive way provided an uncomplicated way forward in such a sellers' market. Goals, policies and programmes simply converged. Profound inquiries into market structures or competitor strategy were thought to be unnecessary, as was the coordination of investment decisions. Production costs and the pursuit of economies of scale – defined as potential reductions in average unit cost associated with higher levels of production capacity – seemed secondary to enlarging output. With sufficient raw materials to expand and production costs relatively low, the 1950s were the 'golden age' of the paper and board industry. During this decade, any individual plant could clearly benefit from a larger scale of operations. Increasing the scale of operations through mergers and acquisitions was a clear and for some firms desirable option, and indeed, several paper producers initiated negotiations with their competitors. Horizontal concentration was attractive because of the speed of expansion they offered. A few mergers occurred, but most firms followed the familiar strategy of internal expansion. These comprised a cautious policy of ploughing profits back into equipment. Small firms were not condemned for their inability to obtain large-scale production units. The sellers' market and the profitability of the whole branch allowed them to expand gradually and work on increasing their productivity (Fig. 8.2) (Bouwens 2004, pp. 138–140).

The mid-1960s were a turning point for the Dutch producers of paper and board. The golden years of the industry were over. Firstly, this was a result of an expansion

[2] Calculations based on CBS Production statistics paper industry (1950–1960).

Table 8.1 Paper machines in total width in metres, 1925–1961

	<1.50	1.51–2	2.01–2.5	>2.5	Total
1925	20.2	23.9	43.8	19.5	107.1
1929	18.9	26.2	55	30.5	130.6
1933	15.2	29.4	59.4	38.5	142.5
1938	13.4	27.5	64	44.3	149.1
1946	7.9	28.7	55.4	44.2	136.1
1950	9.3	34.2	66	47	156.5
1954	9.3	41.4	74.8	54.7	180.2
1958	12.6	39.4	97.3	75.8	225.1
1961	8.8	51	90.8	80.9	231.5

Source: CBS Production statistics paper industry (1925–1961)

Fig. 8.2 Productivity (tons per employees, *left axis*) and number of employees (*right axis*) in the Dutch paper and board industry, 1938–1966 (Source: Calculations based on CBS Production statistics paper industry 1946–1967)

of production capacity in Europe and the rest of the world. Most paper and board markets showed signs of saturation. Scandinavian and Finnish pulp producers in particular challenged the Dutch and European industry by shifting the emphasis from pulp to paper. They increased the degree of vertical integration, and especially that of forward integration. Keen to add value to their forests as a natural resource, the governments of these countries stimulated and supported strategic changes undertaken by pulp producers. Compared to their rivals in Western Europe, the Scandinavian and Finnish producers of paper and board had a clear competitive edge. The abundance of cheap raw materials allowed them to avoid intermediary costs. The ability to turn pulp into paper with no need for drying and reconstitution – a necessity for intra-process shipping – offered yet another advantage. Aside from the advantages of vertical integration, the industry could rely on the availability of

relatively inexpensive sources of energy. The so-called Scan cartels greatly enhanced the market power of their members. These conventions determined uniformity in prices, terms of delivery and quality regulation (see, e.g. Lamberg et al. 2006; Bjuggren 1985; Häikiö 2001).

This development resulted in discussions in Europe on a supranational division of the production of paper and board by which the Scandinavian and Finnish industries would concentrate on manufacturing bulk products and the West European industry would focus on the production of speciality grades. This was a long-term alteration and only partly feasible. The existing production structure, the proximity of large consumer areas and the use of waste paper as an alternative to cellulose and wood pulp complicated such a division for the West European industry (Correspondence VNP to Minister of Economic Affairs and CEPAC, 7 April 1959).

The problems facing the Dutch paper and board industry in these years were aggravated by the European Community's trade policy and tariff reductions. It should be underlined that this policy created hardly any new trade for Dutch paper and board producers at any time after 1958 and the production structure was scarcely affected.[3] Export was and always had been an essential part of the business. Therefore, the prevalent overcapacity during the second half of the 1960s led to falling prices and decreasing profits. At the same time, company returns were being adversely affected by the increasing cost of labour and the need for a higher level of investments to conform to ecological standards. The increase in energy prices during the 1970s served to compound industry difficulties still further (Bouwens 2004, pp. 150–155). This prompted the exploration of new strategic options. Internal expansion was no longer self-evident. Confronted with saturated markets and fierce competition from Scandinavian and Finnish producers, Dutch companies began to investigate new strategic concepts. External expansion emerged as a viable alternative. During these years, many firms believed horizontal concentration was the way to benefit from economies of scale and at the same time made a further elimination of competition possible. As a result of this alteration in strategic thinking, the number of firms declined, while at the same time, production still increased (Fig. 8.3).

After 1965, corporate strategies also shifted to vertical integration and diversification. It could be argued that this was the characteristic answer of an industry entering the phases of maturity and decline.[4] Many paper and board producers tried to protect their supply of raw materials by entering into long-term agreements with Scandinavian and North American pulp producers. Both VGZ and KNP – the leading firms in the Netherlands – made it possible for the North American companies Crown Zellerbach and MacMillan Bloedel to participate in their share capital. More important, however, than the benefit of being associated with companies holding strong positions on pulp and paper markets was the creation, by these financial partnerships, of new expansion prospects. MacMillan made it possible for KNP to build a new large-scale machine for the production of coated

[3] Calculations based on OECD, L'industrie des pâtes et papiers (1958–1970).

[4] See, for example, de Jong (1981) and Berends (2001).

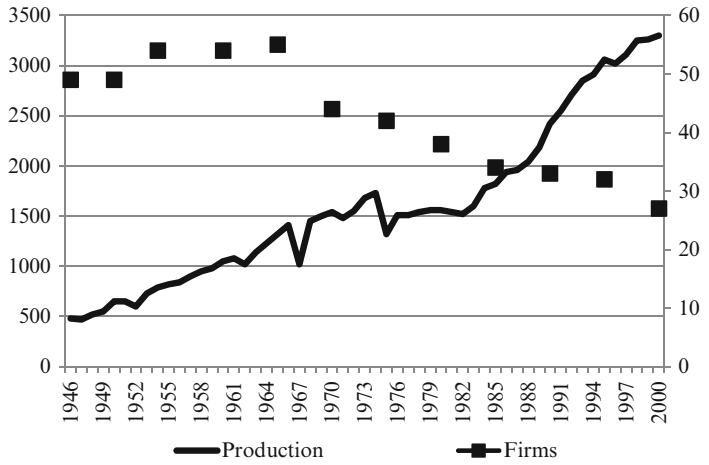

Fig. 8.3 Production (1,000 ton, *left axis*) and concentration (number of firms, *right axis*) of the Dutch paper and board industry, 1946–2000 (Sources: Calculations based on VNP Annual reports (1952–2001) and CBS Productions statistics (1946–2000))

paper and with the support of Crown Zellerbach VGZ was even able to build a completely new plant for the manufacture of punched cardboard (Bouwens 2004, pp. 155–165).

The second half of the 1960s witnessed an impressive number of acquisitions made by producers of paper and board in the pursuit of forward vertical integration. There was an almost unilateral scramble by the firms to establish footholds in their rapidly changing industry. It should, however, be noted that the majority of these transactions with firms in the converting industry were fairly insignificant and often very unbalanced. The initially highly fragmented structure and small scale of the converting industry made the process of forward integration an arduous one. Their strategy of vertical integration was a defensive reaction to developments abroad but was insufficient to safeguard market positions or even to reduce transaction costs (Bouwens 2004, pp. 149–151). Defensive imitation and the creation of a countervailing power were used as arguments for acquiring firms in the converting industry. Operating within the national context – during these years Dutch firms never crossed international borders – this reasoning was largely rhetorical.

During the 1970s, the industry went through a severe crisis. For the first time since the Second World War, production dropped (Fig. 8.3), and most companies suffered losses. This limited the companies in their growth strategies. Expansion gave way to capital deepening and the restructuring of various segments of the industry. Research into the structure of the industry showed that its deterioration was not just a result of its cyclically sensitive character. Compared to competitors in the rest of Western Europe, the Dutch industry was working at a low degree of capacity utilisation (Table 8.2), and production costs ran high.

The Association of Paper Producers VNP and the Ministry of Economic Affairs initiated several projects to reduce energy costs, increase the use of waste paper and

Table 8.2 Capacity utilisation in %, 1966–1982

	Netherlands	West Germany	Belgium and Luxembourg	France	UK	Italy
1966	91	91	92	97	–	76
1971	81	82	97	90	87	68
1976	77	81	90	82	85	82
1982	88	88	89	87	86	78

Source: OECD (1982)

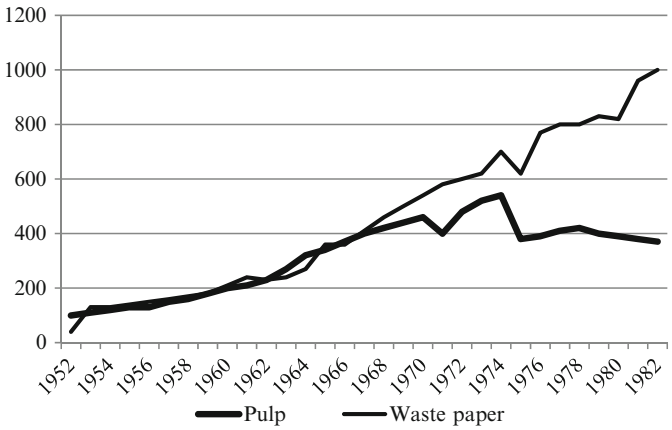

Fig. 8.4 Use of raw materials in the Dutch paper industry (pulp and waste paper, 1,000 ton), 1952–1982 (Source: CBS Productions statistics 1952–1982)

decrease the output of ecologically undesirable pollution. Rationalisation became the key concept of the industry during these years. After 1975, cost reduction and rationalisation were mainly achieved by increasing the scale of the existing production capacity and phasing out obsolete machines. In a relatively short period of 7 years, the number of machines was reduced by one third. It is interesting to note that the composition of the output did not fundamentally change. The Dutch paper and board producers still produced a wide array of grades and varieties, both bulk and specialised products. One of the main differences from the period before the crisis of the 1970s was the use of domestic raw materials, for example, waste paper (Fig. 8.4). After years of assessing the strengths and weaknesses of the Dutch paper and board industry, a path for its future was plotted with relative ease. The industry had in the opinion of businessmen, consultants, bankers and politicians a clear right to existence, even for bulk products that were manufactured with a base of waste paper. The immediate vicinity of large consumer areas safeguarded it a competitive advantage over their international rivals (Bouwens 2004, pp. 196–202).

In the meantime, businessmen formulated new strategic concepts in reaction to the deteriorating markets of these years. Energy efficiency, reduction of pollution

and improving productivity were just one side of the coin. Large firms especially looked for opportunities to spread the risks of business and no longer put all their eggs in one basket and to hedge their bets. KNP and also Bührmann Tetterode (BT), a well-known listed firm that manufactured paper and board, sold office requisites and produced machines for publishing houses undertook acquisitions as part of a common strategic alternative of concentric concentration in which mergers take place between firms that are not direct competitors but nevertheless share a common element in their activities. Both firms took advantage of a complex restructuring process of the national board industry and with the support of the government acquired the lion's share of the solid board producers. Paper and board had a similar production technology, and this kind of diversification appeared to be a popular strategic option with large companies. Except for BT, which diversified into sportswear, toys and many other commodities, Dutch producers of paper and board stayed close to their core business. 'Pure' conglomerate mergers, being mergers between firms with disparate activities, were very common in the industry, but a rare exception in the case of paper and board. KNP, the dominant producer of coated paper grades in the Netherlands, successfully acquired producers of solid board, folding boxboard, corrugated cardboard and many firms from the converting industry (KNP Annual reports 1970–1982). Diversification was not the industry's panacea. Rather, it was a strategic tool to be used with great care and deliberation. While BT and especially KNP successfully applied strategies of concentric diversification, VGZ went into liquidation. Once the pride of the Dutch paper and board industry with more than 7,000 employees, five plants producing a wide array of newsprint and coated paper, VGZ failed to make hard choices in the diversity of products it manufactured during a period of low economic activity. It proved to be extremely difficult to close down production centres that had long been part of the corporation. The unfavourable portfolio and accumulating debts forced the managers of the firm to restructure the corporation. They peeled VGZ like an onion, but the financial position limited its options for restructure. In the end, bankruptcy was unavoidable. The distressing part of this development was the fact that the various plants that started up their activities again were very profitable during the 1980s (VGZ Annual reports 1965–1980; see also Bouwens 2004, pp. 209–223).

After the crisis of the 1970s and the early 1980s, the Dutch industry could handle the international competition. The capital deepening was beginning to pay off. Dutch paper and board producers had modern production machinery at their disposal. With more power plants coming online, the cost of energy was reduced by about 50%. While import of cellulose and wood pulp decreased during the 1970s (Fig. 8.4), the use of waste paper doubled and even rose by a further 11% during the 1980s. Rationalising the production process, combined with an attitude of moderation to income policy, served to increase productivity (Bouwens 2004, p. 257; van Zanden 1998; Sluyterman 2005, pp. 214–219). After the recession, the diversification of the 1960s and the early 1970s made way for a new strategy. Most firms now focused on their core business, trying to achieve economies of scale and upgrade their portfolios. The economic recovery and the increasing demand for paper and board stimulated these processes of internal and horizontally oriented external

Table 8.3 Turnover and invested capital Dutch paper and board industry in Dutch guilders (*f*), 1982–1993

	Turnover in *f* million	Invested capital in *f* million	Invested capital in % of sales
1982	2,322	165	7.1
1983	2,432	135	5.5
1984	2,891	263	9.1
1985	3,155	321	10.2
1986	3,112	371	11.9
1987	3,150	933	29.6
1988	3,620	412	11.4
1989	3,667	377	10.3
1990	3,829	381	10
1991	3,818	604	15.8
1992	3,649	295	8.1

Source: VNP Annual reports (1982–1993)

Table 8.4 Top-10 paper and board companies in Europe and the world (capacity, 1,000 ton), 2002

Europe		World	
1. Stora-Enso (Fin)	12.400	1. Stora-Enso (Fin)	15.200
2. UPM-Kymmene (Fin)	10.600	2. International Paper (USA)	14.200
3. M-Real (Fin)	6.400	3. UPM-Kymmene (Fin)	11.700
4. SCA (Swe)	5.600	4. Georgia-Pacific (USA)	9.400
5–6. Jefferson-Smurfit (Ire)	3.800	5. Smurfit Stone Container (USA)	9.000
5–6. Norske Skog (Nor)	3.200	6. Weyerhaeuser (USA)	8.500
7. Kappa Packaging (UK)	3.200	7. Nippon Unipac (Jap)	8.200
8. Mondi Europe (UK/USA)	2.900	8. Oki Paper (Jap)	7.700
9–10. Burgo (It)	2.600	9. Abitibi	7.500
9–10. SAPPI Fine Paper Europe (SA)	2.600	10. Norske Skog	6.400

Source: Finnish Forest Industries Federation (2003)

expansion. Between 1982 and 1993, internal expansion was overwhelming, and the capital invested as a percentage of the sales was on average over 12% (Table 8.3). The number of production units with an annual capacity in excess of 50,000 ton almost tripled. Compared to the production capacity in other European countries and the scale of these production capacities, the Dutch paper and board industry was among the leading industries in Western Europe (Fig. 8.5).

The increase in production during the 1980s was quite impressive. The industry performed well during the late 1980s, with production records broken, profits growing and investments steadily increasing. These were augmented by wise income policies, falling oil prices and relatively low interest rates. Competition was again fierce, but not as aggressive as it was during the late 1960s. This was due to an

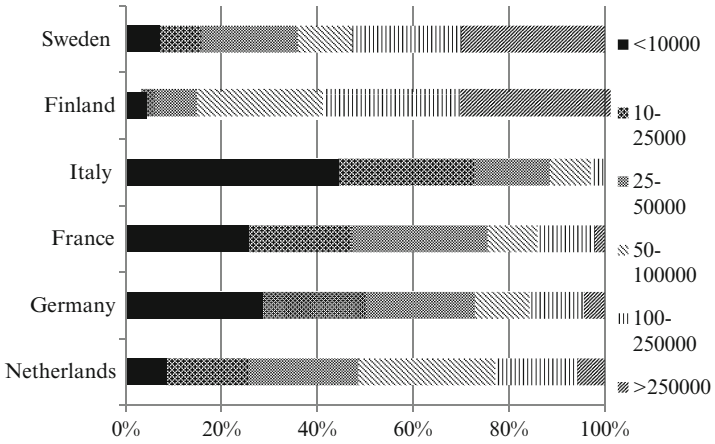

Fig. 8.5 Capacity in different size classes (tonnages, per cent share) of the paper and board industry in selected countries, 1993 (Source: VNP Annual report 1993)

international division of markets and the production of different qualities. For example, the newsprint the Dutch producer Parenco manufactured with the use of waste paper was of a totally different quality than the newsprint Scandinavian and North American firms made with the use of cellulose and wood pulp (Minutes Board of Supervisors Parenco 14 December 1988).

Especially the more sophisticated grades, such as coated paper, showed spectacular growth rates in the Netherlands. Horizontal concentration and a more concentric diversification were the strategic instruments of choice for companies seeking a strong market position. Strategies of forward and backward integration now became part of the core business, used to reach a low-cost-based position on the market. Many firms tried to increase their influence on the market by acquiring wholesalers to secure their sales. Companies that depended on the availability of waste paper incorporated firms that specialised in gathering these raw materials. Expansion and scaling up, however, were not only business opportunities. They were a sheer necessity for anyone wishing to play a role on the international paper and board markets. Even producers of speciality products that concentrated on product differentiation and operated in niche markets were forced to work within larger corporations. Not infrequently, it was consolidation that made expansion financially possible. Incorporation into a larger entity made the production of fewer grades and plant specialisation feasible. Specialisation was just another way of scaling up production capacity. Synergy with regard to purchasing raw materials and gearing investments as well as the free and mutually beneficial exchange of knowledge provided additional incentives for large-scale, incorporated operations (Bouwens 2003, pp. 304–310).

As a result of these new insights, a new merger wave occurred. This wave differed from the earlier one of the 1960s by the size, value and prominence of the mergers

and acquisition targets (see, e.g. Donker 2001; Schenk 2006). Some of the largest firms in the business were now targeted for acquisition. The merger wave of the 1980s was a wave of the mega-mergers. KNP and BT merged in 1993 and established a firm with 160 subsidiaries that employed 28,000 people in 30 countries and had a turnover of 11.9 billion Dutch guilders (5.4 billion euro).[5] Naturally, this was not the only form of expansion or risk distribution. Joint ventures and buying shares in competing or affiliated firms became most popular in these years. 'Look before you leap' seemed to be the motto. The internal expansion of the industry and the merger process never quite eliminated competition. The number of players on the markets of paper and board diminished, but overcapacity still posed a major threat. Focusing on a core business and leaving the path of diversification made existing market structures extremely vulnerable, thereby making the performance of competitors much more important. Most paper and board producers in the Netherlands kept a close watch on the behaviour and strategic considerations of their competitors. Mergers between big corporations were often prompted more by the prospect of strategic comfort and the elimination of competitors than by creating wealth for shareholders. Although the firms would never admit it, defensive imitation seemed to be very apparent (Schenk 1995; DiMaggio and Powell 1983, pp. 147–160; Bouwens 2003, pp. 52–58).

The internationalisation of the Dutch paper and board industry gained momentum during the second half of the 1980s and the early 1990s. Mayr Melnhof, Mölnycke, SCA, Scott Page Continental, Fort James and Smurfit all acquired Dutch companies, thereby consolidating their European market position, gaining access to distribution channels and securing substantial market shares. One after another, Dutch firms were sold to foreign corporations, and the control of domestic production units was diluted by foreign ownership. At the beginning of the 1990s, about 40% of the paper and board companies were no longer Dutch owned, and this development accelerated throughout the 1990s. Stora-Enso, Norske Skog, Kappa Packaging and SAPPI – all belonging to the top 10 of Europe – acquired production units in the Netherlands.

The restructured industry, with its modern and efficient production units located in the immediate vicinity of large consumer areas, was a very desirable target for acquisition in the eyes of many foreign corporations. This development was fed by the European Community decision of the late 1980s to integrate the European market from 1992 onwards. National boundaries were quickly losing significance. The foreign corporations that most often originated in countries with natural resources dominated the industry landscape, not just because of their access to cheap and high-quality raw materials or their technological edge but because they wielded capital in amounts local competitors could not hope to match. As previously mentioned, paper and board markets were very international, and with the internationalisation of the ownership structures, the significance of trade increased. Already in 1993, about

[5] The merger also included wholesaler VRG: Minutes Board of Supervisors KNP (1992–1993), KNP Annual report (1992), and KNP-BT Annual reports (1993).

75% of Dutch paper and board production was exported, and 80% of the paper and board consumed in the Netherlands came from abroad (VNP Annual report 1993).

The internationalisation of the Dutch industry accelerated during the last decade of the second millennium. Large corporations all became part of a foreign multinational organisation, and even small specialised firms were incorporated, often by global players who were relatively unknown or did not have a strong resource-based derivation. The only Dutch firm that could compete with foreign corporations was KNP-BT. After the Swedish Stora, KNP-BT was the largest producer of paper and board in Europe (VNP Annual report 1993). The pride of the Dutch industry lost its position very soon as a result of a dismantling process initiated by the shareholders and after a period of mismanagement (Bouwens 2004, pp. 314–320). In 2000, the Dutch industry included firms from Norway, Sweden, Finland, France, the United Kingdom, Austria, Ireland, Italy, South Africa and the United States. Only 4 of the 27 companies were still Dutch owned (VNP Annual report 2003). The internationalisation of national industries was a worldwide phenomenon, but the ownership structure of the Dutch industry was the most global. Concentration and consolidation were the order of the day. The number of players decreased. At the end of the 1990s, the five largest corporations that manufactured newsprint had a market share of 83%. The five largest producers of LWC even attained a percentage of 85. During the mid-1980s, this was only 30% (Gullichsen and Paulapuro 1998).

The Dutch paper and board industry went through a new process of transformation and became part of international decisions within a local context. As a national industry, paper and board became very vulnerable. After 2000, multinational corporations replaced production units, closed machines and sometimes even dismantled whole plants. The national Association of Paper and Board Producers VNP that celebrated their 100 years' anniversary in 2004 with the motto 'celebrating the future' had to admit that this future of a national industry would be arduous and complex. One of the major tasks of the association would be to promote and improve the condition for the industry to stay in the Netherlands. Developing and improving new technologies focusing on immediate and accelerated energy savings, new sources of raw material or developing new relations with supply chain partners were supposed to be among the most important instruments to convince multinational decision-makers to invest in the Netherlands (VNP Annual reports 2000–2008).

8.4 Similar Strategies

One especially noteworthy industry feature is the strategic analogy that manifested itself during the second half of the twentieth century. Companies formulated and implemented near-identical strategies to prepare for and react to changing circumstances. The fact that many firms operated on various paper and board markets or that the scale and scope of their activities diverged did not seem to be very distinctive in their strategic choices. During the 1950s and the early 1960s, internal expansion was a strategic mainstay. Then after 1965, vertical integration

and concentric diversification attained prominence. These strategies were replaced during the 1980s and 1990s by a strategy that focused on each company's core business. It is not easy to find the cause of this strategic homogeneity. The reasons for parallel strategic choices are dynamic and an accurate assessment of the true determinant is not easily made. Three determinants that affected the synchronisation of business strategies can be discerned and elucidated: economic, institutional and strategic. It should be noted that these factors do not compete with each other but can be seen as interactive and interdependent.

The significance of the economic environment is most striking. The paper and board industry is cyclically sensitive. One could even argue that the development of the industry reflected the economic climate. The capital intensity of the industry enhanced the cyclical character. One of the features that appeared frequently during the twentieth century was overcapacity. The delay between the decision to invest and the moment the new machines went into production often caused tensions in the industry. Paper and board producers were initially unable to coordinate their investments with precision because of the low degree of concentration and the high degree of geographical dispersion. Different companies tended to invest at the same time, causing a discontinuous growth of production capacity, a process showing strong similarities with the hog cycles (Bouwens 2003, pp. 35–36, 303–304; Berends 2001, pp. 11–14). The sensitivity to the business cycle is an important element in explaining the similar strategies paper and board manufacturers formulated. Companies adapted their strategies to the traits of the markets in which they were buying and selling, and these traits were dependent on the stage of the growth cycle. For example, vertical integration and diversification were phenomena of the phase of maturity, when growth was slow and increasing market shares difficult. As regards mergers and acquisitions, the number of transactions clearly increased during periods of economic prosperity and decreased in times of economic downturn.[6]

Nevertheless, economic entities – however great their influence – were not alone responsible for the odd synchronicity of strategy observed in the industry. Market dynamics alone are not enough to determine the strategic options of the firms. The paper and board industry was not a self-regulating mechanism, but a set of institutions in which governments and firms alike played a crucial role. Formal and informal business rules and agreements, as well as available technologies, greatly affected the activities of the businessmen. Legislation, codes of conduct, contracts and conventions were extremely important in that they reduced uncertainty and structured the interaction between firms. The importance of the business interest association has already been mentioned (cf. Whitley 1992, 1999; Hall and Soskice 2001; van Dijck and Groenewegen 1994). This shared environment also created what Douglas North already called isomorphism. Firms acting in the same institutional environment were more or less forced to adjust their strategies in the same or similar directions, since the number of strategic alternatives was limited (North 1990). Many examples are available. One of the most striking cases in point was the

[6] See, for example, Ravenscraft and Scherer (1987) and Schenk (1999).

mentioned policy of the Scandinavian and Finnish governments on vertical integration of the local pulp industries from the 1960s onwards. This placed immense pressure on West European producers of paper and board that were confronted with new competitors entering the markets with large-scale production units already in place. Governments influenced the competitive environment of the industry in every country by measures ranging the implementation of severe anti-pollution standards to the subsidising of cost-intensive restructuring programmes. More informal rules likewise determined strategy. Paper and board producers had several tacit agreements and unwritten codes of conduct. During the 1950s, for example, when manpower was in short supply, it was simply not done to buy up each other's employees. Unspoken laws further proscribed that tender offers were taboo, cartel agreements secret, participation in common technological projects compulsory and even ensured that consultation between employers and employees on the introduction of full continuity of the production process universal (Bouwens 2004, pp. 340–343).

Thus, particular market circumstances and the formal and informal rules of the game determined company strategies to a greater or lesser extent. Since all companies in the industry were affected by these factors, the probability was high that their strategies would be similar. A third explanation for the analogy of strategies would be the application of bandwagon theories and the concept of defensive imitation. With regard to strategies of internal expansion and concentration especially, the concept seems plausible in the extreme. Companies would follow a first mover or try to maintain their competitive viability by formulating a strategy of internal expansion or by entering into agreements with other parties. The prevention of financial and competitive decline was the primary motivating factor for managerial decisions. Uncertainty and lack of understanding with respect to technology and corporate strategy were powerful forces that encouraged imitation (Schenk 1995; Bouwens 2003, pp. 46–51).

8.5 Conclusion

Competition dictated the strategies employed by the paper and board industry after the Second World War. Strategy was likewise related to changes in the economic, institutional and competitive environment of the industry. History and path dependency played a role as well. The future of the Dutch paper and board industry that was already a topic of discussion during the 1960s did not result in the most rational conclusion. Strategies on internal and external expansion changed over time and were a product of their time. These processes might well be evaluated and re-evaluated after a few years. Reappraisals could lead to the reversal of strategy and, for example, the turnaround of mergers and acquisitions without discussion of failure. The rapid succession of corporate strategies during the second half of the twentieth century transformed the industry: a transformation in which fewer producers manufactured more paper and board on an increasingly international scene. As a result, markets became transparent, but competition and entrepreneurial uncertainty did not decrease.

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Chapter 9
Is There a Southern European Model? Development of the Pulp and Paper Industry in Italy, Spain and Portugal (1800–2010)

Miquel Gutiérrez-Poch

9.1 The Origins and the Nineteenth-Century Modernization Process

9.1.1 The Basis of a Common Technological Space

In the past, the countries analysed here, together with France, formed a relatively homogeneous papermaking space due their geographical proximity and their political history. Islamic Spain was the gateway of papermaking in the Western world and the first noteworthy paper concentration was there. With the loss of Spanish centrality, the international leaders in papermaking were first Italy and then France. The main papermaking districts in Italy were Genoa and Venice, both with a strong export orientation. Genoa had an important market in Spain. It was the development of Spanish papermaking which served to oust the Genoese during the last third of the eighteenth century. Previously, Genoese skilled workers had set up some paper mills in Spain, which increased its number of paper mills from around 200 in the mid-eighteenth century to 400 fifty years later. The growth was mainly located in Catalonia (from 69 mills in 1766 to 200 in 1792) and in the region of Valencia (the village of Alcoy had one single mill in 1755 and 38 in 1801). The reason for the development was the demand on the part of the state and that from the American colonies (especially for cigarette paper). The Portuguese

This article is part of the research project "Origins and development of the exporting industrial districts, 1765–2008: an analysis from the viewpoint of economic history," directed by Jordi Catalan (Spanish Ministry of Science and Innovation) (HAR-2009–07571).

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J.-A. Lamberg et al. (eds.), *The Evolution of Global Paper Industry 1800–2050: A Comparative Analysis*, World Forests 17, DOI 10.1007/978-94-007-5431-7_9,

development during the eighteenth century was very modest, but there was a certain expansion in the early nineteenth century (Fernándes Alves 2000, p. 157, 2001, pp. 30–34). Following the Spanish path, Genoese skilled workers set up some of the pioneering Portuguese paper mills. However, at the end of eighteenth century, the epicentre of papermaking had moved from the Western Mediterranean to the Atlantic (the Netherlands and the UK).

9.1.2 Late Mechanisation and Handmade Paper Continuity

The Southern European papermaking industry continued to decline during the nineteenth century due to delayed industrialization. Considering the close relationship between paper consumption and economic growth, Southern Europe had very low annual consumption rates per capita (in 1873, this was 1.7 kg in Italy, 0.8 kg in Spain and 1 kg in Portugal). The most developed countries had consumption rates of four or five times of these levels. The low Spanish and Italian rates were partly offset by their demographic potential, generating fairly significant markets. By contrast, Portugal had a meagre market.

The papermaking industry exemplified Southern European technological backwardness. The three countries began to use the continuous production machine, the symbol of mechanisation in papermaking, very late. In addition, the modernisation process was also very poor. Spain and Portugal first started working their first Fourdrinier machines when mechanisation was already quite mature in the United Kingdom (279 machines in 1837) and in France (148 machines in 1840). A French papermaker said, ironically, analysing the papermaking section of the Universal Exhibition of 1867: "Nous passerons sous silence l'Espagne et le Portugal. Quant à l'Italie, il y a quelques progrès à signaler, mais ces progrès se produisent très-lentement" (Payen and Vigreux 1867, p. 380). The technological dependence was extremely high in Southern Europe, with machines and skilled workers coming mainly from France (Gutiérrez-Poch 1999, 2006). In Spain, the "French connection" was virtually complete. On the contrary, the machines coming from Paris and Angoulême shared the market with the British ones in Italy and Portugal. In all three cases, the continuous factories sold their output to their domestic markets protected with high tariffs.

Italy was a relative exception to this backward pattern (Sabbatini 1997). The first Fourdrinier began to produce paper in 1827 in Borgosesia (Piedmont), but the diffusion of the new device was modest. They worked 60 machines in 1864 and 95 in 1876 (jointly with 73 round paper machines). The political fragmentation prior to unification made the first steps of the modernisation difficult. The new machines were mainly located in Northern regions (Piedmont and Lombardy had 50 machines in 1876) and in Campania (where the pioneering machine started working in 1847 and 25 machines were operational in 1876).

Spain and Portugal were among the last countries to adopt the continuous production technology. The Spanish pioneering first machine was set up in 1839 in

Manzanares el Real (Madrid) (Gutiérrez-Poch 1999). The mechanisation process was also very slow: 14 machines in 1845, 20 in 1856 and 48 in 1879. The main productive agglomerations were in the surroundings of Madrid, the Basque Country and Catalonia. The most successful were the last two. The Spanish mills mostly had only one machine and/or their owners usually had only one factory. This began to change during the 1860s in the Basque Country with the establishment of quite important papermaking groups.

The Portuguese mechanisation was even later and poorer. It began in A Abelheira (in Tojal) in 1841 (de Matos Sequeira 1935; Leitao Bandeira 1995, p. 32). There were ten machines working in Portugal in 1873. An important change was the establishing in 1875, due a merger process, of Companhia do Papel do Prado, which led the Portuguese papermaking industry for decades.

The other side of the coin was the continuity of handmade paper. In this, France could also be included, but with a strong modern papermaking industry. This "traditional" pattern confirms the technological gap between Southern Europe and most industrialised countries. The three countries analysed kept a high rate of vats per machine in 1873. It is necessary to remember that the vats are the place where the paper was made by hand, and it is a good way to approach the capacity of a hand paper mill. Italy had a rate of 0.97, Spain of 7.7 and Portugal of 2.1. The rest of Europe had a rate of around 0.5 vats per machine. In 1908, the handmade production of the total output was 1.3% in Italy, 3.1% in Spain and 6.2% in Portugal. The remaining countries, with the exception of the Netherlands, did not reach 1% (Krawany 1910, pp. 11, 199, 234). In a few cases, these handmade paper mills were not a sign of atavism. For instance, some of them were mainly producing for export markets. These firms were simply following a niche specialisation strategy.

Italy had a very important handmade paper manufacture in the early nineteenth century. This productive base decreased during the following decades as a result of mechanisation. Although handmade paper recovered somewhat in the 1870s, soon after, it began its definitive decline. They worked 847 vats in 1864, 813 in 1876 (plus 175 already closed), 687 in 1882 and 485 in 1889. Many of the closed vats were replaced by "tamburo" or "picardo" machines, which made a paper very close to handmade one. In 1896, there were 216 vats still working, and in 1912, there were 97.

The handmade capacity also fell at the beginning of the nineteenth century in Spain. The decline increased from 1840 onwards due the growing presence of continuous paper production in the market. Modern paper was supplying to, for example, the bulk of printing paper demand. There were around 280–300 mills and 400 vats in 1845. Soon after, some recovery of handmade paper began. The mills numbered 369 in 1856 with 531 vats. The recovery continued during the two following decades, with 757 vats in 1879. Their decline started in 1880. In 1900, 233 vats were still operational, whereas in 1918, there were only 108. The adoption of "picardo" machines, the Italian machine mentioned above, which began operating in 1877, partially compensated for this fall in handmade capacity.

Portugal, due to its late development and the size of the country, had only 28 papermaking factories in 1852 (including the continuous ones) (Ferreira dos Santos 1997, p. 48). The main concentration was in the Aveiro district with 15 factories,

mainly in the village of Feira with 11 of them. Companhia do Papel do Prado, the leading firm, combined its five Fourdrinier machines and two round machines with 10 vats. In Portugal in 1908, there were 49 vats still working, and in 1922, there were 22 (Krawany 1910, p. 234, 1925, p. 363).

9.1.3 From Centrality to Peripheral Condition: Raw Materials

In the mid-nineteenth century, Southern Europe enjoyed an exceptionally good position in the international papermaking raw materials market. Italy, jointly with Germany, was the central supply point of the international rag market for use in papermaking. Leghorn was the most important exporting port. British and US papermakers used Italian rags. The appearance of wood pulp and the development of the Italian papermaking industry itself contributed to the decline of these exports. Spain was also a very important point in the supply of papermaking fibres in the esparto grass cycle during the 1860s. Esparto production was concentrated in Southeast Spain and Northern Africa. However, esparto was not used in Spain for papermaking purposes because of the intensive utilisation of coal and chemicals, both very expensive there. The demand for such a scarce resource led to higher prices and the fall of exports due the greater competitiveness of Maghrebian "alfa." Finally, wood pulp caused its importance to decline.

9.2 Fighting a Losing Battle: Wood Pulp and Change of Scale (1890–1945)

The papermaking industry in both Iberian countries and Italy continued to lose their international significance during the last years of the nineteenth century and the first half of the twentieth century. The growing importance of wood pulp put the axis of the sector in areas with dense forest cover.

9.2.1 Wood Pulp: New Equilibrium

None of the three countries analysed achieved self-sufficiency in wood pulp. Only Italy had a significant pulp sector. There were 28 pulp production centres and 65 grinders in 1896 (87 grinders in 1903). Most of these factories were in the Piedmont, Lombardy and Campania. All of them were focused in mechanical pulp. The exception was a bisulphite factory opened in 1883. There were 36 factories for mechanical pulp (with 105 grinders) and three for chemical pulp in 1913 (Bureau of Foreign and Domestic Commerce 1915, p. 86). From the 1920s onwards, the production of both types of pulp grew exponentially. The origin of this development was the

autarkic project led by the Fascist government. The mechanical pulp output grew from 12,300 ton in 1921 to 23,500 in 1925 and to 144,600 in 1938. The wood came mainly from black poplar plantations. The increase of chemical pulp output was also important. One crucial market for chemical pulp was artificial textile fibres. Italy was the second largest producer in the world for this kind of fibres in the mid-1920s, and it began an impressive growth. The most important firm was SNIA, with industrial assets in Spain soon later. Chemical pulp production especially grew before the Second World War. Its total output was 65,000 ton in 1938 and 227,000 in 1940.

The Spanish wood pulp production sector operated with a limited production capacity in the late nineteenth century. The first two factories were set up in the early 1870s and were still operational in 1890. This number increased to six in 1900 (the majority in the Basque Country). All of them produced mechanical pulp with one exception which was focused in bisulphite. The public initiative boosted the cellulose production in the early twentieth century. These supports came in 1928 from the Instituto Forestal de Investigaciones y Experiencias, one of whose fields of work was searching for new plant species for cellulose production (among them the eucalyptus tree), and in 1933 with the Comisión Mixta de la Pasta de Papel. The leading role in pulp production came from La Papelera Española (LPE). The Basque firm increased its output from 3,000 ton in 1905 to 14,000 in the early 1930s. However, Spain imported around the 60% of its pulp consumption in the mid-1930s and further 15% came from imported wood.

There was only one pulp factory in Portugal in 1890, established in 1888, and with an output oriented to the foreign market. The factory in the Aveiro district was owned by the British firm The Caima Timber Estate and Wood Pulp Company Ltd. It was still the only Portuguese pulp factory in 1908. Its output in 1910 was 3,900 ton. The factory mainly used wood from maritime pine (*Pinus pinaster*), but it only managed to produce a particularly poor quality bisulphite pulp. The owners of the factory experimented with eucalyptus wood to improve quality. Interestingly, this kind of pulp was already on the market during the 1920s. There were only two pulp factories in operation in 1912. Just before the Second World War, the Portuguese output was still very low (5,823 t in 1939) and mainly for export.

Therefore, the Southern European countries depended heavily on pulp imports. The important paper output capacity of Italy and Spain in absolute terms made them significant markets for pulp-exporting countries. In 1905–1909, Italy ranked fifth among the pulp importers (3.6% the world's total amount) and Spain was the eight (2.2%) (McKenna 1912, p. 28). As a consequence, the main wood pulp producers and commission agents from Northern and Central Europe considered both countries as preferential targets. A. Wertheim & Co. from Hamburg, an important pulp commission agent, in 1899 had commercial headquarters in Spain (in the Basque Country) and Italy (in Milan). In the Spanish district of Tolosa in the Basque Country in 1930, The Northern Pulp Co., a joint project of some Scandinavian exporters, was established. The Finnish Cellulose Union established its Spanish central office in Bilbao (Basque Country) and the Italian one in Milan.

9.2.2 From Crisis to an Initial Recovery (1880–1914)

Papermaking in Southern Europe came from decline to a modest improvement of its relative weight from late the nineteenth century until the outbreak of the First World War. The growing technological complexity increased foreign dependence, although it began to appear some specialised engineering workshops in Italy and Spain. The Italian case was the most successful among the three countries. However, its growth was modest in a comparative frame. Paper production was around 70,000 ton in 1889 (40,000 from the 100 Fourdrinier machines). The machines numbered 169 in 1896 with a production of 63,280 ton. The protectionist bias of the 1887 tariff favoured the development. The machines grew up to 171 in 1903 and to 268 in 1913. Most of these machines had low productive potential. The axis of modern paper was still located in Piedmont, Lombardy and Campania. A sign of the growing maturity of the papermaking sector was the formation in 1888 of the Associazione dei fabbricatori di carta ed arti affini del Regno d'Italia, the publication of technical journals (*L´Industria della Carta*), the creation of technical research institutions (Regia Stazione Sperimentale per lo Studio della Carta in 1909) and papermaking schools.

During this period, Spanish papermaking recovered in size. The 48 machines of 1879 grew to 71 in 1890 and to 113 in 1900. The protectionist tariff of 1891 helped this development. Proof of the incipient maturity was the appearance of technical journals (*Mercado del Papel* from 1892 to 1894, *La Industria Papelera* from 1898 to 1907), papermakers' associations and a specialised engineering sector for machine building (the main workshops were in Tolosa in the Basque Country). The change during the 1890s was both quantitative and qualitative. The new machines had a greater capacity than those already working. In this context, the Spanish papermaking industry faced an overproduction crisis. The answer, after the failure of some cartel projects, was the creation in 1901, through a merger process, of the future leading firm: La Papelera Española (LPE). The new company had 28 machines, 11 factories and accounted for 37% of Spanish production. The Spanish output reached 94,743 ton in 1913 (6.2% yearly growth from 1902). Once more, a protective framework, with the 1906 tariff, boosted the growth. The process of factories failing and new ones being founded was continuous as a result of the problems. To avoid such entrepreneurial volatility, the papermaking factory owners created an association, the Federación de Fabricantes de Papel de España in 1908, and cartels such as the Central Papelera in 1914. Nevertheless, the Spanish papermaking industry was losing ground in an international frame at least until 1900. The Spanish output in 1882 was 11.5% of that in the United Kingdom and 14.3% of that of France. In 1900, these output shares fell respectively to 8.7 and 11.6%.

The Portuguese papermaking development was even poorer with only 12 machines in 1889. The leadership from the business point of view of Companhia do Papel do Prado was consolidated. Prado increased its factories from two in 1881 to five in 1890 (Fernándes Alves 2000, p. 158) and six in 1908 (with seven machines). This productive structure took advantage of the protectionist tariff of 1892.

9.2.3 *Different Patterns in the Papermaking Industry (1914–1939)*

The state intervened increasingly in the three countries during the interwar period. In Italy, this was focused by the Fascist regime; in Spain, by the Miguel Primo de Rivera dictatorship; and in Portugal, by the Salazarist Estado Novo.

The growth of the Italian paper production during the interwar period was very modest (1.8% yearly). The First World War caused the output fall in Italy. The production in 1914 was 296,700 ton. It had fallen to 270,000 ton in 1920, and it was still only 215,000 in 1921 (Ferrari 1999, pp. 106–107). The most dynamic period was the first half of the 1920s. This was a result of the protectionist frame built by the 1921 tariff. The output reached 340,000 ton in 1926. From then onwards to 1932, the output was around 310,000 ton. It increased to around 478,000 ton from 1935 to 1938. They worked 235 machines in 1910 and 260 in 1938. According to the Fascist autarkic aims, in 1935, the 'Ente Nazionale per la Cellulosa e per la Carta (ENCC) was created (Dell'Orefice 2003).

The First World War had an initial positive effect on the Spanish papermaking industry (reaching an output of 103,423 ton in 1916), but during the last 2 years of conflict, production fell to the levels of 10 years earlier (around 58,000 ton). The main reason was a shortage of raw materials. As the conflict ended, demand grew and hence output increased to 100,617 ton in 1920. The establishing in 1919 of the Sociedad Cooperativa de Fabricantes de Papel, Almacenes Generales de Papel and Sociedad Arrendataria de Talleres de Manipulación de Papel reactivated the cartelisation policy led by LPE. The leading role of the firm from Bilbao was clear. It ranked high in the Spanish industrial sector. LPE in 1917 ranked 26th among the Spanish firms (sixth among the industrial ones) (Carreras and Tafunell 1993, pp. 149, 154, 172). The normalisation of the demand caused a fall in the production to 45,521 ton in 1921. From 1922 to 1935, the production increased again, reaching 181,853 ton in 1934. Thus, Spanish papermaking improved its international position. In 1900, it produced the equivalent of 8.7% of the British output, 11.6% of the French one and 20.3% of the Italian one. These rates in 1929 were respectively of 11, 21.3 and 46.7%. The protectionist tariff and the interventionist policy of the period affected the papermaking industry. The government kept the newsprint regulation set up during the war to maintain price levels. From May 1928 onwards, the competencies of the different public institutions dealing with papermaking were gathered under the Comité Regulador de la Industria del Papel, which had the rights to "*authorize the setting up, extension, machinery changes or transfer"* of paper production.

The economic policy applied in Portugal by the Salazarist regime strengthened the oligopolistic structure led by Companhia do Papel do Prado, which in 1922 had six factories and eight machines. The total number of firms was 20 with 23 machines (Krawany 1925, pp. 258–259). The 29 factories collected by the international catalogues in 1910 grew to 48 by 1938. The output in 1928 was around 9,000 ton, 13,650 in 1933 and 23,065 in 1939. The greater part of the output was packaging and wrapping paper grades (Fernándes Alves 2000, p. 160).

9.3 Pulp Production in Southern Europe (1939/1945–2010)

Pulp and papermaking production geography have changed profoundly during the last seven decades, especially from the mid-1980s. One main characteristic of this shift has been the decline of the leading countries (United States, Canada, Japan and the Scandinavian countries) in the face of the dynamism of other areas (Southern Europe, Latin America and Asia) (Abramovitz and Mattoon 1999, pp. 15–18). The reasons and the chronology of the changes are different in each case. In Southern Europe, the improvement in the supply of papermaking fibre (both pulp and recovered paper) was crucial. Southern Europe, with the exception of Italy, had a very poor pulp industry in the mid-twentieth century. The reality was different in the early twenty-first century when Spain and Portugal gained prominence. Before the present crisis, the Iberian countries had an output of around 2 million tons and Italy produced only 500,000 ton (see Fig. 9.1).[1] Spain and Portugal ranked among the 15 biggest producers in the world. In contrast, Italy fell lower than the twentieth place. Spain and Portugal mainly produced chemical pulp (bleached sulphate), whereas in Italy, the bulk of its output is mechanical pulp – see Tables 9.1 and 9.2a,b. There are also differences dealing with markets. Iberian pulp has an important export market. The Italian producers sell most of their pulp in the domestic market. Moreover, although in absolute terms it was only incidental, Southern Europe has developed a certain capacity of pulp production from alternative vegetable fibres (sugarcane bagasse, rice straw, hemp, sisal, cotton linter).

9.3.1 Italy: A Declining Pulp Industry

The Italian pulp industry reached its highest level in 1937–1938 with around 180,000 ton (80% of mechanical pulp), mainly produced from black poplar. The production level was already higher in 1948 than in the pre-war period. At the same time, the relative weight of mechanical pulp was falling. The most of this kind of pulp was produced in Piedmont and Lombardy. The chemical pulp came from the same two regions and also from Friuli-Venezia Giulia and Emilia-Romagna.

The late 1960s and the early 1970s were a turning point. The pulp output reached its maximum level during the first half of the 1970s (around 930,000 ton) (see Fig. 9.1 and Table 9.1). From that time onwards, the production decreased. The pulp production in 2006 was at the same level as in 1961. From the early 1980s, the output of mechanical pulp declined because of the increase in semichemical pulp. Italy is practically self-sufficient in mechanical pulp and depends heavily on imports for the chemical pulp.

[1] In the comparative tables and figures, the data were taken from FAOSTAT. In the national analysis, the data were taken from national statistics.

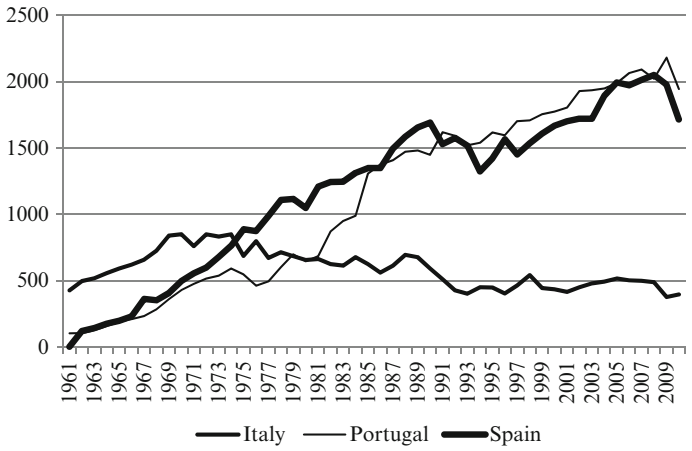

Fig. 9.1 Production of wood pulp in Italy, Spain and Portugal 1961–2010 (1,000 ton) (Source: FAOSTAT)

Table 9.1 Structure of pulp production of Italy, Spain and Portugal (1961–2010, in %)

	Mechanical			Semichemical			Chemical		
	Italy	Spain	Portugal	Italy	Spain	Portugal	Italy	Spain	Portugal
1961	68.7	53.2	4.8	17.9	–	–	13.5	46.8	95.2
1970	65.1	28.6	–	20.1	2.4	–	14.7	69.1	100.0
1980	81.4	17.2	–	14.4	3.0	–	4.3	79.8	100.0
1990	76.0	10.5	–	14.9	7.2	–	9.1	82.3	100.0
2000	63.1	6.7	–	27.6	0.7	–	9.2	92.6	100.0
2010	70.3	4.9	–	29.7	–	–	0.0	95.1	100.0

Source: FAOSTAT (not including dissolving wood pulp used for synthetic fibres, etc.)

Table 9.2a Structure of chemical pulp production of Italy, Spain and Portugal, 1961–2010 (%)

	Unbleached sulphite			Bleached sulphite		
	Italy	Spain	Portugal	Italy	Spain	Portugal
1961	–	–	12.7	–	–	14.3
1970	15.2	–	0.2	72.0	4.4	14.8
1980	0.0	–	0.2	100.0	2.6	16.3
1990	0.0	–	0.2	100.0	–	7.9
2000	50.0	–	0.0	50.0	–	5.2
2010	–	–	0.0	–	–	6.4

Source: FAOSTAT

Table 9.2b Structure of sulphite pulp production of Italy, Spain and Portugal, 1961–2010 (%)

	Unbleached sulphite			Bleached sulphite		
	Italy	Spain	Portugal	Italy	Spain	Portugal
1961	–	–	39.4	–	–	33.5
1970	9.6	44.7	16.5	3.2	50.9	68.6
1980	–	33.1	16.6	–	64.4	67.0
1990	–	20.6	22.6	–	79.4	69.2
2000	–	13.7	16.4	–	86.3	78.4
2010	–	10.6	9.6	–	89.4	84.0

Source: FAOSTAT

9.3.2 Spain: From the Franco Era to International Markets

The first Franco era improved access to fibrous raw materials other than wood (e.g. broom, straw, rice straw) and the national wood pulp production. The domestic raw materials to produce pulp covered only 25% of demand in 1933–1935. By early 1940s, this percentage had risen to 77%. Of domestic pulp production, 13% was from straw and 23 from esparto grass in 1945. These production shares in 1950 were respectively 9.5 and 24%. The use of these fibres was high until the early 1960s. The importance of recovered paper was also high due to high tariffs for pulp imports.

The rise in the first Franco era was crucial in developing the pulp industry. The aim was to increase pulp production for both papermaking and artificial fibres uses. FEFASA (Fabricación Española de Fibras Artificiales) in Miranda de Ebro (province of Burgos) and SNIACE (Sociedad Nacional de Industrias Aplicadas de the Celulosa Española) in Torrelavega (province of Santander) were established in the first half of the 1940s to provide cellulose for artificial fibre production. The first of these had German capital and the second one had Italian shareholders. The pulp output fluctuated from 22,000 and 30,000 ton during the 1940s and early 1950s (with to peaks of 37,000 ton in 1951 and 1952). Most of the capacity was for mechanical pulp produced in LPE factories. The mechanical pulp factories were mainly located in the Basque Country. The first Franco era projects became reality rather slowly. The most important initiatives came from the state (from the Instituto Nacional de Industria, INI, and its Comisión Gestora de la Celulosa created in 1951). After some delays, the idea was to set up three factories. The state established the business structure in 1956 and 1957, but new delays prevented the factories from working until the 1960s. At the same time, some private firms such as Torras Hostench, Celulosas del Nervión (created in 1951 to make sulphate pulp) and Fibras Papeleras S.A. (created in 1956) began to produce pulp. Consequently, the output grew from 29,714 ton in 1954 to 105,630 in 1959.

The definitive step forward in pulp production came during the 1960s. Output grew to 393,000 ton in 1968. The increase affected both mechanical and chemical pulp. The first grew from 67,000 ton in 1960 to 187,051 in 1966. This was mainly at LPE factories, which in 1966 produced 51% of the Spanish output (Asenjo Martínez 1967, p. 180). A very important part of the growth in chemical pulp came

from the INI factories. The first one to begin working was Celulosas de Pontevedra S.A. in 1963 (in Galicia). The project used as a reference the Portuguese factory of Caçia (Rico Boquete 1999, pp. 109–144). The second one was the Empresa Nacional de Celulosa de Huelva (Andalusia) in 1964. The third one was Empresa Nacional de Celulosa de Motril (Granada, Andalusia) with a papermaking factory from 1963, although the pulp factory only began to produce in 1967. The Motril factory managers planned to use sugarcane bagasse from the area as raw material, but this project never succeeded. The chemical pulp output exceeded the mechanical one from 1967 onwards as a result of the new factories. The First Development Plan and the Acciones Concertadas promoted by the Franco government helped the development. The three state-owned firms merged in 1968 into ENCE (Empresa Nacional de Celulosas SA). The INI invested heavily in the Huelva and Pontevedra plants. The goal was to increase bleached short-fibre pulp because until then the main part of the production had been unbleached. ENCE added in 1972–1973 to their factories a new one in Miranda de Ebro due to FEFASA takeover.

Private firms also shared this dynamism. The main examples were Torras Hostench, Celulosas de Asturias (created in 1970) and Papelera Guipuzcoana de Zicuñaga. Bleached pulp production exceeded unbleached in 1971. Production of bleached pulp was 42,888 ton and unbleached was 83,945 in 1965. They were respectively 284,538 and 54,559 ton in 1975. The positive trajectory changed to stagnation during the second half of the 1970s. The relative importance of mechanical pulp decreased from 30 to 40% to less than 5. Meanwhile, the production of bleached sulphate pulp has expanded. It exceeded 1 million tons in 1985 and from 2000 onwards has been around 1.3 million tons (total output of chemical pulp would be around 1.5 million tons). ENCE sold their factories in Motril (to Torras Hostench) and in Miranda de Ebro (to Scott). Later on, the state firm consolidated its potential with the takeover of Celulosas de Asturias S.A. (1998–1999), which was the object of an important investment. Of the Spanish pulp production, 53.5% came from ENCE factories (1,113,000 ton) in 2007. Chemical pulp production reached a peak from 2003 to 2008 with an average of around 1.9 million tons. The output in 2009 fell to 1.7 million tons, but it recovered reaching levels close to 1.9 million in 2010.

A characteristic of the Spanish pulp industry is the low level of integration with papermaking. ENCE has no paper machines. The case of Grupo Iberpapel (with Papelera Guipuzcoana de Zicuñaga) is different (with a level of self-supply close to 100%) and Torraspapel (in 2006, its level of self-supply was close to 50%). Another example is SNIACE, which produces sulphite pulp to make artificial fibres (viscose). An indication of the limited degree of integration is the marked export orientation. Spain sold 52% of its 2010 pulp production to foreign markets.

The growing need for wood caused some Spanish firms to look for foreign supplies. A pioneering example was the investment by Torras Hostench in Brazil during the 1970s. This international bias acquired real magnitude during the second half of the 1980s. The investments by Grupo Iberpapel in Argentina and Uruguay date from the late 1980s. Nowadays, Iberpapel owns 22,934 ha of forest in Latin America. ENCE began to invest in Uruguay in 1989 and set up a wood subsidiary in Latin America in the mid-1990s. ENCE expanded its forest properties in Uruguay from 2005 to 2007. The aim was to supply a projected new pulp factory with a

capacity of 1 million tons. This project finally failed, and ENCE assets in Uruguay have been sold in May 2009. In contrast, the presence of pulp multinationals in Spain has been marginal. Rottneros, a Swedish firm, purchased the Miranda del Ebro factory from Kimberly-Clark (this factory has closed down in April 2009). Another example is Smurfit which acquired Celulosas del Nervión in 1995.

The production of pulp from vegetable fibres retained some importance. The main firms are Celulosas de Levante S.A. (CELESA) and Cotton South S.L. (CELSUR). CELESA was created in 1952 to use rice straw from the Ebro delta. Nowadays, it uses fibre from sisal, abaca, flax and hemp. The preferential destination is its parent company Miquel y Costas & Miquel S.A. CELSUR was created in 1953 to use the esparto grass from the Southeast of Spain. Nowadays, it uses cotton linter imported from the Mediterranean East. These fibres are mainly used in the production of cigarette paper, filter paper, banknotes and other types of special paper grades.

9.3.3 Portugal: Similar to the Development in Spain

Portugal had only one pulp factory (Caima) at the end of the 1930s. Thus, the Portuguese papermaking industry was heavily dependent on pulp imports (Branco 2010, p. 73). The necessity of boosting this sector was first seen in 1941 with the setting up of Companhia Portuguesa de Celulosa SARL (CPC). The development of the pulp industry had a turning point with the "Lei do Fomento e da Reorganizaçao Industrial" of 1945, which focused the state participation on the "basic" industries. The pulp and newsprint industries were among these. As a result of that, the state entered as a main shareholder in CPC. The financing to develop cellulose industry came from the Marshall Plan. The CPC factory in the Aveiro district began production in July 1953 with a capacity of 39,000 ton of chemical pulp from pine wood. It also began to produce mechanical pulp in 1955. Research on using eucalyptus wood following the Australian example started in 1956. The aim was to make kraft pulp. The new product, the reason for the subsequent growth of the firm, was already on the market in 1957. A. Branco (2010) has described this development saying: "This change was a crucial step towards gaining an international market share" (Branco 2010, p. 76).

CPC purchased shares of Sociedade Industrial de Celuloses, initially created as a competitor. Finally, it began to manage it. At the same time, the number of applications to the government to set up new pulp factories grew. The state decided to regulate the new factories in 1966 (Fernándes Alves 2001, pp. 61–62). CPC also significantly increased its capacity in the late 1960s. There were also some foreign investment projects, such as one led by the Swedish Billeruds Aktiebolag in 1967. The British-owned Caima Pulp Co. expanded its capacity with a bisulphite factory in 1961. Finally, CPC stopped making mechanical pulp and newsprint in 1969.

The bulk of the Portuguese pulp industry was nationalised in 1975, after the end of the Salazarist regime. The resulting firm was Portucel-Empresa de Celulose e Papel de Portugal EP. From then onwards, it began an important change, both qualitative and quantitative. The total output of pulp was 616,000 ton in 1977. It was

all chemical pulp (43% of bleached sulphate from eucalyptus). The percentage was already 56 in 1982: a total of 909,000 ton. Production reached 1,296,000 ton in 1985 (with 68% of bleached pulp). SOPORCEL (Sociedade Portuguesa de Celulose SARL) set up its first factory in 1984, reinforcing the specialisation in bleached sulphate. Its percentage reached 74 in 2000 with the production of 1,774,000 ton. The output in 2007 was 2,092,000 ton. Portugal in 2006 was the tenth largest world producer of chemical pulp. Initially, the integration between pulp and papermaking production was low, although the situation has changed. Of the production, 70% was market oriented in 1977. This share fell to 65% in 2000 and to 55 in 2009.

The growing maturity of the Portuguese pulp industry led to the setting up of the ACEL (Associação das Empresas Produtoras de Pasta de Celulose) which was merged in 1993 into CELPA (Associação da Industria Papeleira).

9.4 Recovered Paper: Old Paper and New Hopes

Environmental concern has turned recovered paper into a strategic issue in papermaking industry (Abramovitz and Mattoon 1999, pp. 37–48), especially in the EU. Thus, the European Declaration on Paper Recovery was signed in November 2000. Its aim was to reach a recycling rate of 56%. In this context, the European Recovered Paper Council (ERPC) was created by CEPI (Confederation of European Paper Industries)[2] and ERPA (European Recovered Paper Association). The declaration was renewed in 2006 with a recycling rate to reach of 66% in 2010. The result was 69% (after a peak in 2009 of 72%). The target for 2015 is 70%.

Southern European countries, especially Spain, have succeeded in this challenge (see Table 9.3). This new prospect has contributed to reducing the significance of forest in developing an important papermaking industry. Southern Europe, especially Spain and Italy, has as a favourable factor their large papermaking market. The three countries together collected over the 20–21% of the recovered paper of the total by CEPI members during the last years.

Italy is the fourth European country in the volume of recovered paper (in 2010, they had recovered 6,318,000 ton). In the early 1970s, the Italian recycling rate was 21%, clearly below the average of the European members of OCDE (Gobbo 1974, p. 24). This tendency has continued until recent times, having recycling rate indicators below the CEPI average. Exports of recovered paper during the last decades have grown.

[2] CEPI was founded in 1992 as a result of a merger of CEPAC (Confédération Européenne de l'Industrie des pates, papiers et cartons) and EPI (European Paper Institute). CEPI is a non-profit-making organisation regrouping the European Pulp and Paper Industry. Its mission is to promote the members' business sector by taking actions in environment, energy, forestry, recycling and competitiveness. During these years, there have been some new entries (Eastern Europe countries) and some members have left (Ireland and Denmark). Now, CEPI has 19 members, most of them EU member states: Austria, Belgium, Czech Republic, Finland, France, Germany, Hungary, Italy, the Netherlands, Poland, Portugal, Romania, Slovak Republic, Slovenia, Spain, Sweden and the United Kingdom. The other two members are Norway and Switzerland.

Table 9.3 Indicators of the evolution of the use of recovered paper in Italy, Spain and Portugal

	1981	1991	2000	2010
Utilisation rate[a]				
Italy	46.5	55.3	55.4	57.8
Spain	46.8	64.8	81.3	82.4
Portugal	34.2	39.2	30.5	75.3
CEPI	–	39.1	45.4	50.7
Recycling rate[b]				
Italy	33.5	36.5	41	59.2
Spain	37.7	37.9	48.2	71.9
Portugal	37.8	40.7	44.8	63.4
CEPI	–	40.9	52.5	69.3
Europe (EU-27)	–	40.3	51.8	68.9

Source: CEPI, Historical Statistics 1991–2010 European Pulp and Paper Industry and CEPI. 1981 data from ASPAPEL, Yearbook

[a]Utilisation rate: percentage of recovered paper utilisation compared to total paper production

[b]According to the New Declaration on Paper Recycling of 2006, recycling rate is "recovered paper utilisation + net trade" compared to the total paper and board consumption. This indicator is exactly the same as the collection rate calculated until then

The Franco era policy, and the lack of a powerful pulp industry, generated an important paper recovery structure. Of the total papermaking fibre in 1950, 26% came from recovered paper. In the early 1970s, the production of pulp from recovered paper was around 700,000 ton (in 1968, was only of 397,344 ton). This structure was relatively intact during the 1980s. The collection rate (recycling rate according new CEPI conception) was round about 25% in 1971–1972, and the utilisation was 29.4%. The corresponding figures for 1981 were 37.7% and of the 46.8% (see Table 9.3). The recovered weight in 1981 was 992,500 ton. It grew to 2,116,600 ton in 1995. Due to imports, the increase in consumption of recovered paper was even higher (from 1,210,200 ton in 1981 to 2,689,500 in 1995).

The improvement during recent decades has been even more important. Recovered paper in 2007 reached 4,923,000 and 5,667,700 ton in consumption. After that, and following the general path because of the crisis, it decreased. In 2010, it was only 4,637,100 and 5,103,400 ton. Spain has increased its rate of recovered paper among the CEPI from 6.7% in 1991 to 8.5% in 2007, being 8.1% in 2010. This growth has its origin in the Acuerdo Marco para el Fomento de la Recuperación y Reciclaje de Papel signed by ASPAPEL (the Spanish papermaking employers' association), the Spanish Environment Ministry and the Asociación Española de Recuperadores de Papel y Cartón (REPACAR) in April 1994. As a result, selective trash collection become more common and the recycling rate improved from 41.1% in 1995 to 59 in 2006, 69% in 2008 and 71.9 in 2010. The aim was to reach the average level of the CEPI members (69.3% in 2010) (see Table 9.3). In recent years, Spain still imported between 9 and 14% of the consumption of recovered paper. The utilisation rate grew from 64.8% in 1991 to 82.4 in 2010 (after a peak of 85% in 2006), being one of the highest rates in Europe. Some large factories using recovered paper as a main fibre source have thereafter appeared. Some of them made corrugated case materials such as SAICA and EUROPAC,

meanwhile Papelera Peninsular uses it to make newsprint from 1992 (increased through a new factory in 1998).

Portugal plays a very important role in Southern Europe's recovered paper market. Recovery increased notably during the 1980s and the 1990s. According to CEPI data, in recent years, it has doubled (from 392,000 ton in 1998 to 823,000 ton in 2009 and to 706,000 in 2010). However, its relative use has been decreased due the impressive growth of paper production with virgin fibre and the growing exports of recovered paper. This way, Portugal has become one of the most important origins of Spanish imports of this kind of fibre. It was the second largest foreign supplier of recovered paper after France in 2007 with a share of 27%. This position is a result of investment in Portugal by Spanish firms such as SAICA and EUROPAC. Nevertheless, its recycling rate has important room for improvement because it is below the CEPI and EU average.

9.5 The Basis of Development in Papermaking (1945–1986)

The basis of the current productive reality in Southern Europe was settled from the Second World War to the mid-1980s. In those years, the traditional productive structure reached its zenith, and soon later, it began to decline. In the first phase (from 1939/1945 to 1960), the less dynamic papermaking industry was the Spanish one (see Fig. 9.2).[3] From 1946 to 1961, the paper production in Spain grew 5.7%, 13.9 in Italy and 7.4 in Portugal. In the second phase, from 1961 to 1986, the growth was spectacular. The Italian production increased yearly by 7.3%, the Spanish 15 and the Portuguese 11. As a result of that, the relative weight of the three countries in the world's production grew from a modest 2.9% of 1961 (2.2% for Italy, 0.5% for Spain and 0.2% for Portugal) to 4.2 in 1986 (2.3, 1.6, and 0.3%, respectively). From the European point of view, the three countries jointly grew from 8.8% in 1961 (6.7% for Italy, 1.6% for Spain and 0.5% for Portugal) to 12.5 in 1986 (6.9, 4.7, and 0.9%, respectively).

Southern Europe had an important incentive for its papermaking development: the growth of the domestic market. In the first place, the market increased its size, especially during the 1960s and the early 1970s, due the demographic growth. Italy grew from 47,104,000 million inhabitants in 1950 to 56,598,660 in 1986. The population of Spain increased from 28,008,750 million to 38,641,260. The second reason for the growth was the consumption per capita. From 1945 to 1961, the improvement was relatively low in the Iberian countries and slightly more dynamic in Italy. Spain and Portugal increased their rates from 6 kg per capita in 1950 to 13 in 1961. Italy increased from 11 to 36 kg. In any case, the three countries were far away from the paper consumption of Germany (87.8 kg), France (64 kg) and United Kingdom (99.8 kg). The Iberian countries improved from 1961 onwards. Spain reached 87 kg

[3] The Portuguese data for 2010 from FAOSTAT are slightly different those from CEPI and CELPA. FAOSTAT quantifies the paper production in 1,456,000 t. CEPI has quantified it at 2,018,000 ton and CELPA at 2,035,900 ton. For comparative purposes, all the data of this graph came from FAOSTAT.

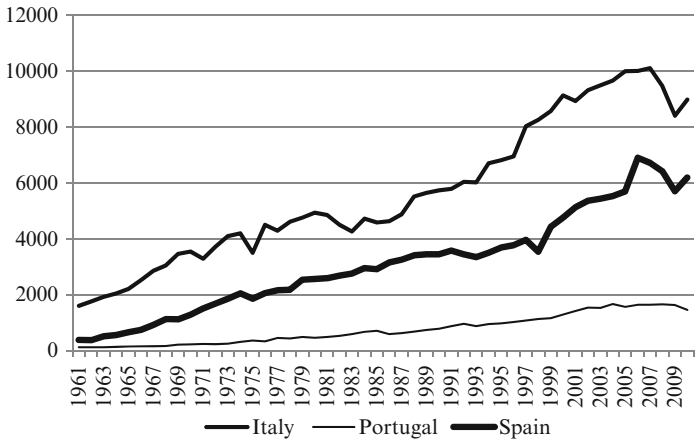

Fig. 9.2 Production of paper in Italy, Spain and Portugal 1961–2010 (1,000 ton) (Source: FAOSTAT)

per capita in 1986 and Portugal 57. Italy followed above them with 95 kg. However, they were still below the levels of developed European countries. The EEC had an average of 124 kg (including Spain and Portugal) and 131 kg (excluding Iberian countries). Among the countries with a higher consumption per capita were Germany (185 kg), France (126 kg) and Finland and Sweden (above 200 kg). Only Greece (with 60.1 kg) and Ireland (75.1 kg) consumed less paper per capita than Italy and Spain. The Portuguese consumption was the lowest among the EEC countries. These increases reflect the high income elasticity of paper consumption, and therefore, the economic advances of the countries analysed. The economic development boosted wrapping paper consumption, while improvement in literacy and schooling did likewise with writing and printing paper.

Exports also grew during this period. In Spain, they were in 1961 less of 0.5% of the production; in Portugal, the 7; and in Italy, the 2.3. The respective percentages in 1986 have amounted to 14, 35 and 18%. It was simply the announcement of the future internationalisation.

Relating to paper grades produced, Southern European countries, with the exception of Italy, have been characterised by the low production of printing and writing paper. This was especially marked in the newsprint case. The bulk of the production was focused on other kinds of paper and board (see Table 9.4).

Italy exceeded the pre-war production levels in 1950 (in 1935 and 1938, it made 478,000 ton and 538,000 in 1950). Since then onwards, a rapid growth began which led to 1 million ton in 1957 (Ferrari 1999, p. 157) and 1,599,600 in 1961. It was the prelude of the 1960s dynamism when the output doubled (in 1970, it was 3.5 million tons). From the mid-1970s onwards, the production did not increase from the levels reached in 1975 (4.5 million tons).

The abundance of small and very small factories characterised the Italian productive structure. Italy had 350 firms and 450 factories in 1950. The most important part of the production growth of the 1950s and early 1960s was due to the setting up

Table 9.4 Structure of the papermaking production of Italy, Spain and Portugal, 1961–1986 (%)

	1961	1970	1975	1980	1986
Newsprint					
Italy	18.3	8.8	7	5.6	4.6
Spain	21.1	12.5	5.6	4.2	4.4
Portugal	16.3	0.3	–	–	–
Printing and writing					
Italy	25.3	32.9	30.1	36.5	42.6
Spain	34.2	25.2	28.1	27.9	24.8
Portugal	15.8	19.7	15.1	18.8	20.2
Others					
Italy	56.4	58.4	62.9	57.9	52.8
Spain	44.7	65.8	66.3	67.8	70.8
Portugal	68	80	84.6	81.2	79.8

Source: FAOSTAT

of more factories. In 1961, there were already 506 mills, 640 in 1964 (Vlora 1964, p. 27) and 665 in 1966 (536 with an output lower than 5,000 ton) (Gobbo 1974, p. 54). The model of small factory was mainly located in Tuscany (the province of Lucca alone had 115 factories in 1964). From then onwards, there began a rationalisation process. In 1971, there were 589 factories and only 230 in 1986 (65 had a capacity under 5,000 ton) (Ferrari 1999, pp. 169–170).

The production of graphic paper was declining, while that of wrapping paper and board increased (46.3% in 1951, whereas by 1973, it had increased to 53.1%). However, from the mid-1980s, the trajectory reversed and the production of graphic paper increased (but not newsprint). It was 40% in 1986.

The maturity of the industry and the compromise with the technological change were manifested by the setting up in 1967 of ATICELCA (Associazione Tecnica Italiana per the Cellulosa e la Carta), restructuring of the Italian TAPPI (Technical Association of the Pulp and Paper Industry) branch (founded in 1958).

The Spanish papermaking industry, due its dependence on imported raw materials, suffered especially from the consequences of the policy of the first Franco era governments. According with the economic stagnation, the pre-civil war levels of production, around 170,000–180,000 ton, were not recovered until early 1950s. The average annual production from 1940 to 1950 was 140,000 ton (with a yearly increase of 3.9%). From 1950, the production was around 180,000 ton but did not take off until 1951 (with 225,244 ton). From 1951 to 1961, the output grew by 7.5% yearly.

The papermaking sector was included in the First Development Plan among the industrial sectors in need of an urgent reform. It was also characterised as subject of "Acción Concertada" to solve the backwardness, to concentrate the fragmented productive structure and to renew the machinery. The Spanish factories were also affected by the liberalisation of the 1963 tariff, which was completely applied from 1965 onwards (Esteve Rey 1971, pp. 6–17; Asenjo Martínez 1967, pp. 117–121). The main victims were the graphic paper producers (especially newsprint). The increase in production during the 1960s was impressive. It went from 381,300 ton

in 1961 to 1,280,900 in 1970 (a yearly growth of 10%). During the 1970s and the first half of the 1980s, growth slowed down to 5%. Spain ranked 25th position among the world's paper producers in 1961, but it rose to 13th in 1986.

The productive structure of the Spanish papermaking sector began the 1960s extremely fragmented. Pulp and paper factories numbered 261 in 1959 and employed 20,947 workers. A total number of 198 plants had less than 100 workers (Menal Gabas 1961, p. 33). In 1962, there were 260 factories with 166 employing less than 100 workers and 213 producing less than 1,000 ton per annum (Bielza de Ory 1973, p. 672). This even grew to 298 factories in 1965. The closing down process began during the second half of the 1960s. There were 245 factories in 1977, 231 in 1979 and 180 in 1986 (with 19,700 workers).

Paper grades other than graphic ones drove the growth. In 1981, 34.7% of the production was focused on wrapping materials, 7.9 on paper for bags and 10.8 on board. Spain was practically self-sufficient in corrugated packaging materials. At the same time, the production of printing and writing paper increased in absolute terms (this was not the case for newsprint). In 1981, the total of printing and writing paper was covered by the national production, while the domestic production percentage in newsprint was only 52%. These indicators had not changed much by 1986.

From the point of view of location, the predominance of the Basque Country, Catalonia and Valencia was clear. In 1966, they concentrated respectively 33.5, 22.4 and 12.4% of the Spanish production. As a result of the development of other regions, such as Aragon, they went respectively to 27.7, 23.8 and 9.8% in 1971.

During this modernisation process, Instituto Papelero Español (IPE) (Asociación de Investigación de la Industria Papelera) was founded in 1963. IPE focused on economic and technical research related to the paper industry. The new research institute began to publish a technical Journal (*Investigación y Técnica del Papel*). The growing need for skilled workers was met with the setting up in 1965 of the Escuela Sindical Nacional de Técnicos Papeleros of Tolosa. Also, the Escuela Técnica Superior de Ingenieros Industriales de Terrassa began to cover the need for papermaking engineers. From the point of view of the employers' association, and included in the Franquist structure, the Sindicato Nacional del Papel, Prensa y Artes Gráficas was founded in 1941 and reformed in 1964 as Sindicato Nacional del Papel y Artes Gráficas. After the dismantling of the trade union of the Franco period (which included employers) in 1977, ASPAPEL (Asociación Española de Fabricantes de Pasta, Papel) was created.

The paper production in Portugal increased during the Second World War (from 23,065 ton in 1939 to 33,537 in 1945). It was remained unchanged until 1953 at around 40,000 ton. From then onwards, it grew 13% annually on average from 1952 to 1961 and 11% from 1961 to 1986. The change was parallel to specialisation in pulp, although papermaking in the early 1970s was poorly integrated with pulp production (Fernándes Alves 2001, p. 64). From that time onwards, the degree of integration increased. The production was focused on wrapping paper, board and thin cardboard (in 1950, 64.7% of the production; in 1961, 59.8%; and 75% in 1980). Therefore, graphic paper had a minority role, but it began to grow (it was around 20–25% of total production during second half of the 1980s). By contrast, newsprint had disappeared from the Portuguese production.

The productive structure was very fragmented. There were 75 factories in 1945 (65 with less than 100 workers and 54 with less than 21). This characteristic did not change, even though the total number of factories increased. There were 112 factories in 1961 (101 with less than 100 workers and 75 with less than 21). They had very poor and old technological solutions. During the 1970s, a modest rationalisation began that reduced the number of factories to 90 by 1973 (74 with less than 100 workers). They still were 77 in 1986. The most important papermaking focus was in Aveiro district (40 out of 75 factories in 1945, 65 out of 112 in 1961).

As a result of the development of the papermaking sector, FAPEL (Associação Portuguesa de Fabricantes de Papel e cartão) was set up. Another sign of the maturity of the industry was the creation in 1980 of TECNICELPA Associação Portuguesa dos Técnicos das Indústrias de Celulose e Papel, following the Spanish IPE model.

9.6 The Papermaking Industry in Southern Europe and Its International Success (1986–2010)

As during the previous period, Southern Europe increased its relative importance during the preceding 25 years, although slowly due to Asian dynamism. Likewise, it went from 4.2% of the world's production (1986) to 4.8 in 2007 (2.6% for Italy, 1.8% for Spain and 0.4% for Portugal). The crisis caused the South European share to fall to 4.2% in 2009 and 2010. On a European scale, their weight increased from 12.5% in 1986 to 16 in 2007 (8.8% for Italy, 5.8% for Spain and 1.4% for Portugal). In this European frame, too, their shares fell to 15.7% in 2009 and to 15.4 in 2010.

During this phase, the growth of the domestic market becomes more dependent on the increasing per capita consumption and less on population growth. The levels of per capita consumption for 1986 were 95 kg in Italy, 87 in Spain and 57 in Portugal. In 2006, they were respectively 201, 176 and 106 kg. The present crisis has had a clear impact. They had a per capita consumption in 2010 respectively of 177, 140.2 and 104.7 kg. Thus, there was still some room for improvement compared with more developed countries. A second incentive was the growing export orientation, especially for Spanish and Portuguese paper from the entry into the EEC in 1986 onwards. Italy in 1986 exported 17.7% of its production, Spain 13.9 and Portugal 34.7. The exports were respectively 34.7, 40.8 and 80.6% in 2007. Italian exports increased to 39.9%, the Spanish ones to 49.5 and the Portuguese to 92.8 in 2010. The other side of the coin was that imports grew faster than total consumption. In 1986, of the total consumption, 30% was imported in Italy, 25 in Portugal and 20 in Spain. These import shares in 2006 were in each case 44, 67 and 52%, and in 2010, they were respectively 49.4, 77.2 and 51.4%.

The growth of both exports and imports is linked to the increase of the specialisation in the productive structures of Southern Europe. Spain and Italy focus their production on grades different than graphic paper (with a strong presence of corrugated case materials). By contrast, Portugal, from the 1990s onwards, focused its growth on graphic paper (see Tables 9.5, 9.6, and 9.7). The Spanish and Italian

Table 9.5 Structure of papermaking production of Italy, Spain and Portugal 1986–2010 (%)

	1986	1990	1995	2000	2007	2010
Newsprint						
Italy	4.6	4.1	2.7	1.9	2	2
Spain	4.4	5	4	6	5.8	5.1
Portugal	–	–	–	–	–	–
Printing and writing paper						
Italy	42.6	39.2	38.1	31.6	32.2	31.7
Spain	24.8	24.1	23.3	21.4	24.3	21.3
Portugal	20.2	21.4	44.8	54.3	63.6	64.1
Other paper and board						
Italy	52.8	56.7	59.2	66.5	65.8	66.3
Spain	70.8	70.8	72.7	72.6	69.9	73.7
Portugal	79.8	78.6	55.2	45.7	36.4	35.9

Source: FAOSTAT

production of graphic paper was below the EU and CEPI average. The Portuguese one was above. On the contrary, in the grades of paper related to wrapping and corrugated board, the production of Italy and Spain was clearly above the EU and CEPI averages, and the Portuguese one was below them (see Tables 9.6 and 9.7).

The number of factories in Southern Europe has gone down. The three countries had altogether 499 factories in 1991 (including both pulp and paper factories) which is 31% of the total number of 1,601 in CEPI countries. The numbers have declined to 268 of the total of 998 which is still 29.6%. The Southern countries still had the most of the smaller factories of Europe. In terms of papermaking mills, the three countries still had 44% of the mills with a volume of less than 10,000 ton and only 21% of the mills with a volume more than 100,000 ton in 2010 in the CEPI area (see Table 9.8). Thus, they have a more fragmented production structure than other European countries because of their productive specialisation.

The Italian production has doubled during the last 25 years. Stagnation characterised the 1980s. Certain dynamism was recovered during the 1990s, pushing the production up to slightly more than 10 million tons in 2007, but it dropped to around 8.5–9 million tons the following years. In 2010, Italy was the world's 11th paper producer (and the fourth in Europe after Germany, Finland and Sweden).

At the same time, it changed its productive structure. The Italian factories went from 230 in 1986 to 207 in 1998, to 186 in 2007 and to 169 in 2010. This rationalisation process was less intensive than in other countries. For example, the factories producing less than 5,000 ton were not affected by the closure wave (32 factories in 1998 and 31 in 2009). The process has been focused on medium-sized factories. Employment diminished from 27,900 workers to 22,800. The areas where production is concentrated are Lombardy, Piedmont and Tuscany.

The structure of the production has changed. The specialisation among graphic papers has been intensified in coated paper. Sanitary and household paper production has been especially dynamic (see Tables 9.6 and 9.7). In fact, Italy was the main

Table 9.6 Structure of the production of paper in 2003 (1,000 ton)

	European Union (15)		CEPI		Italy		Spain		Portugal	
	Total	%	Total	%	Total	%	Total	%	Total	%
Total graphic	42,333	48.8	46,529	49.0	3,102	33.1	1,491	27.4	957	62.9
Newsprint	9,332	10.8	10,772	11.3	182	1.9	306	5.6	–	–
Uncoated mechanical	5,550	6.4	6,406	6.7	157	1.7	–	–	–	–
Coated mechanical	9,166	10.6	9,416	9.9	1,148	12.2	–	–	–	–
Uncoated wood free	9,114	10.5	10,402	10.9	545	5.8	628	11.5	957	62.9
Coated wood free	9,171	10.6	9,533	10.0	1,070	11.4	557	10.2	–	–
Sanitary and household	5,407	6.2	5,958	6.3	1,338	14.3	494	9.1	68	4.5
Total packaging	35,019	40.4	38,357	40.4	4,407	47.0	2,958	54.4	486	32.0
Cor. case materials	20,195	23.3	22,494	23.7	2,680	28.6	2,333	42.9	353	23.2
Cartonboard[a]	11,603	13.4	12,118	12.8	1,332	14.2	455	8.4	77	5.1
Wrappings	3,221	3.7	3,745	3.9	395	4.2	170	3.1	56	3.7
Others	3,724	4.3	4,162	4.4	525	5.6	495	9.1	10	0.7
Total	86,783	–	95,006	–	9,372	–	5,438	–	1,521	–

Source: CEPI Annual Statistics 2003
Note: The percentage is over the total production
[a]Other paper and Board for Packaging

Table 9.7 Structure of the production of paper in 2010 (1,000 ton)

	European Union (15)		CEPI		Italy		Spain		Portugal	
	Total	%	Total	%	Total	%	Total	%	Total	%
Total graphic	39,783	45.6	44,080	45.7	3,034	33.8	1,632	26.4	1,461	72.4
Newsprint	5,845	6.7	9,787	10.1	181	2.0	315	5.1	–	–
Uncoated mechanical	6,724	7.7	6,495	6.7	98	1.1	323	5.2	–	–
Coated mechanical	–	–	8,918	9.2	1,149	12.8	–	–	–	–
Uncoated woodfree	7,275	8.3	9,903	10.3	454	5.1	446	7.2	1,461	72.4
Coated woodfree	17,075[a]	19.6	8,977	9.3	1,151	12.8	549	8.9	–	–
Sanitary and household	5,889	6.7	6,724	7.0	1,287	14.3	713	11.5	89	4.4
Total packaging	37,559	43.0	41,466	43.0	4,265	47.5	3,234	52.2	466	23.1
Cor. case materials	21,840	25.0	24,926	25.8	2,342	26.1	2,774	44.8	394	19.5
Cartonboard[b]	8,494	9.7	4,139	4.3	1,476	16.4	379	6.1	61	3.0
Wrappings	3,535	4.0	12,400	12.8	446	5.0	81	1.3	11	0.5
Others papers	4,083	4.7	4,259	4.4	403	4.5	614	9.9	2	0.1
Total	87,314	–	96,529	–	8,988	–	6,193	–	2,018	–

Source: CEPI Annual Statistics 2010 and Eurostat (for European Union data). The national data from CEPI have been completed and corrected with Eurostat data

Note: The percentage is over the total production

[a]Includes total coated paper

[b]Includes other paper and Board for Packaging

Table 9.8 Number of papermaking mills in different size classes 2010

	CEPI		Italy		Spain		Portugal	
	Total	%	Total	%	Total	%	Total	%
–10,000 ton/year	198	24	57	33.7	21	28.4	9	36
10,001–25,000	120	14.5	36	21.3	8	10.8	8	32
25,5001–50,000	129	15.6	24	14.2	14	18.9	2	8
50,001–100,000	127	15.4	20	11.8	13	17.6	3	12
100,001–200,000	90	10.9	23	13.6	13	17.6	–	–
200,001–300,000	60	7.3	6	3.6	2	2.7	–	–
+300,000	101	12.2	3	1.8	3	4.1	3	12
Total	825	–	169	–	74	–	25	–

Source: CEPI Annual Statistics (2010)

European producer of this kind of paper from the mid-1990s until recently. The German output has been slightly greater than that of Italy since 2008.

The Spanish papermaking output doubled from 1986 to 2007 (a yearly increase of 3.7%), despite stagnation from 1989 to 1994. The production in 2007 reached 6,714,000 ton. After that, as a consequence of the crisis, the production fell to 6,414,300 ton in 2008 and dropped to 5,679,200 in 2009. The output had a modest improvement in 2010 reaching 6,193,400 ton. In 2007, Spain kept its place as the world's 13th paper producer but in 2009 and 2010 dropped to the 15th place. During this period, the closing down of factories increased. There were 180 paper factories in 1986 and only 79 in 2010. This rationalisation process accelerated in recent years: in 1995, there were 130 factories, in 2003 still 139 factories and in 2007 only 99. The process focused on the very small factories. The number of paper mills producing less than 10,000 ton per annum fell from 99 to 21 from 1986 to 2010. The other side of the coin has been the growing number of large factories. Mills producing more than 100,000 ton per annum increased from two in 1986 to 18 in 2010 (there were 20 in 2007). The result has been a significant improvement in productivity.

The Spanish papermaking industry changed profoundly from the point of view of regional location. In 1990, production took place mostly in the Catalan (29.7%) and Basque (20.3%) areas. Valencia region contributed only 6% and Aragon 14.9. In 2007, production has shifted to Aragon (27%), while production in Catalonia (with a 23%) and the Basque Country (13%) had shrunk. The average production of the Catalan factories was 37,660 ton per annum and of those from Aragon 226,574. Of the total number of 99 working in 2007, 41 factories were located in Catalonia.

The most dynamic types of paper were corrugated case materials and hygienic and household paper (see Tables 9.6 and 9.7). The first one went in 1986 from 36.5 to 44.8% in 2010. The second rose from 6.4% to 11.5. Meanwhile, the graphic paper lost its relative weight (around 25–30%). The most important graphic grade is coated wood free (it had been around 35% of the graphic paper for 20 years), jointly with the uncoated wood free (27.3% of the graphic paper in 2010). Newsprint improved its relative weight because of the setting up in 1998 of the new factory Papelera Peninsular. Now, newsprint is only 5% of the total output.

Since 1986 Portugal has tripled its production, in 2004, it produced more than 1.6 million tons. Since then, production has stagnated. However, in 2010, the output was slightly over 2 million tons. This happened at the same time as a radical modernisation of the production structure. According to CELPA, 95 firms produced paper in 1982 (with 7,200 employees). By 2000, the firms were reduced to 57, with 60 factories (51 with a production of less than 10,000 ton) and 3,980 employees. By 2005, they had diminished to 39 firms and 40 factories with a total number of 3,581 employees. The total number of workers in 2009 was 3,241.

The growth of production during the last two decades has been focused on graphic paper (UWF: uncoated wood free). This was 24.7% of the total output in 1986, reaching 72.4% in 2010 – see Table 9.7. This change emerged during the 1990s and has intensified from 2000 onwards. Especially important has been the production of paper for office and photocopy use. At the same time, the integration between pulp and papermaking industries has increased. The integration at the moment is around 50%. The second specialisation has been corrugated case materials (18%). The Portuguese production has a heavy export orientation (in 2009, 87% of the total was exported and 96% of graphic paper). Its most important market is the EU. Spain accounts for 17% of sales, while the domestic market accounts for 18%.

In Portugal, the progressive maturity of the sector explained the setting up in 1993 of CELPA (Associação da Industria Papeleira) as a result of the merger of ACEL (Associação das Empresas Produtoras de Pasta de Celulose) and FAPEL (Associação Portuguesa de Fabricantes de Papel e cartão).

9.7 Changes in the Business Structure

The changes analysed above have had consequences for the business structure. The point of departure was the dominance of the SMEs with family ownership and with the domestic market as their main target. Nowadays, big corporations with a growing international orientation have gained centrality. This process has two main effects: the birth of big firms with a commercial and productive presence in foreign markets and the entry of multinationals. Both forces are part of the strong merger policy arising from the 1980s onwards (Zavatta 1993, p. 108; Pesendorfer 2003).

During the last two decades, large international players have appeared in Spain and Portugal. Italy has had these even earlier. The firms from the three countries have gained a place in the rankings of the sector led by USA, Scandinavian and Japanese firms. *Pulp & Paper International* in 2010 noted the presence of six firms from the countries analysed in "The Top 100," including converting. These firms are Burgo Group (33th), Portucel Soporcel (49th), Fedrigoni (74th), ENCE (85th), EUROPAC (92th), Reno de Medici (95th) and Altri (98th). They would be eight if they had included Lecta and SAICA. The first one, with headquarters in Luxembourg, has the bulk of its assets in Italy and in Spain (and France, too) ranked 38th. SAICA does not appear in the ranking because *Pulp & Paper International* had no data of it. In terms of their productive specialisations, these firms are real leaders. These

"hiding champions" have made Southern Europe their main field of action. The Spanish firms have invested heavily in Portugal (and France). The Italian firms have Spain among their strategic targets.

During the 1960s, big papermaking multinational groups began to enter Southern Europe. This process was accelerated during the last two decades of the twentieth century. Big corporations from USA, and Central and Northern Europe have paid preferential attention to Italy and Spain because of their market size.

The Italian business structure was very fragmented. The business network in 1950 consisted of 304 firms and of 292 in 1974. During the 1970s and 1980s, some firms disappeared that had dominated the sector (Cartiere di Verona, Cartiere A. Binda, etc.). The total number of firms diminished to 164 in 2000. The leading groups, such as Burgo Group S.p.A, Gruppo Fedrigoni and Reno de Medici, consolidated their positions. There were 139 firms in 2009. Thus, Italy is still an example of a dense system of SMEs.

The leading firm in 1950 was Burgo Società Anonima with a capacity of 153,400 ton. It reached 398,000 ton in 1974. Its share of total production was 16% in 1960 and 12 in 1972 (Gobbo 1974, p. 73). It merged with Cartiere Marchi S.p.A in 2004. The process was completed in 2007 with the birth of Burgo Group S.p.A with a production in 2007 of 2,866,000 ton in its thirteen factories. During the last 20 years, Burgo has become a real global player in international market. In 1994, Burgo acquired a Belgian papermaking and pulp factory (Burgo Ardennes). This factory was previously owned by the Spanish firm Torras. Burgo Group is the third European producer of coated mechanical paper and the sixth of coated wood-free paper. Nowadays, it is the most important papermaking group in Southern Europe and the fourth in the European Union. Likewise, it is the leading newsprint firm in Italy, using recovered paper as its main raw material.

The Gruppo Fedrigoni, dating back to 1888, has focused its expansion in special printing paper, editorial, stationery and paper for luxurious boxes. The international expansion, where Spain was a central point of interest, began in 1987. Its other specialities include security paper as a result of the takeover in 2001 of Miliani Fabriano from the Istituto Poligrafico e Zecca dello Stato. The productive merger of Fedrigoni Cartiere and Fabriano in Fedrigoni S.p.A was announced at the end of 2010. Fedrigoni also has a division for self-adhesive papers. This branch opened a factory in Brazil in late 2009.

Reno de Medici (RDM), firm created in 1967, specialises in cartonboard production. RDM began an international expansion in the mid-1980s. RDM merged in 1997 with SAFFA. The result was one of the biggest European board producers. Spain was also strategic in this policy because Sarrió, a Spanish firm, was a part of SAFFA assets. At that time, RMD owned two board factories in Spain. RDM merged in March 2008 with the European recycled cartonboard division of the Canadian Cascades Inc. The firms created a joint venture (Careo) for the sale of all kinds of board both from virgin and recycled fibres. RDM currently owns eight factories (five in Italy, one in Spain, one in France and one in Germany).

Besides these big corporations, there are some family businesses, linked mainly with tissue paper in the Lucca district in Tuscany. They have made important

international expansions since the early 1990s. The best examples are Kartogroup, CartoInvest, Industrie Cartarie Tronchetti, Cartiera Lucchese, Sofidel, Grupo Lucart and Cartiera Carma. This district produces 70% of the Italian tissue output, representing 20% of the total European output. Spain has been a preferential target in their investments (Kartogroup, CartoInvest, Industrie Cartarie Tronchetti and Sofidel). Lately, Eastern Europe has become a preferred target (Industrie Cartiere Tronchetti owns a mill in Poland). Lucca has also become a dominant centre of tissue converting machinery with 25 engineering workshops specialised in papermaking machinery.

The presence of multinationals in Italy began in the mid-1960s with Ahlström (Finland) and International Paper (United States), among others. This tendency has been intensified during the last years. James River acquired assets in sanitary paper in 1990 (now they are part of Georgia Pacific), and Svenska Cellulosa Aktiebolaget SCA purchased CartoInvest in 2002, also specialised in tissue paper and with important assets in Spain. The last case is especially interesting because the former owners of CartoInvest kept the property of Cartiera Carma, and this Tuscan firm has taken over in 2009 some assets owned by SCA.

The change in the Spanish business structure was radical during the second half of the twentieth century. It was extremely fragmented in 1950. Until the mid-1960s, there were around 280–290 factories in operation. The closure was extremely intensive during the industrial crisis of the 1970s and early 1980s. Papermaking firms numbered 193 in 1981, but this fell to 110 in 1995. The rationalisation process followed during the following years. Paper factories in 2005 numbered 116 and 83 in 2009. The pulp mills numbered 25 in 1991 and 12 in 2009. ASPAPEL, the Spanish employers' association, had 80 members in 1990 and only 58 in 2009. The present business structure has become increasingly innovative. One of the most important challenges has been energy efficiency. The most important papermaking firms (e.g. ENCE, SAICA, EUROPAC) are among the main producers in cogeneration (combined heat and power CHP) in Spain.

The leading firms have changed. Until the 1950s, La Papelera Española (LPE) was at the top, although declining (in 1950, it produced 34.1% of the total paper output and 22% in 1966). LPE ranked 75th in 1948 among the big Spanish firms (29th among the industrial ones). It had fallen to 96th place in 1960. In 1974, ENCE was 75th and LPE 107th (Carreras and Tafunell 1993, pp. 159, 164, 172). In 1989, one of the last years of its productive life, it only accounted for 8.5% of Spanish paper production. Its output was mainly focused on newsprint (in 1989, it produced 75% of the total output and 33% of the total consumption). LPE suspended payments in 1992 and declared bankruptcy in 1994. Some of their factories continued to operate with other owners: PAPRESA (newsprint), the pulp and the paper factory of Aranguren (split into two different firms) and the board and carton board mill of El Prat de Llobregat (Barcelona) (previously transferred to the Italian SAFFA and closed some years later).

LPE symbolises the crisis of the Basque papermaking industry from the second half of the 1980s. Its "paper" landscape underwent a profound change full of closing down mills and diverse problems. Recently, an answer to this problem has been

sought through a merger movement. Examples of this are Paperalia (the result of the merger in 2004 of Echezarreta and La Salvadora) and Galgo Paper (merger in 2005 of Papelera Tolosana and Papelera del Leizarán). Both mergers failed, and the firms have ceased to operate, the first one in 2006 and the second one in 2007.

Papeleras Reunidas S.A. symbolises a regional decline in Valencia. This company was created in 1934 and ranked second in Spain in some periods among papermaking firms. But during the crisis of the 1970s and early 1980s, it was affected by the obsolescence of their technology. Its relaunch, under the name of Papelera Alcoyana S.A., failed in early 1990s. The firm finally closed down its factories.

The dominance of LPE was challenged from the 1970s by ENCE, Torras Hostench and Sarrió Cía. Papelera de Leiza. More recently, SAICA and EUROPAC have grown in importance.

Torras Hostench, owned by a Catalan papermaking family from the eighteenth century, began to grow after the Spanish Civil War. It even owned forest plantations in various parts of Spain. The 1960s and the early 1970s witnessed profound modernisation and high growth. The main product was coated paper. The 1970s crisis caused Torras to suspend payments in 1982. It was purchased by the Kuwait Investment Office in 1986. Certain problems in the management caused the Kuwaitis to sell it in 1999 to a firm from Luxembourg; LECTA. This company is owned by the British CVC City Venture Capital Partners. LECTA also has factories in Italy (Cartiere del Garda) and France (Condat). Torraspapel accounts for 50% of the productive capacity of the group. The strategy of LECTA is to have a central presence in the areas of Southern Europe with a high density in the printing industry (in order to compete in transport costs with Scandinavian producers) and to have a very versatile production system. Nowadays, Torraspapel has seven factories in Spain focused on special paper, coated (CWF), uncoated, self-adhesive, thermal, carbonless paper, etc. Torraspapel has a pulp factory. Its sales of paper exceeded a million tons in 2008, but in 2010, they reached only 856,000 ton.

Sarrió, Compañía Papelera de Leiza was founded in 1970 by the merger of the wholesaler Sarrió, Compañía Anónima de Papeles S.A. (set up in 1948) and Papelera de Leiza (with a factory from 1959). Their specialisations were board and coated paper. Sarrió suspended payments in 1978. This was the beginning of a very difficult period, which culminated in the merger in 1989 with the Italian SAFFA. It exchanged assets with Torraspapel in 1991, transferring its paper factories to focus on cartonboard. Finally, Torraspapel took over Sarrió the same year.

ENCE was the result of a merger in 1968 of the three pulp firms owned by the state. It increased its assets with some subsidiaries in the forest business and with the takeover of a pulp factory located in Miranda de Ebro in 1972–1973. It set up a rationalisation programme in 1986, selling two factories (Motril and Miranda de Ebro). It went public in 1989 and also began its partial privatisation process (completed in 2001). At the same time, it started to acquire forests plantations in Uruguay. In 1998, ENCE acquired Celulosas de Asturias S.A., another Spanish pulp producer. In recent years, it has expanded its factories. An essential part of its expansion programme was to set up a factory in Uruguay. This project was completely linked with the Uruguayan forest plantations (they amounted 170,000 ha). Finally, the new

factory faced a lack of liquidity. As a consequence of the problems, in May 2009, ENCE sold the majority of its assets in Uruguay to Stora Enso and to the Chilean Celulosa Arauco y Constitución S.A. At the moment, the main shareholders of ENCE are a group of Spanish banks. ENCE is a leading producer in renewable energies with biomass (180 MW).

The improvement of the Spanish positions in the recovered paper market has also had its consequences. Two big firms have emerged linked with recovered paper: SAICA Sociedad Anónima Industrias Celulosa Aragonesa and EUROPAC (Papeles y Cartones de Europa S.A.). Both firms are family owned and produce corrugated case materials.

SAICA, established in 1943, has grown very fast since the mid-1980s. Its speciality is corrugated case materials. The bulk of its productive capacity is in Aragon, with a factory in France (bought in 2002) and various production locations for corrugated board boxes. It took over the box-converting factories of International Paper in the UK in 2006. Two years later, it did the same with the box factories of SCA in Italy and in the UK. One of the main assets of SAICA is its recovering paper network (in 2010, it had 40 centres in Spain, Portugal and France). It also owns 45 factories for corrugated board. Its production of paper in 1989 was 235,000 ton. Nowadays, this has reached around 2 million tons. It was the third European firm in corrugated case materials in 2006 after Smurfit Kappa and SCA. At the moment, its main project is a paper factory in the UK with an investment over €300 million. The new factory, located in Partington (Lancashire), started up its machine in mid-January 2012. In late 2011, SAICA acquired 49% of a Polish corrugated board factory in a joint venture with the German Group Thimm.

EUROPAC (Papeles y Cartones de Europa S.A.), originating at the end of the nineteenth century, was created in 1995 as the result of a merger. During the privatisation process, EUROPAC acquired the Portuguese firms: Gescartão, PORTUCEL Embalagem and PORTUCEL Viana. It expanded its international assets in France in 2008 and in Portugal in February 2009. The aim of this expansion was to increase its self-sufficiency in recovered paper (it was 63% in 2009). The paper production has grown from 149,000 ton in 1997 to 573,000 in 2007 (48% is from recovered fibre) and 868,000 ton in 2010. In 2006, it ranked fourth in Europe among the European producers of brown kraftliner with a capacity of 320,000 ton, coming mainly from the Portuguese factory of Viana do Castelo. The same year, it ranked 11th among the corrugated case materials producers. The purchase in May of 2008 of some assets, a paper factory and a corrugated board factory, from the French group Otor caused it to improve its position to fifth place (after Smurfit Kappa, SCA, Saica and Mondi/Bauerfeind). In 2009, it also acquired two French Mondi subsidiaries producing corrugated board. In late 2010, it took over Cartonnerie Val de Seine owned by SCA. The purpose of this project was to reinforce EUROPAC in the French market. The result has been that France was the final destination of 53% of the sales.

The only example with a high degree of integration between papermaking and pulp production is Grupo Iberpapel (with Papelera Guipuzcoana de Zicuñaga S.A.). Its forest division has eucalyptus plantations in Spain and Latin America (Argentina

and Uruguay). The wood pulped in the factory located in Hernani (Basque Country). The neighbouring paper factory is completely integrated with the pulp mill. Iberpapel is specialised in high-quality paper for office use.

Another firm with important growth is Miquel y Costas & Miquel S.A., with its mother firm established in late nineteenth century and specialised in low-grammage paper (especially cigarette paper). Its market share in Spain has been growing, as in the merger of 1975 with S.A. Payá Miralles and the takeover of the Argentinian division of Papeleras Reunidas in 1985. In both cases, the firms were direct competitors of MCM, which has a privileged position in supplying to big tobacco firms. Its tobacco paper production is about 40,000 ton. Other lines of specialisation are Bible paper and specialty paper. MCM has among its subsidiaries CELESA, specialised in making special fibres. The Catalan firm has planned a €45 million investment to build a new factory focused on special industrial papers with high added value (for the car industry, decorative paper and paper for food packaging). The new factory will open in late 2012.

The big international producers of tissue paper have not avoided the growth of some Spanish SMEs focused on this paper, which also have begun an international expansion project. The best example is the Catalan firm Gomà-Camps, originating in the eighteenth century. GC also has productive assets in France and Portugal. It has invested in a joint venture with the German WEPA to build a new factory in Spain.

The entry of US, Scandinavian and, also, Italian multinationals was a major change in the Spanish papermaking business structure. It should be noted that foreign investments were limited during the early Franco period because of legal regulation. Thus, the process began during the 1960s with the takeover of Cartonajes International S.A. by International Paper and Papelera del Urumea S.A. by Scott Paper (subsequently merged with Kimberly-Clark). The joint ventures were another way to invest in Spain. An example of this was Capdevila-Tambar S.A. set up in 1964 with the participation of the Finnish Tampella. Now, this factory, very close to Barcelona, is owned by Stora Enso. In 1990, 6 of the 13 leading Spanish firms were foreign owned. INPACSA was purchased in 1983 by KIO, an investment group from Kuwait, which in 1986 also purchased Torras Hostench. Jefferson Smurfit entered Spain in 1987 with the purchase of Cartón-Spain, Industria Cartonera and Papelera Navarra. It also increased its presence in European Paper Packaging and Investment Corporation EPPIC (former INPACSA) purchasing 35% of the shares. Its assets, expanded during the following years, now are part of Smurfit Kappa (a result of the merger of Jefferson Smurfit and Kappa Packaging). Wiggins Teape acquired Celulosas de Asturias in 1986. Papelera Calparsoro was purchased in 1988 by the German firm PWA Dekor. Calparsoro has since 1995 been a subsidiary of the Swedish Munksjö Paper. The French Canson, now part of the Arjowiggins Group, acquired Guarro Casas S.A. in 1989. The Catalan firm had its origins in the late seventeenth century. US Newark took over the assets by Viscarret in 1999. The entry of Italian multinationals has had a special importance. The first ones were SAFFA (now Reno de Medici) and Fedrigoni. Especially important has been the presence of CartoInvest, Kartogroup, Industrie Cartarie Tronchetti (ICT) and Sofidel in the tis-

sue paper sector. CartoInvest through Eurotisu S.A. set up a factory near Barcelona in 1993, now owned by SCA. Kartogroup owned a factory in Valencia region from 2002. This factory was the only one not included in the takeover of Kartogroup in 2008 by the German WEPA. ICT invested in a new factory in Aragon with 70,000 ton capacity and working from late 2005. Sofidel set up a factory in Navarra. It began production in 2007.

The greatest transformation in the business structure was that of Portugal. From an extremely fragmented structure, there emerged a world leader. In 1982, the total number of papermaking firms was 95 (plus 4 pulp producers); in 1991, there were 84 firms with 90 factories (plus 4 pulp producers with eight factories); in 2000, these were reduced respectively to 57 and 60 (6 pulp firms with 7 productive centres); and in 2010, there were seven pulp mills and 25 paper factories. CELPA has very few partners: Grupo Portucel Soporcel (4 firms), Grupo Altri (4 firms), the Spanish EUROPAC and Renova-Fábrica de Papel do Almonda S.A. Thus, the business structure has a high degree of concentration in a few firms.

During the 1950s, the leading firm was Companhia Portuguesa de Celulosa SARL (CPC), which entered as a shareholder in other firms (such as Companhia do Papel do Prado). PORTUCEL (Empresa Produtora de Pasta e Papel, E.P.) was established in 1976 as a result of the nationalisation process of the Portuguese pulp industry. Finally, the papermaking firms were incorporated into PORTUCEL. In the early 1980s, the group began to be a clear success. The Portuguese papermaking sector was expanded with the creation in 1984 of SOPORCEL (Sociedade Portuguesa de Papel S.A.). In 1993, PORTUCEL became a holding organised in business areas according to paper production grade. It was the first step towards privatisation, which actually began in 1995. The aim was to continue with state ownership in pulp and graphic paper and, finally, to increase its integration. The privatised assets were linked with recovered paper, corrugated case materials and corrugated board (such as Gescartão SGPS purchased by the Spanish group EUROPAC). In 2000, PORTUCEL took over Papéis Inapa, and in 2001 SOPORCEL. Finally, PORTUCEL was totally privatised in 2004 and acquired by Semapa Group (a firm with assets in the construction and cement sectors). The position of PORTUCEL in Portuguese pulp and papermaking industry is that of an absolute leader. In 2008, it made 1,054,500 ton of uncoated wood-free paper and 1,324,600 ton of eucalyptus pulp. A new paper factory located in Setubal began production in August 2009 increasing firm capacity with its 500,000 ton production. In 2007, it planned some investments in Angola and in Uruguay. It obtained permission in late 2010 to use of an important forest area in Mozambique. Its pulp output is of 1.4 million tons (of which 1.1 million tons is integrated into paper). In its international expansion, its brands (Navigator and Discovery) have been central. The production of energy from biomass has become a focus of its expansion policy.

The second Portuguese papermaking group is Grupo Altri (Caima). This firm produced 639,000 ton of pulp in 2007, of which a significant share was unbleached sulphate pulp. It also makes kraft paper for bags. COFINA, a Portuguese financial group, acquired Caima. First, it purchased a part of the firm in 1998 and the whole in 2000. Altri is a spin off of COFINA pulp industrial assets.

In sanitary and household papers, a Portuguese firm with big potential in global markets has emerged: Renova-Fábrica de Papel do Almonda S.A. This firm has its origins in the nineteenth century, but it began to make tissue paper in the late 1950s. During the 1990s, it began its international expansion with Spain and France as its main targets. Their products are very well known in European markets because of innovative and aggressive marketing with the Renova brand.

9.8 Concluding Remarks

The Southern European countries had some common characteristics in the historical development of both the papermaking and pulp industries. First, they have a strong papermaking tradition (with the exception of Portugal). Paper entered the Western world through Spain during the Middle Ages. In consequence, the axis of this manufacture was around the Mediterranean for quite a long time. Italy and the Iberian countries began to lose ground from the seventeenth century. On the other hand, during this phase, strong links were forged among these countries (jointly with France). This close relationship had different stages of which commercial and technological are included in the most important. The decline intensified during the nineteenth century because of the mechanisation and the growing importance of wood pulp as a raw material. The three countries incorporated the continuous machine late and slowly (in a context of very low paper per capita consumption), and they did not develop a pulp industry. The other side of the coin, in the three cases, was the long history of handmade paper compared to the other European countries. In some cases, this continuity showed no signs of atavism. Instead, some of the handmade paper firms were important exporters, especially those in Spain and Italy. Even now, some of them are world leaders in their respective markets. The decline halted in the twentieth century, especially in the second half. During this period, Southern European countries vastly improved their levels of paper consumption. This was the basis for an impressive growth and great potential in recovered paper. Furthermore, they developed a very important and export-oriented pulp industry (mainly from eucalyptus fibre in Spain and Portugal). As a consequence, the Southern European firms increased their presence on international markets. On the other hand, they tend to prefer the Southern European markets and direct investment there. Some good examples are the Italian assets in Spain and the Spanish assets in Portugal.

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Chapter 10
The South American Pulp and Paper Industry: The Cases Brazil, Chile, and Uruguay

Maria Barbosa Lima-Toivanen

10.1 Introduction

Compared to the history of the pulp and paper industry (PPI) as discussed in other chapters of this book, the history of the PPI in South America is relatively short. It dates only as far back as the mid-twentieth century. The importance of this history resides in the emergence of the region as a world class manufacturer of high-quality, mostly hardwood pulp from Eucalyptus, and through very productive cultivation standards and leadership in costs and productivity.

As a market for paper products, the population of about 386 million inhabitants of South America does not yet consume as much paper per capita as in developed countries. There is still important room for growth. As a space for production, the location in the Southern Hemisphere provides good climatic conditions enabling faster forest growth rates than in Northern Hemisphere, which benefits pulp production. Investments in technology to achieve higher yield from, mainly, eucalyptus plantations is one of the main reasons to get to know the evolution of the industry. Three countries, Brazil, Chile, and Uruguay, especially have invested in the industry and are worth discussing in more detail. The analysis of the PPI evolution in these three countries is justified for they are successful cases, different from other countries in the region, which potentially have the same comparative advantages, such as similar natural resources, as Argentina, Colombia, and Venezuela (Katz et al. 1999).

The knowledge about South America's natural comparative advantages for the growth of plantations to supply wood for pulping is widespread. Brazilian and

The author would like to thank the Brazilian Pulp and Paper Technical Association (ABTCP) for allowing virtual access to its Nucleus of Technical Information and Risi Info for the sharing of data on countries outputs, though these institutions are not liable for the use of any of the information they have provided or allowed access to.

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J.-A. Lamberg et al. (eds.), *The Evolution of Global Paper Industry 1800–2050: A Comparative Analysis*, World Forests 17, DOI 10.1007/978-94-007-5431-7_10,

Chilean pulp and paper producers are among the most profitable companies for using fast-growing eucalyptus trees, and Brazilian companies have become global cost leaders in the production of market pulp (Gurlit et al. 2007) for their productivity. Nevertheless, it will be wrong to consider that only the exploitation of natural advantages is to be credited for the success of PPI in these countries, in Brazil especially. Leading companies have played an important role by exploiting economies of scale and increasing the technological advances of their production, helped by pioneering improvements from the research institutions, working also on the adaptation and genetic improvement of the most suitable species, and legal and fiscal support for the plantations.

The evolution of PPI in South America is linked to a trend in Latin American economies away from import substitution industrialization and toward the large-scale production and export of industrial commodities based on natural resource endowments (Herbert-Copley 1998). The expansion of investments in the PPI in Latin America is directed at external markets and uses basically planted forests of *Pinus radiata* and *eucaliptus* as raw materials. The introduction of these two species, exogenous to Latin America, has received much condemnation as well as appreciation (Toivanen and Lima-Toivanen 2009; Lima-Toivanen and Mikkilä 2006).

Regarding technological development and production output, PPI in South America has evolved unevenly. Common to almost all the countries is the fact that the industry has benefited from government policies that boosted forestation based on high-yielding species for use mainly in pulp production. The region has therefore become very attractive to foreign investment, and its history is considered a successful experience regarding to the production of market pulp. This success is the result of a combination of natural resource advantages, promotional policies, improvements in productivity levels due to new capital investment and the increasing scale of plants (Herbert-Copley 1998), and innovation in forestry cultivation and management (Toivanen and Lima-Toivanen 2009).

The common approach of the governments of most of the countries through incentives for forest plantations has been the driving force for the rise of, firstly, the forests that served to supply raw materials to pulp plants and, secondly, the carrying out of evaluations that justified the business audience the possible benefits of investments in PPI. State and international agencies have provided the needed support to guide and finance investments, as well as technological developments that enabled companies to use raw material, especially wood from the eucalyptus and pine, in their processes in a very lucrative way.

During the late 1980s and early 1990s, investments in the forest sector were based mostly on domestic direct investment. Since the opening of many of the Latin American economies, FDI has started to play a more significant role. For strategic reasons regarding the maintenance of fiber supply, the FDI and also local companies have chosen to establish business in a vertically integrated way, starting with the forest plantations, which have been a motive of government incentive policies.

The region is foreseen as increasing its area of planted forests from 12.5 million hectares in 2006 to 17.3 million in 2020 (FAO 2009). Due to the availability of suitable land and a favorable investment climate, South America will maintain its

competitive advantage in plantation forestry, as well as in pulp production, considering the investments made recently.

A country approach follows, demonstrating how the industry has evolved in Brazil, Chile, and Uruguay, countries that have been at the top of the list of FDI destinations in PPI in South America. In a continuum of development of the industry and the forestry technologies developed, the countries could be ranked from low, the case of Uruguay, to medium, the case of Chile, to high, the case of Brazil. The cases of Chile and Brazil are discussed in more detail, and the case of Uruguay is used as an example of contemporary challenges the industry, especially FDI, may face in the region.

10.2 PPI in Chile

Chilean PPI is heavily export oriented, markedly of pulp and newsprint. Production of higher-value-added paper products is less important, and the domestic paper machinery and equipment industry is relatively weak by international standards (Herbert-Copley 1998). Two groups alone, Angelini and Matte, dominate the industry, have investments in various other economic sectors, and have political influence in the country, which makes them rather powerful.

The study of Chilean PPI can be justified for its success in exploiting its comparative advantages for the production of timber, the government's economic reforms to attract private investment to the sector, the government's introduction of tree-planting incentives, a labor cost lower than the international average, the capacity of the industry to adapt to international market forces, proximity to water transport, and a set of highly trained managers able to define business strategies based on local advantages and external opportunities (Borregaard et al. 2008; Gonzales 2005 in Catalán and Cozzens 2009). Despite its success, there has been no formation of a complex productive chain, industry network, or important interactions among the actors and components of the socio-productive space (Katz et al. 1999).

The surge of export-oriented growth in Chile for the past three decades, to end of the 1990s, is commonly attributed to strict *laissez-faire* policies: macroeconomic stability, avoidance of an excessively high exchange rate, and a dismantling of trade barriers. These were crucial factors, but they cannot be isolated from the government's role in the promotion of export-oriented growth already before 1973 and the policies that fostered and sustained the growth of exports (Herbert-Copley 1998). Four sectors are the main exporters in the Chilean economy: mining, forest, fruit, and fishing. In mining and fruits, there is an important presence of foreign capital, as well as in salmon fishing. On the contrary, in the forest sector, two local groups, Matte and Angelini, have a dominant position, namely, pulp and sawn pine boards, the main products exported in this sector (Fazio 2000).

The evolution of the forest industry in Chile can be divided into periods that go from the early exploration of the country's natural resources to the rise of the industry and its actual dynamism. The first period goes from the early explorations of the

country's natural resources made by the Spaniards to 1931. It was especially during the eighteenth and nineteenth centuries that a significant part of native forests was destroyed to make space for the cultivation of cereals[1] and for cattle-raising, both realized without adequate application of sustainable practices. As consequences of this form of exploitation in the mid-twentieth century, there was significant amount of degraded land of low productive value available for forest plantations (Luraschi 2007; Donoso and Otero 2005).

The forest industry developed in Chile, thanks to the introduction of two exotic tree species to refurbish the country's degraded land: pine (*radiata pine*) and eucalyptus (*Eucalyptus globulus* and *Eucalyptus nitens*). These two species make up about 70% of the forest plantations in Chile. *Radiata pine*, also known as Monterey pine, was introduced to Chile from California at the end of the nineteenth century with no industrial application planned, rather a lucky event. It was the originally German Arturo Junge, owner of a park in Concepción, Chile, who was carrying out experiments with many American conifers and received by mistake a lot of radiate pine. Because the radiate pine grew faster than the species he had ordered, he acquired more of them. Another entrepreneur, the German forester Conrad Peters, impressed by the yield of the species, decided to adopt the plant as a source of pit props for the coal mining operations in the Zone of Coronel y Lota in the XIII Region.[2] Between 1907 and 1912, he planted 400 ha of *radiata pine*, the first industrial plantation in Chile. Around 1865, the first eucalyptus trees were introduced to Chile. The species *Eucalyptus globulus* was planted alongside the paddocks in the agricultural regions of Central Chile (Morales 2003). Extensive cultivation of eucalyptus was introduced in the 1960s followed by experiences with other species of minor importance (Luraschi 2007).

The first paper company to be installed in Chile was established in 1920 as Papeles Cordillera, property of Compania Manufacturera de Papeles y Cartones S.A. (CMPC). It was created by the merger between Comunidad Fabrica de Carton, established in 1918 by Luis Matte Larrain, a local entrepreneur, and the La Esperanza paper and cardboard factory, owned by the German Ebbinghaus (Encyclopedia of Business 2003). Papeles Cordillera had an initial capacity of 2,200 ton/year of packaging and cardboard paper produced by two paper machines. Already by that time, a style of austerity and reinvestment was implemented in the company. In 1923, investments in machinery and facilities raised the company capacity by 50%. Two new paper machines, including a German one, were acquired, together with the enlargement of the company and the building of workers' housing. CMPC's aim was to supply the Chilean demand of all kinds of paper. In order to accomplish its aim, CMPC issued, in 1936, stocks that brought its capital up to 60 million dollars, acquired Machine Number 9, projected the amplification of the electrical plant, and initiated the construction of a plant for mechanical wood pulp production (CMPC 2011).

[1] For a long period of time, Chile was an important grain exporter, which reached its peak during the Californian Gold Rush, 1848–1855.

[2] Most of the Chilean pulp and paper companies are located in this region.

Although it has not been possible to evaluate the environmental performance of the forest sector companies during this first period, an environmental law had already been passed (Law 3133 of 1916), which regulated liquid industrial residues. Before that, already in 1872, the government had passed a law intended to combat the indiscriminate falling of trees and protecting the soil from erosion, but had no success in the enforcement of such a law (Rotman 1976). The next section shows the subsequent period which is marked with the birth of the PPI in Chile.

10.2.1 Laying of the Foundations of Forestry and PPI in Chile: 1931–1973

Experts in PPI in Chile acknowledge that the launching of the foundations of the industry in the period started in 1931, when Forestry Law N. 4363 was enacted. This law dealt with environmental aspects of forest operations, the definition of forest lands, and was a first attempt to promote plantation forestry, allowing tax exemption on declared forest lands for a period of 30 years (Morales 2003). Moreover, other regulation instruments were put in place (on forest typology and exploitation of indigenous forest), the first schools of forest engineering[3] were founded in the 1950s, and two forest service institutions (INFOR and CONAF) were established (Donoso and Otero 2005).

This phase is marked by the government's direct promotion of the PPI between 1940s and 1973. The State adopted a protectionist intervention against external competition, imposing high taxes on imports of forest products, allowing benefits on imports of machineries, prohibiting the export of raw wood, and falling of young forests (<18 years) (Carmona and Garretón 2004). Most of the forestation activities were carried out by the State as well as the research activities (Carmona and Garretón 2004). After this period, from 1974 onward, the policy has been more of an indirect promotion.

An important institution for the promotion of development at this stage was CORFO, Corporación de Fomento de la Producción (Development Corporation). Founded in 1939, it played an essential role in the promotion of the forest sector and its related industries (Luraschi 2007; Katz et al. 1999). Originally, CORFO's plan was to promote Chile's self-sufficiency in paper production; subsequently, it shifted to focus on export-oriented exports (Herbert-Copley 1998). In 1942 CORFO hired American forest experts to evaluate the potential utilization of Chilean forest in industrial operations. Based on the findings of this mission, CORFO established the Forest Sector Development Plan, which included the installation of permanent

[3] The two schools were established at the Universidad de Chile (University of Chile) and at the Universidad Austral de Chile (Southern University of Chile). They were fundamental to the creation of the institutional arrangements and the forest industry in Chile (Donoso and Otero 2005).

sawmills, a chemical plant for processing of long fiber pulp, a fiberboard plant, and a wood impregnation plant (Katz et al. 1999).

The Forest Sector Development Plan did not receive support from the private sector, however. Especially in the case of the pulp plant, CMPC, the only company that could have undertaken the enterprise found it too risky. The proposed plant was required to supply first the internal market, as a means of implementing an import substitution strategy (whereas at the time almost all the pulp was imported from Sweden and Finland). Considering the possibility of exporting, CORFO indicated the construction of a plant with high production capacity. CMPC, however, was envisaging a plant of medium-high capacity, contrary to global standards of the time. CORFO's role in the negotiation with the World Bank for funding was decisive in pushing the CMPC[4] to build the pulp plant Laja and the newsprint plant Bio Bio in the mid-1950s (Herbert-Copley 1998; Katz et al. 1999).

At the end of the 1950s, CORFO secured the installation of another newsprint plant (INFORSA). In 1969 the State took direct control of INFORSA through the capitalization of its debts. Following the Forest Sector Development Plan, credit for forestation was granted, and the wood impregnation plant, Impregna, was built in 1949, in an association between CORFO and Ferrocarriles del Estado (State Railways) (Katz et al. 1999).

During the 1950s CORFO commissioned other studies to evaluate the potentialities and perspectives for the forest sector development, such as forest inventories. In the 1960s CORFO participated in the creation of other companies in the forest sector such as Forestal Pilpilco and Laminsa, a panels producer (in 1967), and Masisa (merging of a private company with a company owned by CORFO (Pupunahue) (Katz et al. 1999)). The major initiatives of CORFO, however, were the construction of two chemical long fiber pulp plants whose output was destined mainly for export, Arauco and Constitución, respectively, in 1972 and 1975, although the private sector (CMPC) opposed these enterprises (Katz et al. 1999).

Considering the forestation activities, the State became directly involved with the plantations through the CONAF,[5] Corporación Nacional Forestal (National Forest Corporation), created in 1970. Between 1970 and 1973, CONAF owned 67% of the 112,847 ha of the reforested area of the country (Katz et al. 1999). Through CONAF, it was possible to (1) lay the groundwork for a primary forest production system based on fast-growing plantations which now cover more than two million hectares; (2) create and institute the SNASPE, Sistema Nacional de Áreas Silvestres Protegidas del Estado (National System of Forest Conservation); (3) establish and

[4] CMPC belongs to the Matte Group, which, because of a conservative investment policy and being concentrated in productive and export operations, survived until the major economic crisis of the 1980s. This crisis occasioned important changes of ownership in the forest sector, as seen in Sect. 10.2.2.

[5] CONAF is a government agency of the Chilean Agriculture Ministry. It was created in 1970 as the Reforestation Corporation. In 1973, it was named CONAF and by the Law Decree 18348 of 1984 had defined as its objective to contribute to the conservation, protection, management, and increase of utilization of the country's renewable natural resources (CONAF 2011).

develop firefighting and fire prevention systems; (4) implement a technical assistance system for small forest owners; (5) develop and update a national registry system on arboreal and bushy formation; and (vi) develop a monitoring system for forest environmental legislation (CONAF 2011).

The activities of industrial promotion were followed by the creation of institutions to promote the forest sector. Besides CONAF, the State established INFOR, which resulted from the support of strong collaboration between FAO, the United Nations Fund for Food and Agriculture, and CORFO. INFOR was officially established in 1965, although it had been functioning as an FAO project since 1961 (INFOR 2011). While in the 1960s Chile was still unknown in the global forest market, INFOR started playing a relevant role in the mechanization of tasks, management of plantations, introduction of genetic improved species and establishment of techniques and wood properties, incentive to use wood in construction, and permanent statistics information on resources, production and trade (Carmona and Garretón 2004). In 1971, CORFO moreover established the committee for wood, pulp, and paper industries with the objective of coordinating the different functions realized by the State (Katz et al. 1999). The State's role in the development of the forest sector in Chile in the period can be summarized by the fact that in 1973 CORFO controlled the majority of pulp and paper plants (except CMPC), the main sawmills, and the main panel mills, besides its high participation in share holdings in forest plantations (Katz et al. 1999).

The technical personnel involved in the industry created their own association in 1972, the Asociación Técnica de la Celulose y Papel – the Technical Association of Cellulose and Paper (ATP-Chile). ATP was established as a private corporation, with the following objectives: (1) to enable and to promote the professional and technical improvement of its associates in the field of manufacturing and the use of cellulose, paper, and its derivatives; (2) to promote technological development, scientific research, and collaboration with companies, universities, and technical and private schools; (3) to organize the collection and distribution of information relating to the cellulose and paper industry; and (4) to present, discuss, and publish technical reports; research projects; and other contributions of the same nature (ATP Chile 2011).

This period represents the moment when foundations of the Chilean PPI were laid down – from the development of plantations to the establishment of first companies and to the institutional arrangements that supported the industry. Nevertheless, the government played the main role. Private initiative assumed a more important role in the next period, with the privatization of state assets.

10.2.2 The Establishment of PPI: 1974–1996

This period comprehends the rise to power of General Pinochet and the dictatorial regime that followed it, an economic depression, and a new wave of accelerated industry growth. From 1974 onward the government adopted a stance of open market

and privatized most of the companies it had held by then. However, indirectly, the development of the forest sector was favored. As immediate effects companies were allowed to export raw and semi-processed wood, which motivated new investments in the forest sector and its related industries, for example, in sawmills and pulp. The suppression of import barriers made it possible for companies to buy raw materials (e.g., chemicals) and capital goods at better prices. As an ultimate consequence, companies had to condone foreign competition, and entrepreneurs in the sector had to adopt a mentality oriented toward exports (Katz et al. 1999).

Regarding the forest sector, this period can be subdivided into three subperiods (Katz et al. 1999). The first phase, ranging from 1974 to 1981, goes from the change of political regime until the last year of growth before the international debt crisis and the collapse of the Chilean economy in 1982. It can be considered the period when the investments in PPI matured and were then privatized.

Considering the regulation mechanisms, the Forestry Law of 1931 was followed by Law Decree 701 of 1974, which intensified the support scheme for plantations by allowing subsidies of up to 75% of the cost of forestation and maintenance of plantations, which were also protected against state expropriation, and tax exemptions and deductions on land ownership and on utilities derived from exploitation of natural and artificial forests. This decree emphasized the economic aspects of the plantations and established some correspondent environmental liability, for example, the responsibility for the reforestation of the area deforested (Luraschi 2007; Borregaard et al. 2008).

A wave of privatization was carried out in the Chilean economy and also affected the forest sector, with the privatization of CORFO's holdings. CONAF's plantations, which owned 117 nurseries in 1976, were all transferred to the private sector in 1980. Thus, Celulosa Arauco, Forestal Arauco, Celulosa Constitución, and Forestal Celco were transferred to the Holding Cruzat-Larraín. In 1976 the Holding Vial bought INFORSA, a newsprint plant, and its 81,000 ha of forests. These companies paid subsidized prices for their acquisitions, since the government charged discounted price and facilitated payment conditions. Although the benefits of these subsidies became doubtful, it was through these transferences that important domestic economic groups were strengthened and became interested in investing in the sector, demonstrating a fairly important change of attitude (Katz et al. 1999; Borregaard et al. 2008).

The production of the forest industry in Chile grew in this subperiod well above the average of the manufacturing industry (9.2% against 1.4%), and important investments, especially those in the production of pulp, reached their maturity (Katz et al. 1999). Such significant growth was due to the entry into operations of the plants of Celulosa Arauco (1972) and Celulosa Constitución (1975). These plants had such an operation capacity that enabled them to compete also internationally. Besides these investments, the optimization and rationalization of the privatized plants contributed greatly to the overall productivity of the sector, which reached 14%/year (Katz et al. 1999).

Data on outputs of the PPI were available during this period for the years 1980 and 1981. The outputs and exports of pulp, paper, board, and newsprint for 1981

were slightly inferior to the results obtained in year 1980. The data for the 2-year subperiods are shown in Appendix 10.1.

The second subperiod refers to the entrance of foreign capital into the industry, and the concentration moves that happened, from 1982 to 1991. It was characterized by economic recovery and further movement toward a free market economy. As means to provide for the economic recovery, the central government reassumed control of former state companies and reprivatized them. On this occasion, the two main economic groups of the country, Angelini and Matte, realized important investments in the forest sector and came to dominate the industry ownership structure as they do up to now. After 1982 a number of significant FDIs in the forest sector entered Chile, often in partnership with domestic groups, when the government allowed the use of debt shares for business transactions.

The average growth of the PPI in this subperiod was smaller than that of the previous period (9.2% against 5.6%) (Katz et al. 1999). Nevertheless, important investments were realized after 1985, due especially to the influx of foreign capital into the industry, which enabled important increase in the outputs of the industry in the subsequent period.

Because of economic crisis that hit Chile in 1981, the government renationalized many companies that were privatized between 1974 and 1978. A second round of privatization started in 1984. In this process of reprivatization, in 1985 the Group Angelini assumed control of COPEC,[6] the biggest conglomerate in Chile, and its forest assets (Celulosa Arauco, Forestal Arauco, Celulosa Constitución y Forestal Constitución). Together with Group Matte, owner of CMPC, which had entered the sector in 1958, with the construction of the Laja plant, the two groups became the biggest and the most prestigious economic groups in Chile (Fazio 1997).

The acquisition of an important stake in Copec was fundamental to the formation and consolidation of Group Angelini. By then, it was the biggest group in the forest sector, mainly in pulp production, because Celulosa Arauco y Constitución (CELCO), part of Copec, was the biggest in the sector in Chile. In Copec, Angelini Group was associated with Carter Holt Harvey International Ltd., which in 1992 sold its interest in the business to International Paper (Fazio 1997). The Angelini Group also founded or acquired stakes in other companies of the forest sector, ranging from plantations to different operations of wood processing, such as sawmills, panels, and wood boards (Fazio 1997).

Besides a noteworthy presence in the forest sector, Group Matte participated in other businesses, such as energy and insurance, and has had representatives in the politics of Chile, illustrated, for example, by the role played by Eliodoro Matte in class representation. Its recipe for success is based on conservatism and a strict debt policy, and because it had concentrated its activities on productive and export operations, it survived the economic crisis of the 1980s well (Fazio 1997). Its main conglomerate in

[6] Copec was founded in 1934 and entered the forest sector in 1976, with the acquisition and subsequent merger of the companies that formed Celulosa Arauco y Constitución. International Paper disputed the participation in the management of Copec after it acquired the share of Carter Holt Harvey in the company. It was not allowed to do so after some maneuvers made by Group Angelini (Fazio 1997).

the forest sector is CMPC, which produces and commercializes pulp and participates in markets of tissue paper, printing, sawn wood, newsprint, and wood and paper derivatives. At the end of 2009, its forest plantations were worth US$1,142.7 million (CMPC 2010). In 1995 it constituted a holding led by Empresas CMPC with five branches: pulp, forest, paper, tissue, and sanitary and paper products (Fazio 1997).

During the late 1980s, especially after 1985, FDI became an increasingly important factor in the industry due in part to the opportunities for investments via debt-swaps (Herbert-Copley 1998). In 1985 the Chilean Central Bank introduced Chapter XIX of the Compendium of Regulations for International Exchanges, which attracted important FDI, quite often associated with local investors. This compendium, compared to LD 600, was more successful in attracting investments in the forest sector. Since 1974, forestry FDI under LD 600 accounted for 2.7% of all FDI. Forestry FDI under LD 600, as a share of the total, reached a peak in 1991 at 12.7% but declined gradually to a share of only 0.7% in 1999. Between 1985 and 1989, total FDI in the forest sector under Chapter XIX was US$1.026 million, equivalent to 22.7% of the total FDI under this provision and five times the amount of capital coming into the country under DL 600. Between 1982 and 1989, FDI inflows to Chile via Chapter XIX peaked at US$1.321 billion in 1989, dropping in 1990 and 1991, when this mechanism ended (Borregaard et al. 2008).

Important forest FDIs carried out in Chile in the period were those of the Anglo-Dutch company Shell, which acquired companies and assets as mentioned: Bosques de Chile (1982), Aserraderos Copihue (1982), Forestal Colcura S.A. (1988), and Industrial y Forestal Colcura Ltda (1988). In addition, Shell established the Forestal e Industrial Santa Fé together with the US-based Scott Paper and Citibank, in 1988, to acquire Papeles Sudamerica (in bankruptcy) and transformed it into the only existing short fiber pulp plant in Chile (Katz et al. 1999; Borregaard et al. 2008). The New Zealand group Carter Holt Halvey, associated with Group Angelini, bought 50% of the holding Copec and, in partnership with Maderas Prensadas Cholguán (of Copec), created Manufacturera de Fibropaneles de Chile (TRUPAN).

In 1992, an alliance between the North American Simpson Paper Co. and CMPC created Celulosa del Pacífico SA (CELPAC), one of the most modern Chilean long fiber pulp companies. CMPC expanded to the printing sector in 1983, when it acquired the Lord Cochrane and turned into the biggest printing (graphic) company in the country, constituting the Envases e Impresores Ltda. Japanese and North American companies also made some minor investments in land forestation (Fazio 1997; Katz et al. 1999; Borregaard et al. 2008). However, both Shell and Simpson Paper sold their participation in the pulp business to the Group Matte in 1998 (Borregaard et al. 2008), and Group Angelini bought 50% of Carter Holt Harvey in Copec (Fazio 1997). In 1995, CMPC bought a 20% interest in the North American Scott Paper in Forestal Santa Fé and also a 20% interest in Forestal Monte Águila (Fazio 1997). The interest, as minority shareholders, in Santa Fé, was also acquired with the intention of getting to know eucalyptus pulp. The market was again to become concentrated on the groups Matte and Angelini.

In internationalizing operations, in the 1990s CMPC set up a partnership with Procter & Gamble for the fabrication and commercialization of disposable diapers

and sanitary towels in Chile, Argentina, Paraguay, and Uruguay. This association allowed it to have access to new technologies and new ways to market its products. In the 1990s it also considerably increased its production capacity of tissue papers in Chile and abroad (Fazio 1997).

Another consequence of the surge of investments in PPI in the late 1980s and early 1990s was that it motivated the growth of local expertise in consulting services. At the beginning of the period, the basic design work was done by foreign firms, either Scandinavian or Canadian, and only the detailed engineering was realized locally. As time passed, local consulting firms have come to take lead in all phases of design work, due to advantages in cost over foreign firms and greater familiarity with the local *radiata pine* specie (Herbert-Copley 1998).

The industry outputs and exports for the subperiod 1982–1990 were significantly improved, especially in exports. Expressed in numbers, there was a 17% improvement in pulp production and 26 in exports, a 76% improvement in paper and board production and 83 in exports, and a 37% improvement in the production of newsprint and 109.5 in exports. These data are available in Appendix 10.1.

Finally, the third subperiod, which goes from 1990 to 1996, marks the concentration of PPI, both in the forest and in the pulp and paper sectors, as well as the internationalization process in which the companies expanded their operations to the southern part of South America, mainly Argentina, Uruguay, and Brazil. Internally, the industry's output and productivity for the period increased considerably, as a consequence of investments made in the last subperiod, to 11.9 and 7.9% annually (Katz et al. 1999). In pulp and paper, the outputs were even higher (15.3% for production and 10.7% for productivity a year) due to the entrance in full operation of four new pulp plants and expansion of paper plants (Katz et al. 1999). Data on the outputs of the industry in this subperiod is presented in Appendix 10.1.

Yet, opportunities for the expansion of operations in Chile were becoming scarce due to a growing shortage of land for new plantations and the introduction of stricter requirements on environmental matters and indigenous communities' rights (Borregaard et al. 2008). Companies therefore invested in other Latin American countries, in a vertically integrated way, in order to facilitate the supply of inputs among the different business areas (sawmills, pulp, paper, and panels) and to negotiate better deals with suppliers and clients through a market-seeking strategy (Calderón 2007). Operations in other Latin American countries were also facilitated by similarities of culture and language, besides geographical proximity. Having capital available and funding options, the two main forest groups acquired land for plantations and operations in these countries.

Funding for the internationalization of Chilean companies in the 1990s was provided by the local capital market and institutional foreign investors with listing of stock in foreign markets, especially through American Depository Receipts (ADR) and bonds. Companies also received support from the Chilean authorities, which adopted relaxed foreign exchange regulations, making those investments abroad easier (Calderón 2007).

In the internal market, by the end of 1996, the figures were such that Celco alone owned about 1/3 of Chile's forest, consisting of *radiata pine* (94.2%) and eucalyptus

(5.8%); Forestal Cholguán had 54,000 ha of forests worth US$1.126 million; CMPC possessed 338,000 ha; and Forestal Terranova, owned by Switzerland's Group Schmidheiny, about 80,000 ha (Fazio 1997). This high level of concentration was shown also in 1996's exports: Celco lead the market with 24.5%; Group Matte, mainly through Celpac and CMPC, with about 20%; and Santa Fé about 7.3% (Fazio 1997).

In 1996 the Group Angelini, through Celco, acquired the Argentinian pulp producer Alto Paraná (APSA). The group increased APSA's capacity to 280,000 tons of bleached pulp and acquired 57,000 ha of forests, of which 35,000 ha were of planted forest (Fazio 1997). With the acquisition of APSA, Celco became the main producer and only exporter of pulp in Argentina. Other investments by Celco in Argentina followed: the acquisition of two sawmills and two wood processing plants, which made it the third largest pulp company in the world and the main producer of sawn wood in Latin America; the acquisition, in 2004, of the forestry assets of Pérez Companc, thus entering the panel fabrication business, using timber from own plantations, manufacturing products of higher added value, and complementing its main activity of pulp manufacturing; and building, in 2001, a MDF plant adjacent to a sawmill it already owned. In 1997, Celco acquired the facilities of Trupán S.A. and Maderas Prensadas Cholguán S.A., expanding the production of plywood, MDF, and hardboard. In 2005, it invested in Brazil (plywood, MDF, and hardboard) and built up its interests in Argentina by acquiring the assets of the French Louis Dreyfus in both countries. Producing at an annual capacity of over one million cubic meters of panels, Arauco has become one of the largest panel manufacturers and the largest plywood producer in Latin America (Calderón 2007).

After achieving a leading position on the Chilean market, CMPC extended its operations strategically focusing on Mercosur.[7] This was a strategic decision by Group Matte aiming at strengthening participation in the domestic market of many different grades of paper and reaching a privileged position in Mercosur and Peru. CMPC then became the leading producer of tissue in Chile, Argentina, and Uruguay and ranked second in Peru.

In the 1990s CMPC made major investments in the paper and tissue sector. In 1995 it started operations in Argentina through the acquisition of full ownership of Productos Tissue S.A. (Protisa) and Papelera del Plata, with which it became the main seller of tissue in the country and the holder of the top of mind brands. In Uruguay, in 1994, it bought a 96.23% stake in Industria Papelera Uruguaya S.A. (IPUSA), which had a market share of 60%. Considering its investments in Chile, Argentina, and Uruguay, the Group Matte became a leader in tissue production in Latin America producing, in 1997, 141,000 ton. Its investments in Peru amounted to US$15 million including a tissue and a cement sack plant. Together with P&G, CMPC assumed control of Prosan Chile and Prosan Argentina. Prosan SA, a branch

[7] MERCOSUR or Mercosul is the Southern Common Market, an economic and political agreement formed by Argentina, Brazil, Paraguay, and Uruguay, with permanent status, in 1991, with Venezuela joining in 2006. Its purpose is to promote free trade and movement of goods, people, and currency. Currently, Bolivia, Chile, Colombia, Ecuador, and Peru are associate members.

of CMPC, was created in 1983 (partnership with P&G began in 1992) to develop in Chile the disposable diaper business. In this business Prosan competes with Kimberly Clark, which entered Chile in 1994. In 1996, 47% of CMPC's revenues came from tissue; therefore, this became a core sector in expansion strategy of Group Matte (Fazio 1997).

10.2.3 Consolidation and Internationalization of the Industry and Claims for Corporate Responsibility: 1997–

Since the end of the 1990s, the forest sector in Chile has been more vertically integrated and concentrated than ever in the hands of groups Matte and Angelini (CMPC and Arauco, respectively). This concentration process led to the exodus of many FDI that had entered Chile in the 1990s, and, though FDI still exists in the sector, it is on a small scale compared to the large domestic companies. For example, FDI from the United States has been concentrated within the board wood subsector, in certain remanufacturing activities. Masisa S.A., which resulted from a merger between Nasisa and Terranova, related to the Swiss Schmidheiny Group, is now 53% owned by Grupo Nueva, also related to the Schmidheiny Group, which maintains a modest position in the board wood subsector (Borregaard et al. 2008). Once the industrial organization of the forest sectors is stabilizing, it is facilitating regional integration in countries like Brazil, Uruguay, and Argentina (Spetic 2009).

Following the concentration moves in the PPI, plantation landholding is also heavily concentrated in terms of ownership and species exploited. For *radiata pine* 71.1% of plantations are owned by 2% of all forestry owners with holdings of over 1,000 ha; two companies alone own more than 75% of these plantations, with similar conditions in the ownership of eucalyptus plantations. In the board wood sector, three companies (Celco, CMPC, and Masisa S.A.) own 100% of the production (Borregaard et al. 2008). For the purposes of this paper, Tables 10.1 and 10.2 present the characteristics of the Chilean companies of the PPI.

Besides the concentration of production, the most important developments in this period concerned the regulation and law enforcement arena and also the expansion of production. The production of pulp reached at the end of this period showed the most significant increase of all times, almost two and a half times more than that achieved in previous years, due to the opening of the plants of Valdivia and Santa Fé 2 in 2004 and 2006. Appendix 10.1 shows the outputs for the period.

The environmental impacts of PPI in Chile have received more dedicated attention since the adoption of stricter environmental regulation and the raising of public awareness. On the one hand, the concentration of PPI and its export orientation have had positive impacts on the environment: through achieving more economic efficiency, it has also achieved more efficient use of natural resources, for example, of water, and by focusing on the markets of more developed economies, the demands imposed by these markets tend to be positive in terms of observation of the environmental legislation, and it has accelerated the modernization of the industry (Luraschi 2007). On the other hand,

Table 10.1 Pulp Plants Operation in Chile – 2010

Plant	Start up	Location	Owner	Type of pulp	Pulp capacity (1,000 ton)
Licancel	1994	VII Region	Celulosa Arauco (Celco)	BSKP/BEKP	140
Arauco I	1971	VIII Region		BKP	290
Arauco II	1991	VIII Region		BKP	500
Valdívia	2004	X Region		BKP	550
Celco	1975	VII Region		USP	355
Nueva Aldea	2006	VIII Region		BKP	1,027
Santa Fé 1	1991	VIII Region	Empresas CMPC	BEKP	376
Santa Fé 2	2006	VIII Region		BEKP	780
Pacífico	1992	IX Region		BSKP	500
Laja	1958	VIII Region		BSKP/USKP	360
Total					4,778

Source: Updated from Luraschi (2007) with information from the firms' websites

Table 10.2 Paper Plants Operating in Chile – 2010

Plant	Start up	Location	Owner	Product	Capacity (1,000 ton)
Cartulinas Maule	1998	VII Region	CMPC	Boxboard	360
Inforsa	1964	VIII Region		Newsprint	200
Cartulinas Valdívia	1951	X Region		Carton board	70
Papeles Cordillera	1920	Puente Alto		Packaging and tissue	330
Norske Skog Bio Bio	1957[a]	VIII Region	Norske Skog	Newsprint	120
				Printing and wallpaper	6

Source: Firms' websites
[a]Major upgrading was done in 1990 and 1995 (Norske Skog 2011)

wealth creation has not necessarily led to improvement of equality or social indicators. Besides, the concentration of production in the hands of a few companies has led to the collapse of less competitive companies and sectors of low yield, such as the small-and medium-sized companies of the board sector. It has also been involved in the loss of jobs and opportunities for small-scale businesses (Luraschi 2007).

Important regulations for the protection of the environment and attendance to the rights of indigenous people and small landowners were put forward. The LD 701 of 1974 was modified in 1998 and in 2000 aiming at extending benefits to small landowners and indigenous groups, which, between 1974 and 1995, had received only 5% of the total funds allocated by the State and the recuperation of eroded soil (Borregaard et al. 2008). A series of environmental norms have been issued from the end of 1990s onward, and they have direct implications on the operations of PPI. They are, for example, LD 90 of 2000 – for the regulation of pollutants associated with the discharge of liquid residues into sea and continental superficial waters; LD 609 of 1998 – for the regulation of the discharge of liquid residues into sewage

systems; LD 46 of 2002 – for the regulation of liquid effluents into underground waters; and LD 167 of 1999 – for the regulation of the emission of odors associated with the production of sulfate pulp. This latter was aimed specifically at the pulp production process adopted by the industry.

A new forestry law was introduced in 2007, following discussions for a native forest recovery and forest development bill, envisaging the protection, regeneration, and improvement of native forests to ensure forest sustainability and environmental policy. The discussions started in 1992. Under the bill, CONAF is responsible for maintaining a permanent forest registry. The bill also makes a forest management plan mandatory for any falling of native forests and addresses forest management plans, norms for environmental protection, conservation funds, restoration and sustainable management incentives, resources for further research, and the establishment of an Advisory Council presided over by the Ministry of Agriculture. There had been criticism that lobbying of both forestry groups, Angelini and Matte, was responsible for postponing the approval of the forestry law for 15 years (Kerosky 2007).

The strategic objective established in the Native Forest Law and CONAF's strategy is to encourage the creation and management of forest resources in a way that generates environmental goods and services, with an emphasis on small- and medium-sized landowners. Two fundamental lines in this case are the strengthening of the forestry institutional framework and protection of an increase in national forests, which includes the enactment of the Native Forest Law (Montes et al. 2008).

Throughout the 1990s important regulations on forestry and the environment were designed and had highly significant impact on PPI. In 1994 the General Environmental Framework Law (Law 19300) was issued. Under this law several instruments of environmental management were introduced: environmental education and research; public participation; environmental quality standards to preserve nature and environmental heritage; emission standards; plans for management, prevention, and cleanup; responsibility for environmental damage; and the system of environmental impact assessment. New regulations on atmospheric, water, noise, and light pollution standards have also been established.

Law 1300 also restructured the Comisión Nacional del Medio Ambiente, the National Commission on the Environment (CONAMA), which was founded in 1990 and is responsible for the coordination of the institutions that deal with the environment. A mechanism introduced by this law and considered very important for the industry was the Environmental Impact Assessment System (EIAS). The EIAS is implemented by CONAMA, when a project or activity involves more than one of the country's regions or by the Regional Commission on the Environment (COREMA), when a single region is involved (Luraschi 2007).

Regarding the enforcement of Law 1300 in projects of PPI, the case of Celco has been very unusual. The company was granted the right to build a pulp plant in the locality of Valdivia based on the EIAS it presented to the Corema of Region X. The approval had been subject to the guarantee that hazardous would be treated in an environmentally safe way and the promise of the development of a monitoring and follow-up plan for its waste products. However, since the mill started operations in February 2004, it has faced public complaints about noise and odors, and it was

accused of being responsible for water pollution and the death and disappearance of the black-necked swans and other wildlife in the Carlos Anwandter Nature Sanctuary,[8] but investigations of the damage found no direct cause and effect relationship between the plant installation and the environmental problems that occurred (Borregaard et al. 2008).

Investigations commissioned by CONAMA and conducted by UACh showed that these problems were mainly caused by the disposal of contaminated effluents from the CELCO's pulp mill, even though the company contested the findings (WWF 2005). The possible explanation for the disagreement between the company and the other parties in the complaints was that the company claimed it had used state-of-the-art technology[9] for the design of the plant. The company and the authorities had relied on outdated knowledge and used less environmentally advanced technology, particularly in the bleaching process and in the treatment plant (WWF 2005), when there were more environmentally friendly bleaching technologies, for example, the TCF. Celco, through its pulp mill Licancel, was also implicated in the environmental problem caused by the dumping of its effluents into the Mataquito River in the Maule Region at the end of 1999.

Although in the late 1990s potential foreign investment projects were the ones that raised concerns about the sustainability of native forest exploitation, in the 2000s two domestic projects, CELCO's Valdívia and Itata, were implicated in environmental pollution. They demonstrate that significant environmental and social problems are still public concerns regarding the native forest substitution, property rights, and the rights of indigenous peoples (Borregaard et al. 2008).

As for environmental certification, most large companies in the forest sector have received both International Organization for Standardization (ISO) 14001 approval and some kind of sustainable management certification issued by some of the forest certification schemes. Yet foreign companies obtained Forestry Stewardship Council (FSC) certification, and domestic companies have obtained the national CERTFOR certification. The latter is recognized by Program for the Endorsement of Forest Certification schemes (PEFC) as less rigorous than FSC certification (Borregaard et al. 2008).

In another expansion move at the end of 2009, CMPC acquired from the Brazilian Fibria the Guaíba pulp and paper plant and forest assets located in Rio Grande do Sul, the southern state of Brazil. The company then acquired a nursery for 30 million plants and planted forest and a plant with productivity capacity for 390,000 tons of bleached eucalyptus pulp and 60,000 tons of writing and printing paper. Strategically, this was an important acquisition for CMPC as it marked its capacity to further explore the eucalyptus pulping technology first tried with the acquisition of Santa Fé.

[8] The Carlos Anwandter Nature Sanctuary is located in the southernmost province of Valdivia. It represents Chile's most important wetland system, the first site to be included by the Chilean government on the List of Wetlands of International Importance (and the first such site in all of South America) (WWF 2005).

[9] The knowledge the company refers to was used for the design of the plant in 1995; however, it was built in 2003–2004, when there were more advanced technologies available (WWF 2005).

The announcement of CMPC's joint venture with Finnish Stora Enso, at the end of the decade, brings to attention the new strategy the company is adopting. Is it a way to CMPC becoming global? If the Nordic standards of environmental performance are to be followed and the cultural proximity between Chileans and Uruguayans, if those were factors that were not paid enough attention by Metsä-Botnia in the building of its plant in Uruguay, are to play in favor of the new initiative, it might be successful. Anyway, CMPC will be faced with a different organizational culture, which is better experienced in doing business globally and might get more experience if it decides to act more globally in the future.

Considering the scale aspects, the Chilean PPI is a clear example of how trade and liberalization have led to an increase in the activity levels of the industry and better economic efficiency of the plants. The industry has evolved from the government enterprise initiative to private initiative based on the exploitation of mainly natural comparative advantages (climate, soil, geographical location of the forests, and proximity to transport infrastructure) for the benefit of the industry. The small domestic market, though, acted as a force to move the industry abroad and to products of more added value (pulp, paper, sawn wood, and panels). The remaining challenge for the industry is to achieve the formation of a sectoral innovation system to expand its competitiveness. It is needed to operate even to the basic step of forming trained experts, especially for the level of technicians.

Vis-á-vis, the fact that the patterns of technological development of PPI in Chile are still lagging behind the best developed countries in the world, it is important to highlight that the industry shall venture in more advanced collaboration with knowledge producers and invest at its own risk to achieve developed country sectoral innovation standards. Although no forest cluster or sectoral innovation system has so far been developed, the country can count on a group of institutions that could make that construction possible. It seems that the concentration that has happened in the sector is the main hindering factor for developments and there is need for a central actor to coordinate initiatives to promote innovation in the sector. The issue of innovation is discussed later in the next section.

10.2.4 The (Sectoral) Innovation System of Chilean PPI

In terms of technological development, Chilean PPI firms have preferred buying foreign technologies instead of developing their own. They are leaders in cost rather than in technological differentiation (Luraschi 2007; Catalán and Cozzens 2009). The dominance of outside suppliers in equipment and engineering has left limited scope for dramatic differences in mill design. Export market pressure has had a common influence on both foreign and domestic-owned firms, which leads to similar types of environmental changes (e.g., decreases in the use of bleaching). The role of lenders has also influenced companies' behavior, since international agencies have tied funding to environmental performance (Herbert-Copley 1998).

Regarding the technological developments in the industry, throughout the 1990s the State promoted a policy of incentives through the implementation of contestable

funds for research and development and the promotion of partnerships among research institutes (public and private) and private companies. The main private companies undertook investments in their own technological development, and actions to give support with R&D for the small- and medium-sized companies were initiated (Carmona and Garretón 2004).

Altogether, there has been a deficit of studies, research, technology transfer, and product development that could have been addressed by public institutions (CORFO, INFOR, CONAF) (Katz et al. 1999). Therefore, it is not possible to say if there is a sectoral innovation system established in the country for this industry. Companies seem to have ably replaced the government entrepreneurial role once the forest sector, in particular PPI, as it has succeeded very well to the point of making the companies very competitive in costs, for example, as well as the definition of investments priorities as exercised by CORFO. The example of Fundación Chile, a partnership between government and private initiative (nowadays BHP-Billiton – Minera Escondida), is worth noting. It is a nonprofit dedicated to the promotion of technology transfer and knowledge networks for the enhancement of Chilean competitiveness by introducing high impact innovations and improvement of human resource capabilities. Besides other sectors, Fundación Chile works with the forest sector, for which it has developed lines of investigation in forest and ecosystems, carbon, products and services, development and climate change, environmental certification, and wood construction and value aggregation, also acting through one of its companies (GENFOR) (Fundación Chile 2011; Katz et al. 1999; Rodríguez et al. 2008).

Universities are also noteworthy as sources of technological development for the industry, although they are yet more dedicated to the education of human resources and have not developed a tradition of serving the sector. Among those accomplishing research of more impact on the sector, based on the acquisition of contestable funds from the Chilean funding system, are Universidad de Concepción, Concepción University (UDEC); Universidad Austral de Chile, Chile Austral University (UAU); and Universidad de Chile, University of Chile (UCHILE). Among research institutions are INFOR, Instituto de Investigaciones Agropecuarias, Chilean Institute of Agricultural Research (INIA), and Fundación Chile (Rodríguez et al. 2008). Analysis based on the number of publications by institutions reveals that UCHILE; UDEC; Universidad Católica, Catholic University (UC); and UAU are the most productive in the country (Rodríguez et al. 2008). To these can be added the Universidad de La Frontera, the University of the Frontier (UFRO), and Universidad de Talca, Talca University (UTA), as being the most productive in the sector post 1990. Besides productivity, other factors may come to cooperate to the formation of a forest cluster in Chile (Rodríguez et al. 2008).

Small- and medium-sized companies have more difficulties to identify and adopt innovations by means of cooperative partnerships. They see the sector as pursuing a culture of mistrust with companies that compete on low costs. The larger companies, however, see collaboration as more important and participate in both international and national networks, although in selected circumstances. Cooperation among the domestic companies, the big ones, happens only in the precompetitive stage, as, for example,

the cooperation in the Forest Genome Consortia, formed by the two biggest companies in the sector, UDEC and Fundación Chile and Cefor (Rodríguez et al. 2008).

Despite the lack of in-house developments, companies have highlighted the need to proceed to genetic improvement of species used in the industry, mainly the *radiata pine*. The example emphasizing this concern is Arauco S.A., which created its own company to carry out this work, the Bioforest S.A. One of the company's main achievements was the incorporation of the technology of plant propagation in 1999, which was done in partnership with a Canadian institution expert in forest biotechnology (Rodríguez et al. 2008). A sample of the existing research capabilities that can be deployed by and for the industry can be seen in Table 10.3, which shows the list of institutions with available to the forest sector in Chile.

Chilean companies, especially the bigger ones, have invested in technological development, but not yet to the point of becoming leaders in technology, rather in costs, because often they adopt a technology already functioning in other sites. Surely there is a scale advantage, considering those companies that belong to the same group and can share the technology acquired. Not developing own technology makes them dependent on their suppliers, however. Altogether, there is a low level of cooperation between firms in the industry, caused by mistrust and a strategy based on reduction of production costs, and between firms and research institutions, which prevents them from the consolidation of a forest cluster, a base for a more dynamic industry (Rodríguez et al. 2008).

If companies invest more in R&D and, especially, in partnerships among themselves and with research institutions, they can also compete for funding from the State, as there are many modalities available, mostly since the 1990s. These funds are managed by CORFO and by Comisión Nacional de Investigación Científica y Tecnológica, the National Commission for Scientific and Technological Research (CONICYT), which funds (Fondef and Fondecyt) are directed by two goals or pillars: the promotion of human capital and the strengthening of scientific and technological base of the country.

10.3 PPI in Brazil

Brazil[10] is a major participant in the global pulp market, being in fourth place among the biggest pulp producers, especially with short fiber pulp, and in tenth place in the production of paper. The Brazilian PPI utilizes planted forests mainly of eucalyptus, which are concentrated in the southeast and south, in the states of Bahia, São Paulo, Paraná, Minas Gerais, and Rio Grande do Sul. By 2011 companies in the pulp and paper sector owned 2.2 million hectares of plantations (Bracelpa 2011), making the sector not only self-sufficient for raw materials but also a supplier of wood to other industries.

[10] This section on Brazilian PPI is based on Toivanen and Lima-Toivanen (2009). References are in the original unless otherwise stated.

Table 10.3 Research institutions with potential application for the forest industry in Chile

Research and education institutions	Research lines
INFOR Others (INIA)	Mitigation of and adaptation to climate change Bioenergy Inventory and monitoring of forest resources Recovery and forest management Productivity and diversification of forest plantations Technology and wood industry Forest breeding and biotechnology Agroforestry systems Plant production and establishment Non-timber forest products Environment and environmental services Forestry information and economic analysis
Bioforest S.A. Forestal Mininco Others	Site productivity Plantations management Wood properties Genetic improvement of radiata pine and Eucalyptus globus Phytosanitary protection
Fundación Chile	Forest and ecosystems Carbon, products, and services Development and climate change Environmental certification Wood construction and value aggregation
Universidad de Chile Universidad Austral Universidad Católica de Chile Universidad Católica de Temuco Universidad Católica de Maule Universidad de Concepción Universidad de la Frontera Universidad de Talca Universidad del Bio Bio Universidad Mayor	Management and harvest Process Management Silviculture Ecology Wood property, bio deterioration, and preservation Wood applications Inventory and SIG Simulation Urban silviculture Products Genetics Environment Ergonomics Rural development Resources generation Soils Chemical application in wood Others

Source: Based on Carmona and Garretón (2004) and Fundación Chile (2011)

The Brazilian PPI is highly concentrated. Although there are 222 companies producing pulp and paper, among the pulp producers, about eight companies produce 90.5% of the total output, and paper production is concentrated in the southeast (49.1%) and south (41.3%) (Bracelpa 2011). Six out of the nine key companies are vertically integrated, producing both pulp and paper.

Only few references are found on the use and production of paper in Brazil before the twentieth century. All publications in Brazil from its discovery in 1500 to about the beginning of 1800 were made on imported paper. Discussion on the need to produce paper internally can be traced back to 1808, when the Portuguese royal family immigrated to Brazil and the demand for the printing of banknotes, newspapers, and official documents increased. There was an initiative on the part of Friar José Maurício da Conceição Velloso, which requested permission from the court to produce unbleached pulp from local raw material. Other initiatives followed during the 1800s, but they were not able to produce pulp and paper of sufficiently good quality and price to compete with the imported paper (ABTCP 2004). There are registries of some plants in São Paulo in the last decade of the 1800s (ABTCP 2008).

The initiative to build up a national PPI in Brazil was born with the attempts to develop eucalyptus pulp, thanks to dedicated entrepreneurial people in organizations such as companies, research institutes and universities, and government, in the early 1900s. The industry grew up around a completely unknown species that came to be used as raw material for the industry and that led to the development of technology dedicated to its exploitation.

In the next sections, the main phases of the development of the industry are shown with regard to the initial exploitations of eucalyptus and the diffusion of its use, first for railroads and later for pulp production.

10.3.1 Rise of Demand and Establishment of a Learning Network on Eucalyptus-Based Pulp, 1900–1955

The main challenge to establish a PPI industry in Brazil was to find native plants suitable for the production of pulp. With government stimulus for research, various raw materials were tested, such as sisal, bamboo, babassu, caroa, rice husk, gingerlily, and banana tree fiber (ABTCP 2004). Considering the technology used at the time for the production of pulp, the sulfate process, the Brazilian pine tree, or *Araucaria pine*, lent itself to exploration, although with not such good output. By 1940, it was responsible for only 3% of the domestic component in the papermaking mills' raw material stocks (ABTCP 2004). It was with the exploration of eucalyptus that the industry came to be known to the wider word.

The foundations of the sectoral innovation system of Brazilian forest products industry were laid in the late nineteenth century, when the railroads introduced eucalyptus into the country. A fast-growing hardwood tree, eucalyptus forms the raw material base and foundation of Brazilian PPI today. Not indigenous to Brazil, the development of Brazilian eucalyptus as a raw material base for the paper industry was a long interactive learning process that involved selection and adaptation of

eucalyptus species into Brazilian biological environment and innovation in hardwood pulping technologies.

Eucalyptus was introduced into Brazil in 1864, and first plantations produced cross tie sleepers for railroads and coal for locomotives. Systematic scientific work to discover the most suitable eucalyptus tree for Brazilian biological environment and its industrial exploitation started in the early 1900s with Edmundo Navarro de Andrade, known as the "father of eucalyptus" in Brazil. Educated in Europe, he launched experimental work to identify the best eucalyptus species for large-scale industrial forestry in Brazil and suitable for the production of different lumber products.

In the early twentieth century in Brazil, pulp and paper were irrelevant to eucalyptus because of the lack of the right pulp technology. The prevalent global standard, the sulfite pulp process, allowed the exploitation of soft wood and long fiber spruce that produced the best quality paper. Technological solutions for making paper from eucalyptus, not to mention in a profitable way, were unknown.

Although Navarro de Andrade did propose the development of eucalyptus pulp processes in the hope of creating a nascent Brazilian PPI, it took several decades to realize the dream. Eucalyptus pulp remained a curiosity as an industrial product and research subject until the Second World War, when raw material shortages and dependence on pulp imports prompted the Brazilian government to introduce incentives for research on new fiber sources.

10.3.2 Introduction of a Comprehensive Government Innovation Policy, 1955–1970

Since the 1950s, three factors have prompted the Brazilian paper industry to invest increasingly in research and development of eucalyptus forestry and pulp process. First, the rise of Juscelino Kubitschek to the presidency in 1955 invigorated ambitious industrial policies. In PPI, for example, Kubitschek envisaged a crash program of national industrialization aimed at substituting imports of durable and intermediary goods and looked to make Brazil self-sufficient in wood pulp and paper by 1960. Second, the worsening global shortage of pulp, materialized in an over 150% market price increase, paralyzed overseas imports into Brazil and prompted interest in new fiber sources. The third and decisive factor was the maturation of sulfate pulp process technology after decades of sustained, global wave of innovation and its emergence as the dominant mass production technology of pulp in the 1950s.

Between 1955 and 1970, the sectoral innovation system of Brazilian forest products industry was significantly expanded and augmented. Government built knowledge creation and transfer institutions, such as research institutes and universities. It also expanded innovation policy and created new policy instruments which focused on the implementation of new knowledge and technology. These instruments included state and federal level forestry initiatives, government subsidies as incentives for investments in new pulp and paper capacity, and various regulatory and legal initiatives. The new policies created a system that could serve as innovation system, as it

encompassed radically different policy sectors and actors, mobilized the private industry in implementation of policy goals through several initiatives, and amounted to a real innovation policy. Finally, these initiatives allowed the Brazilian system to integrate more closely into the emerging global sectoral innovation initiatives, launched after the Second World War.

The most important boost to the Brazilian PPI was the establishment of the sulfate pulp process as the global standard in mass production technology. It promoted industrial growth in regions where traditional wood species could not be effectively processed with the sulfite process. In Portugal, New Zealand, and the south of the United States, whole new industrial regions emerged.

The introduction of the mass production of sulfate pulp presented great opportunities for Brazilian firms, yet its successful application required intensive industry-level technological learning in the new process and its adaptation to Brazilian virgin fiber sources, Araucaria and, most notably, eucalyptus. Industry-wide learning in new pulp technologies during the 1950s increased the share of short fiber production, consisting almost solely of eucalyptus, from the total Brazilian pulp output from a minuscule 4% in 1950 to 60% by 1960.

The main vehicles of this innovation were the new industrial policies introducing new institutions since the early 1950s. A critical tool of the new policy was the Banco Nacional de Desenvolvimento Econômico e Social – the Brazilian Development Bank (BNDES). It developed new financial instruments to support the industry, fostered economies of scale, and supported the improvement of technological know-how in the industry.

In addition, a host of new educational institutions, universities, and government and private sectoral research institutes began to contribute to the pulp and paper sector. An important landmark was the inauguration of first Brazilian school of forestry at the Federal University of Viçosa (UFV) in 1960, which, in addition to providing education, quickly developed into an important research and technology transfer center. Several other universities followed suit and launched courses on forestry engineering, silviculture, and other aspects of eucalyptus forestry. The schools educated scientifically and technically advanced workforce, accelerated the diffusion of knowledge and technology, and improved the international contacts for Brazilians.

A noteworthy example was that of Indústria de Papel Leon Feffer S.A. (nowadays Cia Suzano de Papel e Celulose), which initiated research in 1954, with the support of chemist Benjamin Solitrenick, in order to improve the production process with the use of 100% eucalyptus pulp. In 1957 they produced for the first time 120 metric tons per day of short-fiber pulp on an industrial scale. Nevertheless, the production was higher than the demand, and the company bought another mill to consume its pulp. This sets an example to other companies, such as Papel Simão and Champion Celulose e Papel S.A., which turned eucalyptus into the main raw material in Brazilian papermaking. With the expansion of domestic production, Brazil started exporting eucalyptus hardwood pulp and paper and attracted new entrepreneurs to the business.

To enable the establishment of industry-level learning and innovation, new industrial policies introduced new institutions as of the early 1950s. An important mechanism for the execution of new policy was the BNDES, which extended much

of the government financial aid and coordinated extensively national industrial investments since its establishment in 1952. Until 1967, BNDES extended only loan guarantees to pulp and paper firms. Nevertheless, its projects proved strategically important for the emerging eucalyptus pulp industry, beginning with the pioneering long-term research programs of Cia Suzano de Papel and Papel Simão. Another landmark project was begun in 1957, when the bank launched its third project in the pulp and paper industry and provided support to the Panamericana Têxtil. Upon its entry onto Brazilian market and the eucalyptus pulp industry, US-based Champion Paper Company acquired the mill in 1961 and pioneered there a new strategy that focused on the advantages of eucalyptus fiber. Champion developed the mill into a large-scale research and development site in eucalyptus silviculture, genetics, and chemical pulping.

Following the industry's developments, BNDES introduced its funding policy and by 1968 also started requesting that companies procured at least half of all pulpwood from their own forests and undertake systemic research and development of eucalyptus process technologies and improved paper grades. In addition, the bank motivated the specification of technical standards, through the Associação Brasileira de Normas Técnicas – the Brazilian National Standards Organization (ABNT).

In the institutional area, a series of new laws removed obstacles to eucalyptus and pine plantations and established new fiscal incentives for industrial reforestation. Much of this work culminated in the forestry law, Código Florestal – Forestry Code (Law 4771 of 15/9/1965). This code allowed for the large-scale use of eucalyptus and pine for reforestation and allowed firms to tax-deduct reforestation activities up to 50% of their full value and established government fund to enhance national reforestation activities, though this was only realized in 1970.

The formation of public-private partnership in PPI, which the first example was the Instituto de Pesquisas e Estudos Florestais – Forestry Science and Research Institute (IPEF) – established in 1968 at the College of Agriculture at University of São Paulo (Esalq/USP), gave rise to joint ventures in research and development in the industry. IPEF was formed by a university and 13 pioneering eucalyptus forestry and pulp firms. IPEF provided a template for public-private partnerships in the PPI R&D, and other forestry schools followed its example.

10.3.3 Innovation, Industrial Growth, and Culture of Entrepreneurship, 1970–1985

In the late 1960s, the necessary elements of rapid growth of Brazilian PPI were in place, including mass production sulfate pulp technology, forestry plantations of selected eucalyptus species, pools of scientifically and technologically advanced workforce, comprehensive sectoral innovation system, and capital and advantageous political economy. Domestic short fiber pulp production also increased tremendously, and the paper industry was able to practically eliminate its previous dependency on pulp imports. There was a huge increase in the production of eucalyptus starting in

the late 1970s, and the production of short fiber pulp increased by over 330% between 1970 and 1980, and by 18% between 1980 and 1985. The share of short fiber from total Brazilian pulp production likewise increased from 60 to 74, though in the context of modest growth, this declined to 69% in 1985 (Appendix 10.2).

New firms and entrepreneurs defined completely new corporate strategies that departed radically from those of the incumbent Brazilian firms. Entrepreneurial firms focused on the export of eucalyptus pulp and pursued strategy based on innovative eucalyptus forestry, state-of-the-art sulfate pulp processes, export markets, and economies of scale. They disregarded the industry's traditional emphasis on the vertical integration of pulp and paper production.

Aracruz and Cenibra, for example, launched massive forestry operations with the intention of establishing subsequently large-scale pulp mills and achieved rapid industrial change in Brazil. They spearheaded a new business strategy and model in the Brazilian and global perspectives, as they pursued eucalyptus forestry, economies of scale, and global export trade in contrast to the incumbent pulp and paper firms which produced pulp mainly to supply own paper production. A culmination of this strategy was the transformation in 1985 of the Aracruz and Cenibra's export port (Portocel) in Espírito Santo into a technologically advanced and dedicated pulp export port. A joint venture of Cenibra and Aracruz and financed substantially through BNDES, Portocel featured advanced railroad, road, and waterway communications to pulp mills of Cenibra and Aracruz and created new economies of scale in pulp exports.

Both firms also received important support from the government, through special support measures of the PPI in its second National Plan for Development between 1975 and 1979. The two mills alone produced over 650,000 ton/year once fully in operation, which took a couple of years, sufficient to increase the Brazilian short fiber pulp production 75% from its 1976 level (Appendix 10.2).

10.3.4 Private Initiative and Government Response, 1967–1990

The take-off of the entrepreneurial eucalyptus pulp industry gave rise to new learning dynamics in the sectoral innovation system of Brazilian PPI. Whereas government initiated frontiers of forestry research, nurtured scientific and technological capabilities, and extended other incentives in order to generate private interest in the nascent industry, new entrepreneurial eucalyptus firms invested heavily in R&D. They pioneered new biotechnological research and innovations in Brazil that translated directly and immediately into new business strategies and industrial operations. In the late 1960s, Aracruz and Cenibra recognized that biotechnology enabled improved control of eucalyptus stock and thereby increased productivity. In particular, novel techniques of asexual reproduction marked an important breakthrough in the production of standardized and controlled eucalyptus forests and contributed to tremendous productivity improvements in eucalyptus forestry after 1970. With the pioneering private experiments and research programs, Brazilian government and incumbent paper firms embraced these new technological opportunities and

launched series of initiatives, which turned the country into a leader in forestry biotechnologies.

Investments in eucalyptus R&D quickly yielded impressive returns. Standardized stock improved disease resistance, improved economies of scale in forestry and wood handling, and made the management of the pulp digesting process easier. In addition, biotechnological innovation improved growth yields. The first Aracruz eucalyptus trees required 12 years to grow to logging size, but the company's systematic research and development program diminished the average growth cycle to seven by the mid-1980s. IPEF has estimated that the average annual production of Brazilian planted forests increased from 15 m^3/ha in 1970 to almost 35 in 1985. In 2010 this indicator reached to 41 m^3/ha (Bracelpa 2011).

At state level, actions taken, especially in São Paulo, were important. The Institute for Technological Research of the state of São Paulo (IPT), a public research institute linked to the Secretariat for Economic Development, Science and Technology of the state of São Paulo, set up a testing laboratory to attend to requests from government agencies and private firms. At the beginning of the 1960s, the lab was incorporated into the wood division as two labs: a forest products lab and a by-products (extractives) lab. In partnership with the Finnish company Jaakko Pöyry, in the 1970s, FAPESP supported the upgrading of pulp and paper knowledge and skills at IPT. As a result of these efforts, IPT in 1967 established the Technical Center for Pulp and Paper (CTCP) and in 1981 inaugurated a pilot plant for high yield pulp with 8 ton per day capacity with resources from the Inter-American Development Bank, channeled through the Financiadora de Estudos e Projetos – the Brazilian Innovation Agency (FINEP).

Public and private initiatives gave important input for the industry's technological development and growth. As already noted, IPEF, the public-private partnership for research in forestry, was established in 1960. The private sector quickly created many new institutes and initiatives to advance eucalyptus-related R&D, and the government also expanded its activities. Importantly, the Brazilian Agricultural Research Institute (EMBRAPA) established the Center for National Forestry Research (CNPF) in 1978 in order to address the increased interest in eucalyptus forestry.

In total, eucalyptus plantations increased from one million hectares in 1970 to 3.6 million by 1990, and the majority of the growth came from plantations of biotechnologically improved examples species of *Eucalyptus saligna* and *Eucalyptus grandis*. The growth of the plantation area also gave rise to environmental criticism, such as the alleged spread of monoculture at the cost of biodiversity, and most forestry firms initiated plantation schemes that created corridors of natural forests inside the vast eucalyptus fields.

Aracruz started silvicultural forestry research in 1967, when it created its first industrial eucalyptus plantations using species imported from Rio Grande do Sul and derived from seedlings imported to Brazil in the early twentieth century. Using seedlings of 50 different species, Aracruz created over 1,000 experiment stations to try out different characteristics and sort out the best examples. The cloning program yielded rapid improvements in disease resistance and pulping qualities, and allowed enhanced standardization of fiber raw material.

In Brazil, IPEF and the University of São Paulo in Piracicaba experimented with the cloning technology as of 1975 and also launched a systematic research program on the subject. Other companies, such as Cia Vale do Rio Doce, Cia Suzano, Duratex Florestal, and Klabin, followed the example of Aracruz and launched cloning programs. In most companies, research intensive forestry was delegated to specialized forestry divisions, such as the Florestal established in 1983. Cenibra acquired its seedlings from Southern Africa and established cloning program in Minas Gerais in 1984 and 1985, with cloning operations centralized on the Ipatinga plantation, which exceeded 700 ha by 1989 and 2,500 in 1994. The company evolved its strategy of forest development through a forest development program which outsources the supply of eucalyptus to small farmers of 93 municipalities of the state of Minas Gerais, located within a maximum distance of 150 km from its pulp mill and reached 129,387 ha in 2011 (Cenibra 2011).

10.3.5 Catch-Up Learning Dynamics: Second-Generation Innovation System and Expansion, 1990–

Since 1985, Brazilian PPI's evolution has been characterized by global incumbent firms' catch-up with pioneering eucalyptus pulp firms and consolidation. Latecomers into the eucalyptus business benefitted from the industry's advanced sectoral innovation system, which rapidly diffused the latest innovations and knowledge and government policies, although their success cannot be solely attributed to these factors. Established large-scale paper firms had exceptional organizational capabilities and political leverage to enter the eucalyptus business at a point when the industry's operations and size reached an unprecedented scale in Brazil. Between 1985 and 2005, the eucalyptus PPI expanded steadily, and Brazilian annual production of short fiber pulp increased 60% between 1985 and 1995, and 81% between 1995 and 2005. Total annual production of pulp soared from 3.7 million tons in 1985 to over 10 million tons in 2005 (Appendix 10.2).

This massive expansion entailed profound changes in the industry's organizational structure, as the existing Brazilian firms began to emulate the strategy of the pioneering entrepreneurial firms and caught up with them. Not only have incumbent Brazilian pulp and paper firms entered the eucalyptus paper business, but many global industry leaders have entered Brazil. In 2000, the Finnish-Swedish Stora Enso, then the world's second largest pulp and paper enterprise, entered a joint venture with Aracruz, which was incorporated by Votorantim Celulose e Papel (VCP) into Fibria in 2009, and has since established its presence in Latin America.

The two companies jointly own Veracel Celulose, whose sulfate eucalyptus pulp mill in Bahia went online in 2005 and was to the date the world's largest with annual production capacity of 900,000 tons. The joint venture marked Stora Enso's entry into Latin America and secured access to state-of-the-art eucalyptus know-how. The two companies share production of Veracel, and whereas VCP sells market pulp, Stora Enso uses its entire share to substitute for birch pulp at its European paper

mills. In this sense the joint venture has been an important learning experience for the Scandinavian firm, as it has been able to experiment with new pulp source and to adjust European printing paper mills to new pulp.

The entry of incumbent firms into eucalyptus forestry and pulp business, and the ensuing merger wave changed the industry's organizational structure. In the 1990s, a consolidation wave characterized the Brazilian PPI as over 30 major mergers occurred between 1992 and 2001. Aracruz, Cenibra, Celmar, Veracel, and Jari remained focused upon pulp production and export markets, and accounted for 71% of market pulp production in 2002.

The response of the Brazilian sectoral innovation system to the recent rise of genome research and improvement of eucalyptus has followed largely historical precedents. Firms, industry associations, and regional and federal governments have launched cooperative initiatives that coordinate national research efforts and technology transfer. Indeed, it appears that Brazil's sectoral innovation system is renewing itself at an amazing pace and is poised to be world leader in eucalyptus genomic research. The cooperative nature and extent of the Brazilian genomic research platform, which extends to the regulation of biosafety and other legislative initiatives, represents a departure from the previous structure of sectoral innovation systems.

Eucalyptus genome research took hold in Brazil when some of the leading research institutes, such as IPEF, advocated the possibilities of gene technology for forestry in the mid-1980s. A real turning point occurred in the early 1990s with global advances in genomics research, however. Since 1994, the industry has advocated greater government participation and the initiation of a national eucalyptus genome mapping project, eventually launched at the turn of the millennium. Eucalyptus genome research is supported by particularly strong investment in Brazil. In 1997, the State of São Paulo Research Foundation (FAPESP) created the Organization for Nucleotide Sequencing and Analysis network, which encompasses 30 laboratories across the state. In addition, the Conselho Nacional de Desenvolvimento Científico e Tecnológico – the National Council for Scientific and Technological Development (CNPq) – has funded several research projects, and the Ministério de Ciência e Tecnologia – the Ministry of Science and Technology (MCT) – launched Brazilian Genome Project in 2000. Its many dedicated genome mapping initiatives included Genolyptus project – the Brazilian Eucalyptus Genome Network, launched in 2002, as a major cooperative project, involving key trade associations, universities, research institutes, and government bodies. The Genolyptus project reflects a wider government ambition to create industrial competitiveness through biotechnological research and innovation programs, and it may eventually produce the first transgenic eucalyptus species.

The expansion of forestry-related biotechnologies has been accompanied by increased environmental, social, and ethical criticism of cloning and genome research and development work. This has prompted the government to introduce clear environmental and bioethical limitations. A specific biosafety law regulating several aspects of agricultural biotechnologies and innovation was introduced in the mid-1990s and came into force in 2005, after much criticism (Brazilian Biosafety Law 11105). The law introduced a comprehensive regulatory framework

for biotechnology in Brazil and provides an important framework for innovation in forestry at public research institutions and industry. Its enactment also marked an important extension of innovation policies into ethics and safety laws, and provides one of the latest examples of network learning and expansion in the sectoral innovation system of Brazilian forest products industry.

Movements of expansion and consolidation have still been quite significant in South America at the end of the first decade of the 2000s. The most impressive of these was the incorporation of Aracruz Celulose S.A. by Votorantim Celulose e Papel S.A. The resulting company, Fibria S.A., which began operations in September 2009, became the world leader in the production of market pulp, reaching 5,177 thousand tons in 2009, which corresponded to 38.9% of the total Brazilian output. Fibria operates 5 plants, with a total annual capacity of 5.4 million tons of pulp and 313 thousand tons of paper. In acquiring Aracruz assets, Fibria also bought its participation in Veracel (retaining 50% of the joint venture). In 2009 Fibria sold its Guaíba plant to CMPC, and in 2011 its 50% interest in Conpacel went to Suzano (Pöyry 2011).

A clear example of the expansion of the construction of new plants, and the local concentration of such constructions, is the industrial complex that is being established in the city of Três Lagoas, in the state of Mato Grosso do Sul, Brazil. Inaugurated in March 2009, the Fibria plant, started as a VCP project, started up with the capacity to produce 1.3 million tons/year. The company has a plan to expand its plant by building a second line to produce 1.75 million tons/year (Pöyry 2012). In 1989 International Paper also built a paper plant with annual capacity to produce 200,000 tons/year. The company Eldorado Florestal is planning the construction of a pulp plant, aiming at being the biggest single-line pulp plant in the world, with a production capacity of 1.5 million tons/year, to be started up by the end of 2012. The pulp production capacity to be installed in a single city after all the plants are in operation will amount to 4.55 million tons per year. The supply of wood for these plants is being produced in the surrounding region. Considering all the activities and personnel needed to give support to the operations of these plants, besides the indirect economic activities carried out because of or influenced by their businesses, a study on how the natural environment can cope with the ever-increasing pressure on its resources and the ensuing social and economic impacts due to them will be of some importance, guiding future interventions of this kind, as well as on the corporate social responsibility of the companies.

One could argue that positive impacts are already happening, considering Fibria's results. In justifying the expansion of its production capacity, Fibria has claimed that it has already contributed to the economic development of the region by means of taxes collected, a growth of 300% of the gross domestic product of the city of Três Lagoas and of the 13% of the whole state of Mato Grosso do Sul, besides investments in infrastructure and social programs, such as social support and education as means of carrying out its corporate social responsibility commitments (Pöyry 2011) and the use companies are making of the possibilities for the sustainable use of resources. Surely it has contributed to the increase in the output of the industry (Appendix 10.2). It is not possible, however, to evaluate in the near future only the complete range of potential impacts in the region or in the country with the commencement of projects of such magnitude.

10.3.6 The Sectoral Innovation System of Brazilian PPI

The growth and evolution of the sectoral innovation system of Brazilian PPI has been punctuated by the needs of firms, economic, and industrial policies, as well as the global advances in science, technology, and world trade. The result is a unique sectoral innovation system that applies exclusive Brazilian knowledge and innovation needs, as well as maintaining a division of labor between Brazilian and foreign actors. While large and somewhat diffuse, the system should be characterized as highly focused on the core issues for the competitiveness of Brazilian PPI. Even at the risk of oversimplification, one could argue that the system invests in basic research and fundamental innovation only when it comes to further exploiting the advantages offered by eucalyptus. In the case of research and innovation in other scientific and technological areas, such as chemical processing, energy, equipment, and machinery, the system creates national capacities to use the globally best available practices and technologies.

Brazil as a nation is a late entrant into PPI; therefore, much of the system is geared toward catching up. Evidently, the capacity to exploit and absorb knowledge and innovations from abroad is certainly one of the great strengths of the Brazilian sectoral innovation system. The training and education system in Brazil turns out a body of skillful labor and scientifically and technologically advanced workforce, which can take advantage of the best technologies and practices developed elsewhere. Most firms train blue-collar workers, and there are some vocational schools. Critical for the supply of scientifically and technologically advanced workforce are the federal and state universities, which have created special curricula in pulp and paper science and engineering, forestry engineering, and management. The most important of these are at the UFV, the Federal Rural University of Rio de Janeiro (UFRRJ), and the USP.

State governments and regional innovation systems are playing highly critical roles, too. IPT of São Paulo has provided wide range of R&D services. The most relevant products and research results of IPT have been the first works in Brazil on pyrolysis, gasification of biomasses, and biofuels; the first thermomechanical pulping (TMP) and chemithermomechanical pulping (CTMP) processes in Brazil; the first development of models and simulation and reevaluation and debugging of the code of software GEMS; the first studies on pitch and stickies in Brazilian eucalyptus production; studies on hydrolysis (acidic) of wood and sugarcane bagasse for ethanol production; leadership in the Brazilian collaborative proficiency testing for paper and paperboard; and strategic planning for the sector was initiated in the CTCP with the top managements of the industry (IPT 1999).

Industry associations and professional societies, of which the Brazilian Pulp and Paper Technical Association (ABTCP) and Brazilian Association of Pulp and Paper (BRACELPA) are the two most important, also provide continuing education and disseminate the latest knowledge that is highly relevant for the industry. Knowledge and technology transfer are also catalyzed by several sectoral research institutes and international scientific and technical organizations and especially by the strong presence of foreign firms in Brazil.

Apart from eucalyptus science and technology, foreign firms are a key vehicle of technological learning and source of innovations in the Brazilian PPI. Engineering service firms, such as the Finnish Pöyry Group, provide the latest scientific and technological knowledge and deliver state-of-the-art pulp and paper mills. Equipment and machinery suppliers, such as the Finnish Metso and German Voith, do the same in pulp and paper equipment. The role of foreign firms in knowledge and technology transfer is also facilitated by the industry and trade associations, which often network and liaise with their international counterparts.

Eucalyptus occupies most of the attention of the Brazilian research efforts. The sectoral innovation system maintains a fairly clear distinction between applied and basic research, although the recent advances in genomics and biotechnology blur this distinction. Basic research is mainly carried out at the universities, and three of them stand out as central hubs of research: the Federal University of Rio Grande do Sul (UFRGS), the UFV, and the USP.

In 2002, IPEF listed 54 public research institutes active in forestry and 16 private ones. Although these institutes serve all kinds of knowledge needs in the area of forestry, they also constitute the backbone of the Brazilian knowledge base for industrial forestry. In addition to IPEF, the most important of these are EMBRAPA and the Sociedade de Investigaçoes Florestais – the Society for Forestry Research, at the UFV.

At the federal policy level, several ministries and their agencies have responsibility for the sectoral innovation system of the Brazilian PPI. The key ministries are the Ministry for Science and Technology, the Ministry of the Environment, and the Ministry of Development, Industry and Trade, and their agencies. Naturally, BNDES continues to be of great significance.

The sectoral innovation system of Brazilian pulp and paper is remarkable in two key aspects: research policy and the role of firms. From the point of view of research policy, the fundamental and most serious scientific and technological research goal is to improve the productivity of Brazilian forests and primarily of eucalyptus. This strategy has manifested itself in an ambition to emerge as the global leader in the field, and indeed Brazilian scholars, research institutions, and firms have accomplished this. The scientific and technological ambition level in other research areas is considerably lower, and more attention is paid to capacity building and technology transfer, enabling the quick adoption of innovations developed elsewhere. This same dual strategy also underpins educational policies and institutions.

10.4 PPI in Uruguay

Little understanding of the evolution of the innovation system supporting PPI in Uruguay can be provided due to the relative newness of the industry in this country. Uruguay and the pulp plants in its territory regularly figured in media because of the protests against the installation of pulp mills on the border of the river Uruguay in the mid-2000s. The various motivations for the protests and the

Table 10.4 Planned Investments in the PPI in Uruguay

Company	City	Capacity (tons/year)	Phase	Date of notice	End	Investment (million $)
Montes del Plata (Stora Enso and Arauco)	Punta Pereira	1,300,000		7/2004	2013	1,900.00
Celulosa Argentina	Not decided	700,000	Study		2021	–

Adapted from Lima-Toivanen and Mikkilä (2006), data source: adapted from Risiinfo (2006) and Pöyry (2012)

reasons underlining them have been a subject of discussion, especially in regard to corporate responsibility. A description of the case can be found in Lima-Toivanen and Mikkilä (2006), Kosonen (2008), and Red (2006), for example.

Indeed, the government in the mid-1980s began encouraging forest plantations, which made it possible to increase the PPI output of the country from approximately 37,000 tons of wood pulp in 2005 to 938,000 tons in 2008 (RISIINFO 2009) to projected 2,400 thousand tons per year with the construction of 2–3 new plants, considering announcements released by the industry, according to Table 10.4. This will put Uruguay among the world leaders for size of operations, in pulp (bleached hardwood kraft) production.

November 2007, when the Botnia pulp plant came into operation, PPI in Uruguay had a very low production level, when compared to that of other South American countries. Until 2006 the country has had only three pulp and paper companies: Fábrica Nacional de Papel S.A. (Fanapel[11]), a pulp and paper producer, and Papelera Mercedes S.A. (PAMER[12]) and Industria Papelera Uruguaya S.A. (IPUSA[13]), both paper producers. The combined output of these companies was about 46,000 metric tons per year of pulp and 11, 2000 metric tons per year of paper and paperboard (Lima-Toivanen and Mikkilä 2006). Basically, it can be said that PPI in Uruguay, for the worldwide audience, started with the construction of the Botnia mill, now UPM.

In the institutional arena, the structure that gave support to the forest development in the country was initiated by the Forest Department, nowadays the Ministry of Livestock, Agriculture and Fisheries. The first forestry law of Uruguay, the law 13723, was enacted in 1968, and the Department of Forestry became the executive body in the field and of forestry policy (Polla 1998). Since 1987, with the passing of

[11] Fanapel has an industrial plant (pulp and paper) in Juan Lacaze (Colonia, Uruguay) and notebooks in Montevideo and distributors in Montevideo and Santiago (Chile) (Fanapel 2011).

[12] Pamer was founded in 1937 and produces corrugated paper in an integrated way from forest to paper, and packaging paper and tissues from recycled fiber. It is located in Soriano (Pamer 2011).

[13] IPUSA was built in 1920 and acquired by the Chilean Holding CMPC in 1994. It is located in Pando, near Montevideo. It has two paper machines, two converting line rolls, and a diaper machine for production of disposable infant diapers (IPUSA 2011).

Forestry Law 15939, the government has supported planted forests by granting tax benefits when they are established in Forestry Priority Areas (extending from over 2.5 million to 3 million hectares) (FAO 2009). Availability of inexpensive flat terrain and favorable climate and soil provided ideal conditions for the increase of plantations. By 2005, Uruguay had 0.8 million hectares of planted forests and an annual planting rate of 50,000 ha (FAO 2009). Investments for pulp production carried out in Uruguay were designed following investments or acquisition of those realized in forestation.

The Finnish Botnia's operations started in Uruguay with the buying of 60% of the Uruguayan company Compañía Forestal Oriental S.A. (formerly FOSA) from Shell International Renewables B.V. (Shell). Originally, FOSA was founded in the 1990s by UPM Kymmene Oy and Shell. Forestal Oriental is one of Uruguay's biggest forest owners and a pioneer in eucalyptus cultivation and seedling production. In 2008 Forestal Oriental had approximately 100,000 ha of eucalyptus plantations, which were enough to cover about 70% of the mill's wood need. The rest was covered by buying from private landowners with long-term agreements. For Botnia, the important factors for its operations in Uruguay were the availability of and access to wood and being granted of free trade zone status (Kosonen 2008).

The pulp mill project realized by Botnia S.A. was founded in Uruguay by Metsä-Botnia (82.1%), UPM-Kymmene (12.4%), and Metsäliitto (5.5%), and the Otegui Group, a local partner, participated in the project with a 9% share in the Botnia S.A. In December 2009, the assets of Metsäliitto, M-Real, Botnia, and Forestal Oriental were sold to the Finnish UPM. UPM became the owner of 91% of the Fray Bentos pulp mill and 100% of Forestal Oriental.

The Spanish Ence started investing in Uruguay in 1990 with the establishment of a subsidiary, named Euroflores, to conduct plantation operations and to manage its natural forests. The company owned 94% of 53,000 ha of forest and was the major exporter of pulpwood in Uruguay. Euroflores is also a shareholder in the logistic terminal of M'Bopicuá, also located in Fray Bentos, in Maserlit, a *Eucalyptus grandis* sawmill, which produces 35,000 m^3 of sawn wood per year, and also operates a logistics center in the city of Peñarol, where it has a wood chipping plant (Lima-Toivanen and Mikkilä 2006). Its assets were sold to the Finnish Stora Enso and the Chilean Arauco, which formed the joint venture Montes del Plata in October 2009, aiming to build a plant with a capacity of 1.3 million tons per year. At the beginning of 2011, the government of Uruguay granted the companies the environmental license to proceed with further studies for building the plant.

The companies that have built pulp mills in Uruguay have announced their investments as being carried out following the best available technologies for production and environmental management, with the application of the elemental chlorine free (ECF) process, for example, envisioning the supply of their own paper operations in Europe. This should afford them the support needed as credentials for their operations and environmental standards. However, they should not take it for granted that it will exempt them from receiving criticism be this from locals or Argentinians, though.

10.4.1 The Challenging Environment for PPI in Uruguay and Corporate Social Responsibility

Companies now investing in Uruguay have some precedent situation upon which to build their strategies. The business climate in the country is fairly stable, but the Metsä Botnia project was affected by regional politics, which was an impediment to the approval of the company's operations. The local supply of knowledge and technologies to the companies is another challenge.

As regards challenges to businesses, although the dispute between Uruguay and Argentina over the installation of the pulp plants in Uruguay had become a concern mostly for environmentalists, it also fits the discussion of political conflicts that impact businesses and the social responsibility of companies. Although the case was specific to Uruguay and Argentina, it shows that there is a high level of environmental awareness among people and organizations involved with the approval and social validation of investments of this nature in South America and not only in the case of Uruguay.

As stated before, Ence called off its investments in Uruguay and sold its assets to Stora Enso and Arauco. These companies decided to install their joint-venture pulp mill in Punta Pereira instead of Fray Bentos, as planned by Ence. The Botnia plant went into production on November 2007. The political and legal dispute between Argentina and Uruguay was resolved on November 14, 2010. From that date onward, both countries will share the monitoring of the UPM plant through the CARU. With the granting of the environmental license to Stora Enso and Arauco, the reaction of Argentinians is an expectation for the media and the companies themselves (YLE 2011), although it has not been felt yet.

10.4.2 R&D for the Pulp Mills

Regarding supply of competent human resources and facilities for the forest industry, Uruguay is still lagging behind. According to Foelkel (2008) the main problems are the lack of R&D and educational institutions in the country and the needs for adjustments and adaptations of the forest technology from tree breeding technologies to silvicultural practices and industrial productive processes and best practices. As an example of the last one, forest productivity varies from 10 to 32 cubic meters per hectare per year, far from the 40–50 achieved in Brazil, even though some forest companies use cloning techniques (Foelkel 2008).

The few outstanding institutions in Uruguay that could supply R&D and qualified professionals are the Universidad de la República, the University of the Republic (UdelaR), Laboratorio Tecnológico de Uruguay, the Technological Laboratory of Uruguay (LATU), and Instituto Nacional de Investigación Agropecuaria, National Agricultural Research Institute (INIA), even though they have no tradition in participating in partnerships to provide solutions for such specialized demands. In order to provide solutions, the local industry is investing in upgrading of human resources. There are graduate and undergraduate courses

being created, oriented to forestry and wood technologies. One example of the solutions can be seen through the recently established professional master's degree course in pulp and paper science and technology, in a partnership among Universidad de la República's Department of Forest Products Engineering, Helsinki University of Applied Sciences (Finland), LATU and forest-based companies and suppliers to this industrial segment (Foelkel 2008).

PPI in Uruguay is undergoing a process of ownership restructuration and intensive construction of pulp plants. Companies are relying on in-house expertise for providing technological solutions and have to supply locals with technical education in order to guarantee a supply of labor force. The "Uruguayan case" is a case to follow not only to verify the political and legal outcomes but also because of the possibility of verifying the impact such concentration of plants can have on the environment. It can be a model to influence decision-makers in the government and companies on whether to support initiatives related to the location of new PPI plants.

10.5 Final Considerations

The cases presented in this chapter are representative of the path of development of South American PPI and the recent moves for concentration of pulp producing operations in the region and the expertise established in order to secure its competitive advantage. The different trajectories chosen by the industry in Brazil and Chile, themselves latecomers in the PPI business, may seem well advanced when compared to the very beginning of the history of PPI itself.

In the case of the Brazilian companies, it can be seen that the growth of the industry occurred in tandem with the establishment of technological and educational institutions, often with the participation of companies on the boards of these institutions, which came to play an important role in the development of the companies themselves. The catching up strategy the industry adopted since early on, which originated in the minds of entrepreneurs, in the government, companies, and research institutions, was the main motive for the adopting of technology as the driver for growth and expertise. The cutting edge factor was definitely the adoption of eucalyptus as raw material, which demanded the assembly of a knowledge creation structure to be explored. The visionary instinct of the first explorers of the wood should be given credit for the enterprise. Having guaranteed the catching up with the mainstream, the companies are now benefiting from the competitive advantages built in order to expand its operations and participate increasingly in the world market, especially then in pulp.

The growth of the industry did not happened without criticism from various sectors of society. Although not so strongly as it happened in the case of Uruguay, there have been movements indicating the insufficiency of the environmental and social approaches the companies have taken in conducting their business in the local level. There are, however, many positive examples of how engagement in corporate social responsibility has facilitated the acceptance of the companies by the communities

affected, especially now when the plants are built far from the main urban centers and it is believed they contribute to the reduction of regional inequalities.

In the case of Chile, interactions for technological development of the industry have not happened often enough, for the companies chose not to develop their own technologies and mostly invest in comparative advantages, such as availability of raw materials and lower costs of labor, and building on their local knowledge of the business environment. The concentration and to some extent the lack of competition in the domestic market led the companies to this somewhat comfortable position. The concentration of the industry, the reasons why it happened, showed more of the realization of political and economic instinct of the entrepreneurs who gave rise to it than of their interest in taking part in the technological advancement of the industry. The government was more entrepreneurial in the sense of having started the first operations in the country. Companies in the industry have not challenged themselves to promote novelty in any aspect of their operations. The joint venture of CMPC with Stora Enso in their Uruguayan plant may be of a conflicting nature considering the differences in technological standards of the companies. The companies, however, are taking fewer risks for one has dominium over technology as the other masters the local knowledge. Will it be a successful case, not so media-frenetic, as the UPM plant has been in the near past?

In the case of Uruguay, little could be shown in terms of the competitive situation of the industry because there has been almost none developed until the recent wave in investments that happened in the country. The case remains interesting in any case as to how the recently installed companies will cope with this lack of local technological capacity. The challenges that the new UPM plant has faced might thus be of interest to other companies buying properties and planning to open plants in the country. If the development and acquisition of technology are not an emerging problem, they can bring their own technology in and educate people with the expertise needed; the local identity characteristics play a bigger than expected role in the conduct of business.

Having presented the cases, there remains a question: what will be the future of PPI in South America as a whole? As companies enlarge their operations, how will the countries resources adapt? Especially, what kind of regulations will come into force? As rules disciplining environmental exploration, impact, and preservation have recently been the main subject of discussion, moves toward concentration and the size of companies may call for action from the economic regulators also ruling on prevention of monopolies. In this short history of PPI in South America, one may expect more detailed studies addressing these issues, as well as on the evaluation of different kinds of impacts of the companies' operations and on the whole ecology of the industry itself.

Appendix 10.1: Production and Export by Product (1,000 ton), PPI in Chile, 1980–2007

	Pulp		Paper and board		Newsprint	
Year	Production	Export	Production	Export	Production	Export
1980	632.2	414.8	324.4	86.3	131.0	65.4
1981	617.9	412.4	319.7	59.2	130.7	42.7
1982	552.3	462.1	262.6	71.7	124.4	54.9
1983	656.2	523.4	324.9	113.3	155.2	92.2
1984	682.3	492.7	365.8	136.2	167.6	110.4
1985	679.6	503.1	369.4	144.7	172.1	116.4
1986	693.5	565.2	387.8	152.3	168.8	131.5
1987	708.4	524.6	441.9	136.6	179.5	126.4
1988	728.0	479.2	449.8	131.4	184.3	120.7
1989	679.8	481.6	437.8	139.9	166.5	125.6
1990	644.3	581.1	462.0	131.0	171.0	115.0
1991	934.0	664.5	485.0	155.1	171.0	114.9
1992	1,499.0	1,210.0	508.0	131.5	161.0	111.5
1993	1,491.0	1,160.0	552.0	154.0	180.0	125.0
1994	1,940.0	1,370.0	569.0	167.0	190.0	130.0
1995	1,646.0	1,040.0	557.0	160.0	220.0	140.0
1996	2,060.0	1,340.0	638.0	185.0	300.0	160.0
1997	2,040.0	1,100.0	665.0	210.0	280.0	180.0
1998	2,205	1,729	642	189	163	117
1999	2,430	2,020	796	292	225	164
2000	2,492	1,834	836	322	255	183
2001	2,552	2,173	867	345	276	176
2002	2,617	2,034	978	425	274	218
2003	2,776	2,124	1,109	502	289	229
2004	3,409	2,545	1,230	536	316	247
2005	3,315	2,626	1,213	531	329	248
2006	3,540	2,578	1,332	579	334	260
2007	4,713	1,858	1,378	558	314	232
2008	4,985	4,060	1,388	605	312	220

Source: 1980–1997 Herbert-Copley (1998),[14] 1998–2008 Risi (2009)

[14] 1980–1992 figures taken from Stumpo, 1995, based on INFOR data; 1993–1997 figures are from Pulp and Paper International Annual Reviews, various years.

Appendix 10.2: Production of Long and Short Fiber Pulp in Brazil (tons), 1950–2010

Year	Chemical and semichemical			High yield pulp	Total	Growth (%)
	Softwood	Hardwood	Total			
1950	38,367	1,592	39,959	55,400	95,359	
1951	42,522	2,428	44,950	62,900	107,850	13.1
1952	45,324	9,657	54,981	65,900	120,881	12.08
1953	47,547	8,436	55,983	68,400	124,383	2.9
1954	46,970	16,989	63,959	64,900	128,859	3.6
1955	50,182	22,986	73,168	72,900	146,068	13.35
1956	51,962	25,848	77,810	75,900	153,710	5.23
1957	55,830	30,143	85,973	79,400	165,373	7.59
1958	66,983	52,449	119,432	86,000	205,432	24.22
1959	79,531	65,150	144,681	84,600	229,281	11.61
1960	80,329	119,908	200,237	86,200	286,437	24.93
1961	95,525	133,710	229,235	94,000	323,235	12.85
1962	116,188	161,959	278,147	103,500	381,647	18.07
1963	136,391	183,108	319,499	128,400	447,899	17.36
1964	148,706	195,083	343,789	161,400	505,189	12.79
1965	166,211	203,862	370,073	201,500	571,573	13.14
1966	213,652	237,973	451,625	210,000	661,625	15.76
1967	196,524	278,699	475,223	123,586	598,809	–9.49
1968	209,889	307,237	517,126	106,507	623,633	4.15
1969	226,958	340,353	567,311	116,722	684,033	9.69
1970	278,156	385,907	664,063	113,206	777,269	13.63
1971	292,142	429,358	721,500	136,863	858,363	10.43
1972	308,636	589,704	898,340	140,136	1,038,476	20.98
1973	329,828	641,859	971,687	158,783	1,130,470	8.86
1974	379,169	750,357	1,129,526	164,888	1,294,414	14.5
1975	358,768	830,840	1,189,608	162,578	1352186	4.46
1976	450,502	803,282	1,253,784	182,994	1,436,778	6.26
1977	509,105	993,165	1,502,270	170,177	1,672,447	16.4
1978	539,512	1,274,482	1,813,994	190,343	2,004,337	19.84
1979	606,982	1,840,769	2,447,751	220,138	2,667,889	33.11
1980	755,572	2,117,124	2,872,696	223,569	3,096,265	16.06
1981	742,006	2,053,784	2,795,790	196,535	2,992,325	–3.36
1982	799,421	2,095,349	2,894,770	216,386	3,111,156	3.97
1983	891,731	2,166,042	3,057,773	207,916	3,265,689	4.97
1984	937,643	2,426,742	3,364,385	237,366	3,601,751	10.29

(continued)

(continued)

Year	Chemical and semichemical	High yield pulp	Total	Growth (%)	Year	Chemical and semichemical
1985	1,058,310	2,345,154	3,403,464	312,513	3,715,977	3.17
1986	1,119,768	2,435,639	3,555,407	358,330	3,913,737	5.32
1987	1,164,055	2,500,406	3,664,461	390,471	4,054,932	3.61
1988	1,242,618	2,550,250	3,792,868	397,688	4,190,556	3.34
1989	1,226,011	2,717,868	3,943,879	426,421	4,370,300	4.29
1990	1,174,456	2,740,232	3,914,688	436,455	4,351,143	–0.44
1991	1,212,464	3,134,056	4,346,520	431,596	4,778,116	9.81
1992	1,262,319	3,608,248	4,870,567	431,777	5,302,344	10.97
1993	1,357,412	3,652,776	5,010,188	460,742	5,470,930	3.18
1994	1,363,237	4,013,034	5,376,271	452,599	5,828,870	6.54
1995	1,411,505	4,031,437	5,442,942	492,965	5,935,907	1.84
1996	1,345,347	4,390,831	5,736,178	465,257	6,201,435	4.47
1997	1,282,078	4,622,047	5,904,125	427,037	6,331,162	2.09
1998	1,246,780	4,984,613	6,231,393	455,513	6,686,906	5.62
1999	1,405,298	5,359,525	6,764,823	444,309	7,209,132	7.81
2000	1,422,205	5,539,265	6,961,470	501,796	7,463,266	3.53
2001	1,438,495	5,504,971	6,943,466	468,561	7,412,027	–0.69
2002	1,508,728	6,016,969	7,525,697	495,398	8,021,095	8.22
2003	1,511,866	7,098,339	8,610,205	459,042	9,069,247	13.07
2004	1,537,586	7,612,426	9,150,012	470,131	9,620,143	6.07
2005	1,536,328	8,316,134	9,852,462	499,651	10,352,113	7.61
2006	9,260,341	1,422,192	10,682,533	497,440	11,179,973	8
2007	10,001,444	1,474,842	11,476,286	521,378	11,997,664	7.3
2008	10,612,587	1,576,357	12,188,944	507,602	12,696,546	5.8
2009	11,374,056	1,512,329	12,886,385	428,488	13,314,873	4.9
2010	12,137,071	1,596,541	13,733,612	430,727	14,164,339	6.4

Source: Bracelpa Statistic Reports (various years)

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Chapter 11
The Pulp and Paper Industry Evolution in Russia: A Road of Many Transitions

Olga Mashkina

11.1 The Era of the Russian Empire

11.1.1 Beginning: Development of Technology, Use of Raw Materials and Products

History suggests that manual papermaking in Russia began in the middle of the sixteenth century under the rule of Czar Ivan the Terrible. However, the attempts were not very successful, and many of the mills did not remain operational. Thus, the main drive for development in papermaking was seen during the rule of Czar Peter the Great. The establishment of the first Russian newspaper in 1703 and the publishing of books on science and technology required a lot of paper, thereby giving impetus for the development of the industry (Reztsov 1912; Uchastkina 1972).

The construction of the first manual paper mill, Krasnoselskaya Mill, began in 1714 in the Krasnoe Selo (a place chosen by Peter I). Krasnoselskaya paper mill generated 25.5 thousand roubles in profit. It produced various grades of paper, about three quarters of it being writing paper (Reztsov 1912). A significant part of the production was done at Petersburg Mill, established at the same time as the first mill. In 1727 Petersburg Mill was closed (it used wind power and was non-operational for some time). Later this mill was given to Count Sivers, who had established rules that all companies of Petersburg had to buy paper from this mill and recycle the other materials (old paper, textiles). During this time, a few more paper mills were established, for example, Troitsk Mill (Uchastkina 1972; Reztsov 1912).

The technology of the time included manual papermaking which was heavily based on Dutch influence which began during the mid-sixteenth century. Holland at the time was one of the leaders in paper production (before the introduction of

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J.-A. Lamberg et al. (eds.), *The Evolution of Global Paper Industry 1800–2050: A Comparative Analysis*, World Forests 17, DOI 10.1007/978-94-007-5431-7_11,

rolls), and thus, many Dutchmen were involved in the construction and management of the first Russian paper mills (Chuiko 2009).

The invention of the paper machine revolutionized papermaking. In 1816, the first Fourdrinier machine was imported and installed at the Petergof paper factory (Chuiko 2009). However, the development of mechanical paper production did not spread widely thereafter because the government granted special 10-year agreements ("privilegia") to a few owners. This agreement obliged others wanting to install Fourdrinier machines at their factories to pay a certain per cent of profit to the owner of the "privilegia". This halted the development of mechanical paper production in Russia for more than 10 years, and the first papermaking machine at a private Russian factory appeared only in 1842 (now considered the oldest paper factory and known Paper Concern "Bumaga") (Chuiko 2009; Uchastkina 1972). Domestic papermaking machines were constructed 20 years after the introduction of the Fourdrinier machine, in Yaroslavl and Petersburg regions.

However, due to the cheap serf labour, most manufacturers did not see the need to introduce any new technologies, that is, install the paper machines, and thus, until the end of the nineteenth century, there was no rapid development of technologies.

At the end of the 1890s, technological changes prompted the construction of new pulp factories (e.g. in Riga, Vologda and Petersburg regions). The development of technology required new specialists, and therefore, the education of these specialists. In the 1890s, two higher education institutions were established to teach the specialists and labour force. At the same time, the first textbooks on pulp and paper technology based on domestic experience were published. Also, at the same time, the number of patents registered grew tremendously, showing the domestic development of technology.

In 1882 in St. Petersburg, the first paper factory was built to produce pulp from wood fibre using the natron method, and in 1883 in Tver the first factory was established for sulphate pulp production (Uchastkina 1954).

By 1910 the new technologies revealed some of the problems of the pulp and paper industry, as many of the pulp and paper factories were located irrationally according to the new technological processes which were using wood as a raw material. Also, the forestry practices at that time did not correspond to the needs of the industry, and changes were needed to ensure a better resource base for the growing pulp and paper industry (Chuiko 2009).

11.1.2 Changes in Firms and Industry Structure

Papermaking facilities using manual labour were originally called paper mills or paper manufactures, while the mills that were introducing paper machines were called paper factories. From the beginning of paper production in Russia until the reform of 1861, the papermaking factories and manufactures were of several kinds: "kasennye" (owned by the state), "possessionnye" (owned by merchants) and "votchinnye" (owned by landlords) (Uchastkina 1972).

Table 11.1 Paper production in 1913 in Russia

Pulp and paper production, million tonnes	0.3
Share of the world production of pulp and paper, %	3.6
Pulp and paper industry share of total volume of industrial production, %	2.1
Number of employees, 1,000	55
Share in total employment, %	1.6
Annual production per employee, tonnes	6

Source: Suhodolov and Zyrjanov (1995)

In 1744, 20% of paper manufactures were "votchinnye", in 1800 their share increased up to 50% and by 1857 to 95%. The domination of landlords' paper manufactures using serf labour resulted in the extensive development of the industry (Chuiko 2009).

After the Great Reform of 1861, which abolished serfdom in Russia, the paper industry began to develop more rapidly, especially by the late 1890s, as the dual system of production using machines and serf labour began to disappear.

By 1861 there were about 60 small paper factories in Russia. Despite the advantages of mechanical production, both manual and mechanical production continued to operate in parallel. It was only by 1885–1890 that the manual production of pulp and paper manufacturers disappeared (Reztsov 1910).

By the beginning of the nineteenth century, there were about 200 factories which produced more than 200 thousand tonnes of paper. There were 55,000 people working in the industry, and the share of Russia of world paper production was 2.6% (Uchastkina 1972). See more characteristics of the Russian pulp and paper industry in 1913 in Table 11.1.

Geographically most of the manufactures and paper factories were distributed unevenly, mostly located in the central part of Russia, the southwestern parts and near the Baltic Sea. Such geography was explained by the high population density in these regions which meant both consumers of paper and providers of the raw materials (at that stage rags were the main material for papermaking) (Chuiko 2009; Reztsov 1912).

By the beginning of the nineteenth century, Russia had been producing 20 grades of paper, and by 1908–1919 it had already increased up to 120 grades. However, in general, in nineteenth and early twentieth centuries, Russia was lagging behind the USA and Western Europe in the quantity and quality of paper produced (the quality is explained by the different type of materials used). Paper production per capita was also low, as the domestic demand was low due to the high illiteracy (Reztsov 1912; Uchastkina 1972).

11.1.3 Changes in Regulation and Government Policies

Building the Russian Empire, Peter the Great placed great emphasis on industrial development and as a part of it the development of the domestic paper industry. But the paper industry of the time was very labour and resource intensive. As Peter the

Great wanted to have not only a one-time demonstration of power, gaining new technologies, but also full economic independence during wartime, the Russian paper industry of Peter's times was built on the basis of state manufactures, which were mostly fulfilling military orders, and there was strict state control over the quality (Chuiko 2009).

For some time, paper manufacture was under the jurisdiction of the administrative collegiums of the Admiralty, as the paper products were used in the Russian fleet, for example, for making paper sacks for ammunition. At the same time, several decrees were passed to impose a special reward for recycling old ropes and sails for the needs of papermaking as well as a special tax for peasants, collected in the form of old rags, clothes for the papermaking process (Reztsov 1912; Uchastkina 1972).

In 1714, a few policies towards the development of manual paper manufactures were adopted, such as providing loans for those who wanted to set up papermaking manufactures, prohibiting the import of certain grades of paper and laws which would stimulate state offices to use domestic paper (Reztsov 1912).

The epoch after the death of Peter the Great was characterized as chaotic, unstable, with numerous changes of temporary rulers and elites. At the same time, a restructuring of the war economy to match the new times was needed. By the end of the 1720s, the Russian paper market began to evolve. However, without strict control by the state and low demand for domestic paper, the quality deteriorated, and the technological growth slowed down (Chuiko 2009).

Reforms continued and in 1741, and under the rule of Empress Elizabeth, the paper industry began to combine the elements of planned economy under private ownership. To implement the tasks, the "Manufacture Collegium" was established. The collegium calculated the annual paper volumes necessary for national consumption and realized that it was twice as much as was produced at the time. As a result, the manufactures were granted tax exemptions to stimulate production (Reztsov 1912; Chuiko 2009).

From 1760, the new epoch of Catherine II and the Napoleonic Wars brought changes to the situation in the paper industry, for example, imports of paper to Russia decreased by half, and Russia began to export its own paper to the east (Turkestan, Caucasus). By 1810, all the state organizations were required to use only domestic paper.

During the Napoleonic Wars, there was a partial or limited ban on importing foreign paper which was intended to encourage domestic manufacture. However, the quality of the paper produced was lower due to the lack of competition from abroad (Uchastkina 1972; Chuiko 2009).

The development of the domestic paper industry in Russia at the beginning of the nineteenth century was much encouraged. In 1811, Czar Alexander I signed a decree prohibiting the use of foreign paper in the Senate and other departments. However, the domestic paper supply was not enough. Later, in the 1830s, the import of foreign paper was limited to only the highest most expensive grades. This encouraged domestic entrepreneurs to build more paper factories in Russia (Malkin 1940).

Until the 1890s, both machine and handmade paper existed in parallel due to the lack of domestic machinery, cheap slave labour and low demand for paper.

The Great Reform of 1861 made many changes possible. The Russian paper industry had new opportunities to develop using hired labour and technological options, and by the beginning of the twentieth century, the paper industry of the Russian Empire became an established industry. The period from the end of 1860 until 1900 was the golden age of the old Russian paper industry (Reztsov 1912; Uchastkina 1972).

In the history of the paper industry of the first half of the nineteenth century, the duality of state policy is apparent. On the one hand, there were large industrial companies and, on the other hand, slavery and manual manufactures, which kept the industry on a broad road to development.

The First World War, especially the first phase 1914–1915, had little effect on the development of the pulp and paper industry, while the period 1915–1917 witnessed a gradual decline culminating in collapse (Chuiko 2009).

11.2 Transition to a Planned Economy (Soviet Period 1917–1985)

11.2.1 Changes in Raw Materials, Technology and Products

The pulp and paper industry at the beginning of the twentieth century was lagging behind that of many developed countries (Suhodolov and Zyrjanov 1995). The Soviet regime inherited from the Czarist era paper industry consisting of over 200 mainly small and nonintegrated mills (Solomko 1977). The locations of these mills were mostly market oriented, as the paper industry was almost absent in the European north and the Urals (Rodgers 1955).

Right after the Russian Revolution of 1917, the shortage of paper in the country was tremendous. The need to improve the situation in paper production became one of the main drivers, as the press in Soviet Russia was given a very important role in agitation among the population. The new Soviet era was also an era of Soviet industrialization, and for the pulp and paper industry, this meant an increase in productivity in pulp and paper mills, improvement in production technology and also the building of further capacity in order to win the socialist competitions, which drove industrial production in the Soviet Union and other communist countries. The state electrification plan (GOELRO) also contributed to the industrialization and growth of the large industries and of the pulp and paper industry in particular (Suhodolov and Zyrjanov 1995).

Soviet industrialization brought many changes into the way newly built enterprises were located and strongly stressed raw material and energy sources as location factors as opposed to the market orientation of the Czarist period (Eronen 1984).

The new locations for the development of the Soviet pulp and paper industry were identified by the strategic plans, based on the availability of spruce or fir (which

at that time was used as raw material for sulphite and mechanical pulp) (Eronen 1984; Antonov and Trusova 1976).

At the beginning of the Soviet period, operations at many old pulp and paper factories were discontinued due to lack of fuel, chemicals and additional materials. However, in 1921 the decline in production was halted, and despite the difficult situation in the country, new pulp and paper factories were began to be built.

The efficiency of the paper mills improved as new technologies were implemented. The 5-year plans and building of new mills resulted in a situation in 1936 where the output of paper and board exceeded the levels of 1913 by 75%. The pulp and paper industry was given a lot of attention in the first 5-year plan. The industrialization period of the Soviet economy brought the pulp and paper industry to a new level by building more capacity and improving efficiency, technology and labour at the mills. As a result, the productivity per paper machine grew from 3,050 to 5,000 tonne during the period 1924–1928 (Chuiko 2009).

The Second World War interrupted rapid industrial development and spoiled or postponed many of the growth plans. In the pulp and paper industry, half of the capacity was destroyed or severely damaged (Rodgers 1955). But on the other hand, the annexation of the Baltic states, Kaliningrad region, Finnish Karelia and southern Sakhalin added considerably to the production capacity (Eronen 1984). By the end of the Second World War, there were 53 paper machines operating in the country. The production of pulp dropped by 40% and started to recover only in 1950, reaching a volume of one million tonnes a year (Lieberman 1983).

After the Second World War, the industrial development resulted in increased production in the forest industry, and because of the mass gasification of the country, a lot of wood, which was used for fuel, could be used for the needs of pulp and paper industry (Suhodolov and Zyrjanov 1995). The modernization of production created greater efficiency in production and increased outputs (e.g. the production of sulphur cellulose using continuous pulping equipment, as well as the use of regeneration of chemicals, enabled higher efficiency).

The vigorous development of the industry started in 1959 with ambition plans stressing both raw material diversification and eastward expansion. However, growing constraints on raw material supply and costs forced a change in the late 1970s to a strategy away from eastward expansion towards raw material diversification, market orientation and cost consciousness (Eronen 1984). In the pulp industry especially the production of craft pulp and dissolving pulp had to increase. Also, the range of paper grades had to diversify, as well as the packaging paper and board assortment (Eronen 1984).

Thus, regarding raw materials, the Soviet pulp and paper industry had all the preconditions for successful development. Large quantities of waste from the wood-processing industry and various low-grade woods were also available (Obersteiner 1995).

From the standpoint of raw materials, the production of the industry could have increased by several times. However, from the standpoint of transportation, the industry was somewhat badly deployed. The main enterprises were situated in the central part of the country, while the main sources of raw materials were in Siberia.

To build new plants nearer the raw materials and to reconstruct factories in Central Russia for the use of low-grade wood were going to take a long time (Sopko 1973).

There has been a change in the investment strategy in the forest sector in the USSR over time. After the Second World War, most of the investments were in increasing capacity (Barr 1971). This pattern changed in the late 1970s. More investment was directed to the modernization of existing capacity. Another observation is that the amount of investment remained almost constant over this period, which confirms the observations made in the historic overview that the forest industry (including pulp and paper) was neglected compared to other sectors (Obersteiner 1995).

On the technology side, Russia did not have its own machine-building industry, and its industrial development focused on raw materials. At the beginning of this period, the equipment of the industry consisted of machines purchased from abroad, pulp for paper production was purchased mainly from Germany and Sweden and the wood mass from Norway, both of which were produced from Russian timber of good quality. Thus, the Russian paper industry was entirely dependent on Western supply of all the details, also including the specialist labour. The majority of the equipment used in the country at that time was of foreign origin. In the 1960s, 64% of the equipment used in the production of cellulose was foreign, 55% of that in paper production and 75% of that in cardboard production (Eronen 1984). The domestic paper machines were of low capacity and low technical level. The development of paper machine production became crucial, as only 10–15% of the need was satisfied by domestic production (Chuiko 2009). During the 1971–1975, 177 new machines were built. Improved technical levels allowed an increase of exports by 20%. Due to cooperation with foreign companies such as Rauma-Repola and Parsons & Whitmore, the domestic paper-machine making industry began to produce drying machines. Cooperation with other communist countries also developed, and the programme for long-term cooperation in pulp and paper was established (Malkin 1940; Chuiko 2009).

Regarding the product range, the Soviet paper industry produced more than 800 different grades of paper, but most of it was of rather inferior quality. The lack of testing equipment and market orientation at the Soviet pulp and paper mills severely restricted their competitiveness (Eronen and Simula 1993).

11.2.2 Changes in Firms and Industry Structure

After the Revolution and the establishment of the Soviet state in 1917, the pulp and paper industry had undergone a few fundamental changes. The first and most important change was the total nationalization of the companies. This occurred in stages by 1919 (Chuiko 2009).

The Revolution also brought about some changes related to geographical allocation. The Russian pulp and paper industry was traditionally located in the North,

Northwest and Baltic regions of Russia. After the Revolution, about one-third of the factories found themselves outside the Russian Soviet Republic. Thus, in 1921, there were 137 factories left, out of which only 56 were working. The number of workers decreased to 21,000, and production output fell down to 10% of the previous volume by 10 times (Suhodolov and Zyrjanov 1995; Bumprom 2010).

By 1925, the industry was showing growth and regained the production level of 1913. As the demand for paper was increasing, there was also a need for organizational changes, reconstruction and modernization (Suhodolov and Zyrjanov 1995).

However, after a few years of decline, the pulp and paper industry of the newly established Soviet state began to recover and began building new mills closer to the raw material sources (1924–1928) (Eronen 1982). For example, Balahninsky pulp and paper was built in just 3 years, using machines capable of producing a volume of paper which exceeded that of the rest of the pulp and paper mills in the country. During the years 1924–1928, the production of pulp increased by 56.4% and paper by 36.5%. In the first 5-year plans, the pulp and paper industry was given significant attention. As a result, by 1932 the overall volume of pulp and paper production exceeded the 1913 level by 75%. The quality and assortment of paper had also improved. For example, Mariisk mill was established in 1936 and produced a special assortment of paper and made it possible to cease importing (Suhodolov and Zyrjanov 1995; Chuiko 2009).

In the 1920s and 1930s, a significant expansion of this industrial sector began as a part of a nationwide industrialization drive undertaken by Stalin (Lehtinen 1994). The largest mills Mariisk, Kamsk, Kondopoga and Segezha were established in the 1930s. Later, in 1940–1941, Archangel and Solikam were established.

In the 1950s, the country's overall industrial growth was 172%, while the rate for pulp and paper industry was 150%. During 1940–1950, the share of USSR in the world output of pulp and paper products was about 0.8–1.5% (Bumprom 2010). This was a sign that the pulp and paper industry was falling behind. To remedy this some measures had to be undertaken. In 1960, the government adopted a policy to improve the situation and determine the development of the industry for the next 30 years (Sopko 1976).

During 1960–1980, the Kotlas, Baikal pulp and paper mills and the Bratsk complex were constructed in keeping with the idea of expansion to the sources of raw materials (Eronen 1982). Also, many of the existing mills were modernized and enlarged, including Archangel, Balahnin, Kondopoga, Segezha and Solikam. In the 1980s, the Ust-Ilim forest complex was completed and specialized in the production of bleached sulphur cellulose with a capacity of 550 thousand tonnes per year (Chuiko 2009).

During the period 1940–1970, pulp and paper production in the Soviet Union increased 10.7 times. In the 1960s and 1970s, several integrated plans were created. However, in the 1970s, per capita paper consumption in the Soviet Union was the lowest in Eastern Europe (Sopko 1973).

There were several strategies for location decisions in the pulp and paper industry during the Soviet era with each period representing a certain type of location strategy. First came the pre-war period with an orientation to the raw material sources of the

Table 11.2 Pulp production (million tonnes per year)

Year	1913	1920	1940	1960	1970	1980	1990	1994
Annual production	0.29	0.03	0.44	2.09	4.74	6.77	7.52	3.84

Source: Bumprom (2010)

north Russian coniferous forests and some market orientation. In 1941–1958, the time of war and post-war reconstruction, there was no real strategy, as no mills were built. After 1959, there was a strategy based on raw material diversification and eastward expansion. There were a few constraints on raw material supply and cost development which forced a change in the late 1970s to a strategy away from eastward expansion towards raw material diversification, market orientation and cost consciousness (Eronen 1984).

As a result of all the measures and modernizations by 1987, the USSR was the third largest producer of pulp in the world (after USA and Canada) and the fourth largest (after USA, Canada and Japan) producer of paper and board. However, the share of the USSR of world pulp and paper production and the share of the domestic production were lower than before the Revolution (Suhodolov and Zyrjanov 1995).

At the same time, by the end of the 1980s, the pulp and paper industry accumulated many problems, and many projects did not get finished. The main issue was the unused potential of Siberia and the Russian Far East. The mills which were planned to be constructed were never built, despite the development of energy and infrastructure in those regions. Also, the absence of market information about the relations of production costs and prices of wood raw material and final products resulted in inefficient operation models (Torniainen 2009).

This caused a deficit of pulp and paper products in the country. The same situation was observed in exports, where export volumes were limited (Eronen 1984; Backman 1995).

Table 11.2 shows the changes in pulp production 1913–1994 which reflect the changes in the industrial development described above.

11.2.3 Changes in Regulation and Government Policies

After the Revolution, numerous changes took place as the old system was replaced by the new Soviet system. This gave rise to a number of new regulations, institutions and policies. The property rights were completely restructured, and state ownership was extended to all the industries. The centralization of power was also characteristic of this time. Before the Revolution, the administration and management of forests was also highly centralized, while the organization of the use of forest resources (forest industry) was based on market principles (Torniainen et al. 2010). In the Soviet state, the activities in forests were nominally strictly centralized

and regulated; however, the state forest management bodies were unable to control the unauthorized free-of-charge use of forest resources by large industrial enterprises (Torniainen 2009).

The economic policies of the Soviet time included the nationalization of companies and the complete reorganization of management. In 1917 a committee for paper industry "Glavbum" was established. The growing industry required changes in management, and "Glavbum" was reorganized a few times. In 1924 the first meeting of the paper workers was held and made decisions about the building of new mills, the reconstruction of the existing ones, and discussed improvements in management. In 1928 a new, more extended management body "Souzbumaga" was established. Starting from 1928 the economic development of the country was regulated through 5-year plans. In each of these 5-year plans, the role of the pulp and paper industry was significant, defining the goals and ensuring capacities for achieving them. After the war, the 5-year plans included the development of domestic pulp and paper machine building, and another management body "Souzbummash" was established (Chuiko 2009).

Most pulp and paper enterprises were subordinated to the Ministry of Forest, Pulp and Paper Industries (Minlesbumprom). Prior to October 1980, the pulp and paper industry had a ministry of its own (Minbumprom) (Eronen 1984). Another major organization participating in the development of the industry was the state committee Gossnab, which has been involved since 1970s in building paper mills using waste paper a raw material (Kasparov 1979; Eronen 1984).

In April 1960, a very important decree was passed for the Russian pulp and paper industry: "*Measures aimed at accelerating the development of the pulp and paper industry*", where the main challenges and the solutions were discussed. The pulp and paper industry required a more complex management, and in 1968, a separate Ministry of Pulp and Paper was established. In the 1960s and 1970s, the socio-economic development of the USSR continued, and it increased the demand for growth in pulp and paper. However, during the 1970s and 1980s, economic growth began to slow down, and this was reflected in a slowing of the growth in pulp and paper (Chuiko 2009).

During the planned economy, the transportation costs, energy and water and environmental consequences were not accounted for, so the Russian pulp and paper industry found itself in the midst of criticism from ecologists, scientists and environmental movements due to the growing environmental concerns about the pulp and paper enterprises. As a response, along with the government resolution on "*Measures aimed at accelerating the development of the pulp and paper industry*", there was a decree on "improving environmental protection". As a consequence of these two decrees in the 1960s and 1980s, there were a few new environmental requirements in the pulp and paper industry. The pulp mills began to add water cleaning mechanisms. During the period 1966–1970, such constructions were added in 12 mills. At the same time, a few research laboratories were established to improve wastewater treatment.

Many joint programmes were developed between the ministries of forestry and heavy industry at the end of the 1980s. The Ministry of Construction, the Ministry

of Energy and others took part in the modernization and construction of the pulp and paper industry (Chuiko 2009).

By the late 1980s, the Soviet government decided to give each paper-producing enterprise more decision-making power concerning production and marketing of products (Lilja et al. 1994). However, this did not bring to the enterprises the advantages that were sought. Paper enterprises did not have the necessary capacity to perform in as expected and planned even when they had a certain degree of freedom.

11.3 Transition to the Market Economy

Transition to the market economy brought numerous changes in the Russian economy as a whole and in the pulp and paper industry in particular. All branches of the economy experienced a collapse: industrial production in 1994 fell to the level of 1960.

11.3.1 Changes in Raw Materials, Technology and Products

During the Soviet era, the signals and requirements of a market economy were ignored, resulting in irrational decisions about where to locate large forest industry facilities for roundwood processing and pulp and paper. For example, several enterprises were located in the Russian Far East and Siberia. By the mid-1990s, Siberia was responsible for quite a large share of pulp production in Russia (from 3.8% in 1960 up to 33% in 1994) (Suhodolov and Zyrjanov 1995).

The economic crisis and the transition led to an increase in specific input costs, such as energy and capital (Nilsson and Kleinhof 2001), and revealed flaws leaving badly located enterprises with high transportation and energy costs, far from their consumer markets. In addition to that, there were also other problems inherited from the Soviet times, such as inappropriate harvesting, ignoring economies of scale and producing the wrong products, which revealed itself in the transition to market economy (Nilsson and Kleinhof 2001).

Another legacy from Soviet times was producing a limited number of products on a large scale. In the transition to market economy, companies tried to enlarge their product range and produce new products, such as fine paper, for example, in 1999, new automatic production lines for fine paper manufacturing were installed at Svetogorsk and Syktyvkar LPK, and these companies now occupy the niche that was earlier occupied by foreign producers only (Dudarev et al. 2002).

However, at the beginning of transition, the majority of domestic pulp and paper mills did not manufacture many kinds of high end products (office paper types, art printing paper, food packaging paper, etc.). Also, for some products, domestic production was inferior to the foreign analogues in terms of quality. Thus, production

concentrated on lower-end products, where Russia has manufacturing experience, scale in many of its plants and a cost advantage conferred by low labour costs as well as natural gas prices held by government edict at below world level.

A significant number of regional pulp and paper mills operated with old, worn-out equipment: 98% of paper and paperboard machinery, and 100% of pulp boiling units have been in operation for more than 25 years, 30% of them have been in operation for more than 45 years (Dudarev et al. 2002). This also explains the fact that paper production in Russia was labour intensive (Obersteiner 1995).

At the beginning of transition, technology-wise Russia was not a forerunner. Because of the obsoleteness of the production equipment, many mills did not meet environmental standards (e.g. the oxygen bleaching method is widely used in the world, but not as much in Russia). However, over time, the environmental requirements became stricter, as more international companies entered the market, and competition forced companies to modernize their equipment.

As timber had been the main raw material for the pulp industry, the issue of logging became important in the transition to the market economy. In Russia and the Baltic states, illegal logging and other criminal forest activities were causing huge losses to biodiversity, as well as to economy and society. The scale of illegal logging was dramatic; for example, almost a third of timber logged in the Northwest of Russia was illegally harvested. Russia lost approximately one billion US dollars per year to illegal logging and trade, which in turn restricted the funds available for good harvesting practices, local communities and development (WWF 2008).

International NGOs initiated protest campaigns in the Central European and Scandinavian countries against Western firms' purchases of the wood originating from the old growth forests of Northwest Russia. In some paper companies like Svetogorsk, there were significant changes. For example, in 1998 mill declared that it had stopped cutting the trees in old growth forest. International Paper and Ilim Pulp also started developing various certification systems at about the same time. It was also a difficult transition because in the Soviet era the mill managers had nothing to do with forests and forestry. The paper mills were not considered forest users, and they were never forest tenants. After the transition to the market economy, it became obvious that a company had to start leasing forests and monitor the origin of wood (Kortelainen and Kotilainen 2003, 2006; Torniainen 2009).

The biggest changes in recent decades have been those introduced in bleaching technology minimizing the use of chlorine and greatly reducing or totally avoiding emission of dioxins (Reinstaller 2005), and the increase in the use of recycled paper as an input in the paper production process. When in 2003 a new law on environmental protection was adopted, Russian companies began to actively attain certification ISO 14001 (Chuiko 2009).

In addition to the environmental requirements hastening technology changes, foreign investments were one of the main drivers for the growth of pulp and paper companies during the period of transition to a market economy. Finnish companies invested particularly in solid wood and panel production (Metsä-Botnia, Stora Enso and UPM). In all, the Finnish companies made investments of around EUR 1 billion (Rushton 2008). So far many of them have concentrated on sawmills and corrugated

board plants in Russia, and they are reluctant to invest heavily in a pulp or paper plant on any scale.

In 2009, Russia had around 30 large wood-processing projects with a total cost of more than EUR 30 billion, including the production of cellulose, paper and paperboard as well as timber, particle board, plywood and other house-building materials. Many international companies, including the International Paper, the international paper and packaging group Mondi, the Norwegian-Estonian Estonian Pulp, the Swedish cellulose company SCA and the furniture company IKEA, have all decided to invest in Russia (Rushton 2008).

The general increase in the costs of raw materials, electricity and transportation makes investors search for ways to reduce costs to optimize capacity. However, because of lower prices of wood raw material, fuel and electric energy as well as lower ecological payments, Russian pulp and paper companies still do profitable business. This provides them with a chance to conduct a sequential modernization of current assets for production of advanced and competitive products (Malkov and Malkov 2004a). By conducting timely modernization of existing mills and improving the competitiveness of their products, Russian pulp and paper companies can reach better production volumes of pulp. The most difficult task would be to increase the supply of wood raw material to pulp mills from the current level. This will require the construction of forest roads with hard cover, which will inevitably lead to an increase in prices for wood raw materials and impair the competitiveness of Russian pulp and paper companies (Malkov and Malkov 2004b).

11.3.2 Changes in Firms and Industry Structure

In the 1990s, after the economic crisis of 1998 and the devaluation of the ruble, it became very expensive to buy imported goods. However, this situation did not contribute to the rapid development of the paper industry, as the forest sector in general had problems with unclear legislation and structural inefficiency, as well as a lack of investment. However, shortly after the economic crisis of 1998, pulp and paper began its recovery (see Fig. 11.1). This recovery was mostly due to the loading of existing facilities up to 90% and favourable world prices for pulp and paper. By 2006–2007, the situation in the pulp and paper industry improved, and its growth rates reached 9% (Goskomstat 1999–2009). Figure 11.1 illustrates the outputs of the pulp and paper industries during 1995–2006 by different types of products.

During the period 2004–2007, both demand and output of pulp and paper products increased in Russia. The industry growth of 2004–2007 was mainly focused on foreign markets: 28% of pulp production and 45% of paper and board production were exported (Akim 2008). Major export destinations for these Russian products were China (market pulp, craft linerboard), Ireland (market pulp, craft linerboard), India (newsprint) and Turkey (newsprint) (Akim 2008).

Although the exports of Russian paper and paperboard greatly exceeded the imports, the balance of trade continued to decrease in value, as Russia increased her

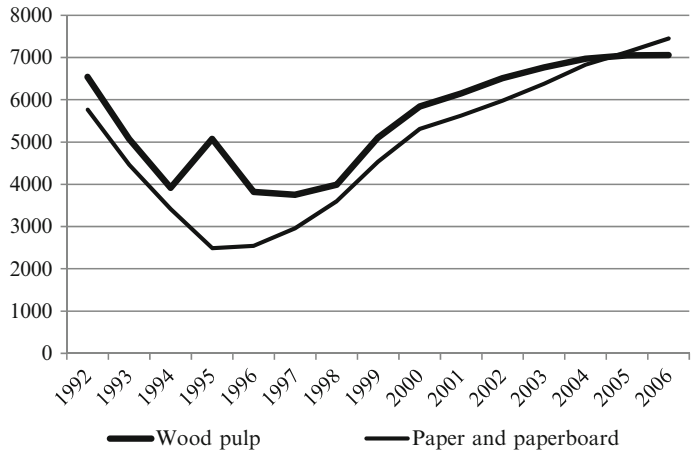

Fig. 11.1 Output of the Russian pulp and paper industries 1992–2006 (1,000 tonne) (Source: FAO 2006)

imports of rather expensive products (such as high-quality materials for containers and packaging, coated paper and tissue), whereas exported products were less costly (Backman 1995).

The export-oriented nature of the Russian pulp and paper sector and the fact that it relied heavily on exports of unprocessed logs and pulpwood meant that the financial crisis of 2008 had a powerful impact on the whole forest sector. From late 2008 to early 2009, a radical change took place both in the structure of exports of forest and paper products and in the internal market. The slump in industrial production in other countries (importers of Russian roundwood) coupled with increased duties on exports resulted in a sharp fall in roundwood exports, mainly to Finland. The global crisis of 2008–2009 caused numerous problems for small businesses and a number of medium-sized enterprises in the Russian pulp and paper industry. As a result, in 2009, growth rate in pulp and paper industry declined and was only 85.7% of the growth rate in the previous year (Goskomstat 1999–2009). In order to survive, enterprises were compelled to invest in new large projects.

The transition to a market economy also resulted in a change of ownership of the pulp and paper companies (Ilyin 1997). However, the change in ownership structure did not result in the better efficiency and productivity so badly needed. Russian forestry enterprises developed a sense of cost consciousness, but not a market orientation. Many firms relied on their ability to respond to the market by reducing costs, but did little to create a market or change their output (Nilsson and Kleinhof 2001; Carlsson et al. 2000).

During the transition, new actors entered the pulp and paper industry in Russia, and the ownership of privatized companies became a key issue (Butrin 2002). A different way of privatization caused different patterns in the development of the mills. Kortelainen and Kotilainen (2003) describe three emergent types of owners:

ownership of managers and outside investors, Russian forest industry corporations and a network of business oligarchs.

Several major mills in Russia were taken over by networks of outside investors. As the pulp and paper industry in Russia became highly concentrated, investors' attention was mostly drawn to these large producers (Kortelainen and Kotilainen 2003). However, some of the companies' control remained in the hands of the managers and employees. In some cases, workers' and managers' coalitions actively defended the autonomy of their companies and rejected outside involvement. Kondopoga, Solikamsk and Solombala are large and relatively successful companies that remain in the control of their employees. However, most of the mills in which workers have retained ownership have not been very successful, as they are usually small, outdated and have not attracted investors (Kortelainen and Kotilainen 2003).

New Russian forest industry corporations emerged. The largest of these enterprises is the Ilim Pulp Enterprise, which produces 20–30% of the total volume of pulp in Russia and employs about 49,000 people. Today, the Ilim Pulp Enterprise is a holding company controlling the Kotlas mill in Archangel region, and the Bratsk and Ust-Ilimsk mills in Siberia's Irkutsk region. These are all among the largest pulp and paper producers in Russia. The company's headquarters are located in St. Petersburg, and it also owns one paper mill near that city in the town of Kommunar in Leningrad region. Ilim Pulp Enterprise's facilities also include 42 logging companies providing raw material for the mills (Kortelainen and Kotilainen 2003; Ilim Pulp 2002). The other new forest industry corporations in Russia are relatively small players. Many of the small and independent mills have also started to create vertically integrated holdings and extend their networks to logging companies to ensure a reliable timber supply.

As a third category, some of the mills have been incorporated into the networks of businessmen or oligarchs. Often this has turned out to be the most contested type of ownership. In recent years, a highly concentrated corporate structure has emerged in Russia. A small number of cash-rich exporters have purchased the assets of various industries across the country. As the most lucrative sectors, such as the oil, metal and automobile industries, have already been divided, the forest industry has become a prime object of attention (Kortelainen and Kotilainen 2003; Latynina 2002). Unavoidably, this has already led to disputes between companies. Frequently these disputes have resulted in open conflicts, which have been called "*paper wars*", after the so-called "aluminium wars" of the mid-1990s. Takeovers have usually involved dubious legal procedures with the aim of gaining access to the majority of a company's shares. Strategies also included lobbying and bribing state authorities to support takeovers, as well as publicity campaigns in the media. In many cases, these takeover bids have resulted in the armed occupation of the mill and the dismissal of its managers (e.g. Latynina 2002).

The Russian pulp and paper industry has become quite consolidated. There are about 165 pulp and paper mills, with 10 of them are producing about 70% of Russian pulp and 80 of the paper (Butrin 2002). These include the Bratsk and Ust-Ilimsk timber industry complexes in Irkutsk region, Kotlas Pulp and Paper Mill (Ilim Pulp),

Arkhangelsk Pulp and Paper Mill, Segezha Pulp and Paper Mill together with Kondopoga in Karelia, Solikamskbumprom in the Perm region, Volga, Mondi Syktyvkar LPK and Svetogorsk in the Nizhny Novgorod region.

11.3.3 Changes in Regulation and Government Policies

The change in the market occasioned numerous changes in regulation and policy. An enormous number of laws were passed in order to enable private enterprises to function and to try to secure their legal rights as well as to impose certain limits on their practices (taxes, environmental requirements, etc.). The legislative reform was rapid with more than 100 new laws and about 200 presidential decrees every year (Pappila 1999; Remington et al. 1998). Many laws related to economic development, for example, have been initiated by international financial institutions. Western experts also did a lot of drafting work for new laws, and the resulting laws have often been incomprehensible to ordinary Russian businessmen (Hendley 1997). Thus, the first 10 years of the transition were characterized by a resumption of the old patterns inherited from the Soviet period despite the rapid change of formal institutions (new legislations and decrees) (Torniainen et al. 2010; Carlsson et al. 2000).

From the beginning of transition, there were also many uncertainties about the division of power – a peculiarity of Russian federalism. Unclear hierarchy of laws, division of powers and contradicting laws made it very difficult to implement laws (Pappila 1999). The changes in the governance system and informal institutions were likewise not easily achieved (Carlsson et al. 2000).

Another important moment in changes of regulations in pulp and paper industry concerned the regulations governing forestry practices and protection of the natural environment. By the beginning of 2000, the entire Russian pulp and paper industry was in the private sector, while Russian forests remained under state ownership, and forests could be leased. According to the (Forest Code of the Russian Federation, 1997) commercial forest use was established through a long-term forest lease system implemented by private industries (Ilyin 1997). However, despite the law requiring the leaseholder's participation, forest regeneration taking place after final cutting has been largely left to state forestry organizations following the Soviet tradition of separate forestry and forest industries (Pappila 1999; Torniainen et al. 2006).

It was only in the 2000s that policies were clearly formulated to reform the old structures of the sector: the administrative decentralization of forest management, the reform of state forest administration at the local level and the privatization of silviculture are all new features of the forest policy (Torniainen 2009).

The new (Forest Code of the Russian Federation, 2007) introduced a decentralization of power from the centre to the regions and the responsibilities of a leaseholder for silvicultural works. It had implications for the pulp and paper industry because previously the silvicultural works had been carried out by the state organizations (*leskhozes*). The forest remained in state ownership, but long-term leases were

provided on the basis of auction, where strategic investors might acquire leases without competition. However, uncertainties and constraints persist. Most of the code's details are still under development, and a huge amount of subsidiary regulations and decrees remain to be renewed before the reform is completed (Torniainen et al. 2006).

Along with the new legislation, the Federal Agency of Forestry, the key structure of forest management, formerly part of the Ministry of Natural Resources, was incorporated into the Ministry of Agriculture in May 2008.

Another controversial regulation was a proposed increase in the level of export tax on roundwood, introduced in 2007. This was received very negatively in the Nordic countries (especially Finland). The Russian roundwood export taxes have changed the way foreign forest companies source their raw timber, particularly China, Finland and Japan. Companies in these countries are changing their strategies for the future manufacturing of wood and pulp products.

11.4 Pulp and Paper in Other Transition Countries

The transition from a communist regime to a market economy seems to create certain common features in the pulp and paper industry in the transition countries. However, these countries have quite different pre-communist economic, cultural and political histories. The Baltic countries of Estonia and Latvia had long-standing and important relationships to the Nordic countries, whereas Poland was much more oriented to Central Europe. Russia, by contrast, interacted with both Europe and Asia but operated more independently on a more global stage. Historical land ownership and forest tenure patterns in these countries were also very different, running from the Czarist feudal system of Russia to the much greater prevalence of small private landholdings in the Baltic countries and Poland. Since the demise of the Soviet system, these countries have again started to diverge in many ways (Meidinger et al. 1999; Nilsson 2005).

The CIS countries exported a considerable percentage of their wood resources to neighbouring countries as well as exporting primary-processed wood products. The average consumption of wood and wood products per capita in the CEE region was extremely low; therefore, this sector was dependent on demand in western countries and other parts of the world and experienced the associated negative consequences (preferred markets, exchange rates, logistic costs, etc.). Newer members of the EU have implemented all the regulations that are valid in EU as a whole, and as their wealth increases, they also experience the trends found in western countries (UNECE 2010).

In 2011, the respective states are still significant owners of the forests in the CEE region with both negative and positive effects, including a substantial influence on the whole market situation. Even though prices are slowly rising, transportation of the wood is an increasingly larger problem for a number of reasons. In general, forest owners are in favour of any kind of revenue from their property, but social and protective demands have become so expensive and complicated that even this

sector, which can work by following the criteria of sustainability, requires increasingly higher subsidies. Central and Eastern Europe are increasingly becoming incorporated into EU procedures and policies and therefore developments.

11.5 Conclusion: What Is Next on the Road of Many Transitions?

The economic transition from early industrialization to the planned economy and later to the market has created a very important piece of economic history in the case of the evolution of the Russian pulp and paper industry. A first major driver for domestic industry development was the Czar's prohibition of foreign paper. The industry began to develop very rapidly after the establishment of paper manufactures in 1840 after the establishment of the first paper factory together with British counterparts. The duality of the existence of both hired and serf labour and manual manufactures as well as machine production was characteristic of that time period.

The analysis of the evolution of the Russian pulp and paper industry has shown that after becoming one of the major players in global pulp and paper in 1913, the transition to the planned economy decreased the role of pulp and paper industries, also alienating the companies from know-how transfer, as well as other market drivers for competitive development.

The Soviet period resulted in the expansion of pulp and paper companies to Siberia and the Russian Far East. The main pulp and paper mills' capacities established in the Soviet time in many ways determined the geographical and economic structure of the companies in their current state. The problems associated with the planned economy are obvious in the development of the pulp and paper industry, especially when the growth was extensive and the industry was aimed at the development of low-grade products. During this time, exports and imports were limited to the socialist countries and certain western countries, which limited the competitiveness of the Russian pulp and paper products. Also, since other indicators rather than supply and demand determined the amounts of produced and consumed, the production of pulp and paper products was skewed.

As the water and energy resources were not properly accounted for, this led to the stagnation of technological development, which made no effort to improve the efficiency of water and energy consumption by the pulp and paper industry.

In the 1960s, there were attempts in policymaking to draw more attention to the problems of the pulp and paper industry and give an impetus for technological improvement as well as environmental improvement (water- and energy-saving technologies) in the industry. Also, research and education in technology was given a central role, and many institutions were established during that time period. These improvements increased the role and outputs of pulp and paper industries.

During the transition to the market and the emergence of new economic conditions, such as transportation costs, consumer markets, exports and imports and prices for timber created new rules for the pulp and paper industry. The new

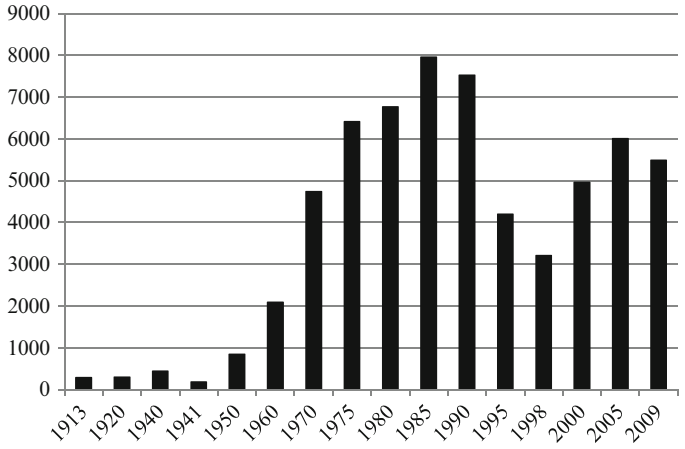

Fig. 11.2 Production of pulp and paper in Russia/Soviet Union 1913–2009 (1,000 tonne) (Source: Adapted from Chuiko 2009; Goskomstat (1999–2009))

mechanisms of the sustainable development of the industry are still under development as the legal bases for forest sector.

Environmental pressures were not taken very seriously during the Soviet era and at the beginning of transition. However, nowadays these have become an important driver for new, cleaner technologies.

The other countries in transition followed similar patterns in their pulp and paper evolution. However, in each country, development patterns differed slightly due to the specific features of the respective countries.

Nowadays, the difference in development, drivers and pressures are much more evident between Russia and other countries in transition. Estonia, Latvia and Poland are members of the European Union. Their policy and social assumptions are therefore geared to conform more closely to Western European assumptions than those of Russia. At the same time, Russian producers and policymakers seem to be very sensitive to European markets, and many decisions are made with an eye to how the resulting products will sell in Europe. Thus, whether differences between Russia and the other countries increase or decrease over time may depend on the degree to which the European market maintains effective pressures for conformity to the standards promoted by forest certification (Fig. 11.2).

During the 200 years of evolution, the Russian pulp and paper industry has survived several major transitions, and each transition has brought major shocks to the development of the industry. However, every economic shock allowed for changes and adjusting to the new conditions.

The future development of the pulp and paper industry in Russia will depend on the competitiveness of the existing pulp and paper companies. The technological obsoleteness of Russian pulp and paper mills with high levels of consumption of raw material, fuel and energy does nothing to enhance competitiveness. However,

because of lower prices of wood, raw material, fuel and electric energy as well as lower ecological payments, Russian pulp and paper companies still do profitable business. This provides them with a chance to pursue the modernization of current assets for the production of advanced and competitive products and to increase the competitiveness of their products. However, lack of existing infrastructure (roads) poses some difficulties, which could lead to an increase in prices for wood raw materials and lower the competitiveness of Russian pulp and paper companies.

As the industry is monopolized by a few large players, the future development will largely depend on their ability to make investments and also on growing environmental awareness of forests and the change to a low carbon economy, which will present more challenges to the pulp and paper industry.

Looking back at history, it is possible to discern a certain path dependency in the evolution of the pulp and paper industry in Russia. The drivers and opportunities remain the economy of scale, potential domestic demand, a large consumer market and the development of domestic high value-added products. At the same time, the challenges are still similar to those of the last century: the Soviet legacy of inefficient institutions, unclear legislation, environmental degradation and a lack of investments in efficient technologies and infrastructure.

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Chapter 12
Global Demand for Paper Products: 2006–2050

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12.1 Introduction

The preceding chapters describe the evolution of the paper industry as constantly changing series of convergent and divergent development paths which almost randomly raise some countries while depressing others. More general patterns in this evolutionary struggle seem to be (a) the role of new raw materials in (b) catalysing changes in (c) technological dominance. For example, the shift in dominance from the UK, Norway and other countries in Europe to Sweden and Finland in the 1960s–1970s may be seen as manifestation of this causal structure. However, in most of the individual articles, the historical explanations presented focus on the supply side of the process. That is, the demand for paper is at least intuitively not considered as a restriction for the industry to emerge and grow.

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J.-A. Lamberg et al. (eds.), *The Evolution of Global Paper Industry 1800–2050: A Comparative Analysis*, World Forests 17, DOI 10.1007/978-94-007-5431-7_12,

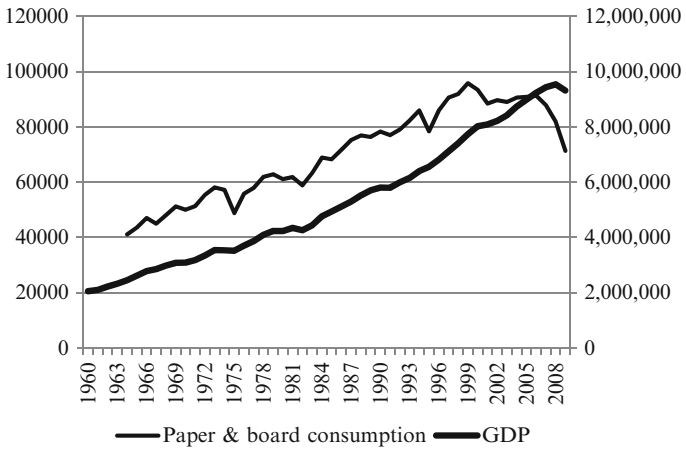

Fig. 12.1 Paper and board consumption (1,000 ton, *left axis*) and total GDP (millions of USD, *right axis*) in the USA, 1960–2009

In a simple evolutionary model, the growth and decline of any industry is a function of the resources available and competition for these resources (e.g. Barnett et al. 1994; Baum and Mezias 1992; Klepper 1996). However, technological knowledge, raw materials, available logistics and other factors enabling the supply of products only partially determine the extent and nature of the niche (Dobrev et al. 2001). Demand for certain products is an equally important or even more important resource determining the survival prospects of any industrial population. When seeking a historical perspective, the neglect of the demand factor in the paper industry is fairly understandable. As has been widely documented in historical studies, before the 1990s paper consumption grew in almost linear correlation with growth in GDP (Jarvinen et al. 2009). The logic in this pairwise growth pattern is that to a certain point, increase in economic prosperity catalyses new uses for paper. This is aptly illustrated in comparisons between a highly developed country (e.g. the USA) and a developing country (e.g. Pakistan). Whereas in the former the annual consumption of paper products may amount to hundreds of kilograms per capita, in the latter case paper consumption is reduced to bare minimum.

Figure 12.1 illustrates that the linear relationship between economic growth and paper consumption in the USA already ended in the 1990s and in other OECD countries some years later. The existing literature has explained this divergence as a function of digitalization, changing media market and other factors (Hetemaki and Mikkola 2005). We offer an alternative explanation based on the assumption that there simply exists a saturation point after which the increasing wealth of nations and individuals does not increase the consumption of paper. From this premise, the aim of this chapter of the book is to present a market forecast for different types of paper products building on assumptions of individual level consumption patterns. What is more, we conclude our analysis with a discussion about the possible implications regarding the evolution of the industry.

Table 12.1 presents a few recent studies analysing the future or alternative futures of the forest sector with different geographical foci (the World, Europe and Finland) and by different methods and techniques. From a methodological perspective, earlier analyses may be divided into quantitative and qualitative studies. Quantitative research usually uses econometric modelling in forecasting the demand for forest products. In particular, as the demand for many forest industry products has historically closely followed changes in the level of GDP, the most common method of making consumption forecasts has been a regression analysis with GDP, product prices and/or population as predictors of forest product demand (a so-called classical or standard approach (Hetemäki and Obersteiner 2001)). Although the approach has yielded fairly accurate predictions of forest product demand in the past, recent studies suggest that the link between GDP and forest product demand may be loosening, particularly in Western countries and especially when considering newsprint and other printing papers. More sophisticated models are therefore usually required nowadays in making future predictions of the demand (especially in Western countries).

The qualitative approaches then potentially offer a richer view of the future of the forest industry, in comparison to mere forest product demand forecasts generated by econometric modelling. Using the Delphi method, scenario building and workshops, expert opinions and workshops, SWOT analysis among others, earlier studies have provided various pictures of the future of the forest industries.

In this chapter, we build particularly on the earlier tradition on forecasting paper product demand by using quantitative modelling. By following the methodology of earlier studies, we aim to construct paper demand forecasts for the main regions of the world for the period 2005–2050. Departing from earlier research, however, we suggest that the basic assumption in earlier studies about the link between paper product demand and GDP breaks down after a high enough average standard of living has been achieved in a country.

The structure of this chapter is as follows: After this introductory section, we explicate our method and material for the demand estimation. This is followed by a description of the factors resulting in a certain amount of paper consumption, that is, population and GDP growth in different parts of the world during the forecast period. After the product and market area-specific forecasts, we conclude with a discussion on the strategic implications of our demand predictions.

12.2 Methodology

12.2.1 Data

In order to construct the demand forecasts, we use historical time-series data on the demand for paper products and GDP at country level and forecasts for GDP, GDP per capita and population at country level for the forecast period 2005–2050. The main source of historical data for the demand for paper products

Table 12.1 Example studies of the future of forest industry

Study	Time period covered	Geographic and forest sector scope	Employed methods	Main results
Tappi (1999): The world in 2015: Four possible scenarios	–2015	World Whole forest sector	1. Expert opinions 2. Scenario building 3. Extrapolation of trends Report uses opinions from individuals from different components of the pulp and paper industry and also from people allied with the pulp and paper industry as suppliers or customers	Two scenarios with a focus on pulp and paper industry: 1. World Paper, Inc. – A global company of the twenty-first century: (1) Global acceleration of mergers and acquisitions in papermaking companies (resulting in approx. 20 major world papermaking companies supplying more than 60% of global paper requirements and several major chemical and machinery supply companies); (2) Real-time mass customization for customers; (3) Increased investments in new processes to reduce process and coordination costs; (4) Increased levels of outsourcing and integration of suppliers in manufacturing operations 2. Paper in a digital world: (1) Definite shift away from paper to the electronic media will occur, but this will not totally replace paper; (2) Converging technologies that allow multifunctional devices; (3) Arrival of web television allowing Internet access by most people; (4) Combined database marketing with on-demand printing technologies; (5) Partnerships between online publishers and advertisers; (6) Increases in targeted direct mail advertising
Morell (2001): Vision of forestry 50 years on	–2050	World Whole forest sector	1. Delphi-method	Ten general level conclusions, including the following: 1. Global forest cover will be stabilised 2. The demand for most forest products will have increased but will be balanced by increases in the supply of all major wood products, as well as technological advances 3. Water will be the world's most strategic resource and one of the most controversial issues 4. Plantations will be the predominant source of fibre for the forest industry and will have a role in recreation

Kärkkäinen (2005): Forest industry of the world (in Finnish)	–2020	World Whole forest sector	1. Expert opinions	With regard to paper production and consumption: 1. Starting point for forecasting paper consumption regionally is the continuing division of the world: Africa lags behind the development taking place in other regions Markets in Asia, and in China in particular, grow considerably Paper production grows in South America; paper consumption does not, however, necessarily grow largely The relative position of North America continues to deteriorate The development in Western Europe may be more positive in comparison to North America
FAO (2005): European forest sector outlook study (EFSOS) 1960–2000–2020	–2020	38 European countries: Western and Eastern European countries and four CIS countries (including Russia) Whole forest sector	Econometric modelling (supported by more qualitative historical analysis of the trends in the industry): 1. Logistic regression analysis	1. In general: Consumption of all forest products increases, but the rate of growth slows down (consumption of forest products grows slower than the economy as whole) Three scenarios: 1. Baseline scenario: Long-term historical relationships in forest products markets will remain the same in the future 2. Conservation scenario: There will be an accelerated shift towards environmental enhancement and conservation of forest resources in the future. Economic growth will be slightly slower than in the baseline scenario 3. Integration scenario: There will be more rapid economic integration and market liberalisation across all of Europe, resulting in higher level of economic growth
Hetemäki and Obersteiner (2001): US newsprint demand forecasts to 2020	–2020	The USA Newsprint	Econometric modelling: 1. Classical model, that is, standard model (consumption is a function of GDP and prices) 2. Bayesian model (incorporates subjective prior information) 3. Ad hoc model (incorporates change in newspaper circulation as an explanatory variable)	1. Classical model is not able to forecast the apparent decline in newsprint consumption 2. The GDP parameter is no longer significant when a post-1987 sample is used for analysis; the newsprint price variable does not appear to contain significant explanatory power 3. The US newsprint demand is likely to decline in the next 20 years

(continued)

Table 12.1 (continued)

Study	Time period covered	Geographic and forest sector scope	Employed methods	Main results
Haynes (2003): An analysis of the timber situation in the United States: 1952–2050	–2050	The USA Whole forest sector	Econometric modelling: 1. The timber assessment model 2. North American pulp and paper model 3. The aggregate timberland assessment system timber inventory model 4. Timberland area change model	1. In general, the US consumption of forest products in 2050 is 40% higher than in 2001 2. The consumption of paper and board products increases from 97 million tons in 2001 to 159 million tons in 2050 (annual growth rate 0.8%) Six projections: (1) Baseline; (2) Changes in national forest level; (3) Lower Canadian harvest; (4) Increased nonindustrial private afforestation; (5) Lower housing activity; and (6) Reduced consumption of paper and paperboard – intelligent consumption
Turner et al. (2005): The US forest sector in 2030: Markets and competitors	–2030	The USA (also the World) Whole forest sector	Econometric modelling: 1. Global Forest Products Model (GFPM)	1. Although the USA, Japan and Europe remain major importers of forest products out to 2030, the rapid economic growth of China will make it the world's largest market for raw wood and intermediate and final forest products 2. Mexico and the Republic of Korea will become important markets for solid wood and fibre products 3. The US share of global exports of industrial roundwood and paper and paperboard will increase out to 2030; however, the total value of exports of the US sawnwood and printing and writing paper decreases
Seppälä (2000): The Finnish forest cluster at a cross road (in Finnish)	–2020	Finland Whole forest sector	Quantitative and qualitative methods: 1. Econometric modelling 2. PESTE analysis 3. Scenario workshops	Quantitative baseline scenario and six alternative scenarios: 1. Baseline scenario (e.g.): Newsprint production decreases considerably (from 1.4 mill. tons in 1996 to 0.5 mill. tons in 2020) Printing and writing paper production remains as a strength of the industry Number of employees decreases as also the share of labour costs of the total costs

				2. Six alternative scenarios: 2.1. 'Nothing changes' --> the cluster is dominated by the present players (three largest forest industry firms) 2.2. 'Network' --> the success of the forest cluster will be based on its capability to develop as a whole 2.3. 'Small is beautiful' --> stresses the importance of networking between small firms 2.4. 'Green consumer's world' --> green business and the use of forests for recreation will dominate 2.5. Technology jump I: 'The Alien' scenario; the cluster threatened and conquered by outside forces 2.6. Technology jump II: 'The Dream' scenario; based on the technological superiority of the cluster
Pöyry (2005): Scenarios for the Finnish forest industry and their effects on wood production strategies (in Finnish)	–2030	Finland Whole forest sector	Quantitative and qualitative methods: 1. SWOT analysis 2. Expert opinions/expert panel 3. Econometric modelling	Five scenarios: (1) Baseline: The paper and board production grows 0.7% annually during 2005–2040; (2) Growth in paper consumption is slower than assumed in the baseline scenario; (3) High energy prices scenario; (4) The supply of the Russian industry grows more than in the baseline; (5) The use of wood as construction material increases Implications: 1. The production of the Finnish industry grows although the growth is slower than earlier 2. Lowering raw-material costs continues to be in a significant role in both chemical and mechanical forest industry

(continued)

Table 12.1 (continued)

Study	Time period covered	Geographic and forest sector scope	Employed methods	Main results
Häyrynen et al. (2007): Globalisation and options for the forest sector (in Finnish)	ca. –2030	Finland Whole forest sector	1. Delphi method	Four scenarios: 1. Current sector (nykysektori): World develops linearly based on the current trends; thus, the change in the forest sector may continue without need for making quick moves 2. New business (uusbusiness): The world will be characterised by increase in risks and opportunities; the forest sector should quickly respond to the changes, for example, by creating new businesses 3. Finland's benefit (Suomen etu): Significant risks exist in world development and international business; the forest sector should focus on low-risk business in Finland 4. Sustainability (kestävyys): Values related to ecological and social sustainability are emphasised; the forest sector should focus on operating based on the principles of sustainable development

is the forestry database compiled and maintained by FAOSTAT (faostat.fao.org), including time-series data on the quantity of production of forest industry products and of the quantity and value of forest product exports and imports from 1965 onwards. On the basis of the data, we calculate the derived demand for the main paper and board grades for every country considered (i.e. amount of production + amount of imports – amount of exports). The historical time-series data for GDP is gathered from the Groningen Total Economy Database (www.ggdc.net/).

With regard to GDP and GDP per capita forecasts, our primary source is Poncet (2006). As the report does not, however, contain forecasts for most Eastern European countries, we use Nobe (2004) as a supplementary source. Finally, for population data, we use population forecasts by the United Nations (World Population Prospects 2006). Of the forecast variants, the medium variant is used. The next section includes a detailed discussion of the population and GDP forecasts, the assumptions behind them and their main implications when it comes to different regions in the world.

12.2.2 Model Specification

Our forecast for forest product demand in the various regions of the world during the period 2005–2050 is built as follows: We start by applying the classical (standard) approach for forecasting paper product demand and predict the total demand for the main paper and board grades (newsprint, printing and writing papers, packaging materials, household and sanitary papers and other paper and board) at country level in the regions of interest as a function of the GDP of the country concerned. Although the model has in the past resulted in fairly accurate predictions of future demand for different paper and board grades, recent studies suggest that at least in the Western countries, the link between GDP and paper and board demand may be breaking down (e.g. Hetemäki and Obersteiner 2001; Haynes 2003). It is highly plausible that paper consumption per capita has already reached its maximum in many of the Western countries and will no longer continue to develop as a function of GDP.

Thus, in order to take this development at least partly into consideration, we modify the results of the classical model by suggesting that the link between paper and board demand and GDP breaks down when the GDP per capita and paper and board consumption per capita reach a certain level (GDP per capita 20,000 in constant year 2,000 USD and paper and board demand 200 kg per capita). After reaching this level, we propose that paper and board consumption starts to follow changes in the population of the country being analysed; the paper and board consumption per capita in the country, thus, remains constant after this.

The standard model for estimating forest product demand was first introduced by Houthakker (1965) and since then has been widely used to estimate demand

elasticities for various commodities (Kangas and Baudin 2003). Total (apparent) demand in the model is explained using product price and GDP. In its general form, the model may be presented as follows:

$$Q_t = fn\left(P_t, \mathrm{GDP}_t, Q_{t-1}\right),$$

where Q_t is the apparent consumption of a paper and board product in year t in region m (e.g. a certain country), P_t is the real price of a paper and board product in year t in region m, GDP_t is the gross domestic product in year t in region m and Q_{t-1} is the consumption of the product in year $t-1$ in region m. Differing from the model, we will predict the paper and board demand only as a function of GDP and paper and board demand in the previous year; this is mainly because time-series data of the paper and board product prices was not available for most of the countries analysed.[1] Thus, the basic model used in the study may be written in the following form:

$$Q_t = fn\left(\mathrm{GDP}_t, Q_{t-1}\right).$$

Following earlier research (e.g. Buongiorno 1977, 1978) and also more recent forecast studies (FAO 2005), the estimation procedure follows a time-series cross-section (TSXS) approach. More specifically, the estimating and derivation of the estimated model takes place in the following way (the product price is also included).

Let us first assume that in the short run, product demand may adjust only partially to GDP and prices and set Q_t, P_t and GDP_t as before. Then, assuming cost minimization under a Cobb-Douglas technology with constant returns to scale, coupled with partial adjustment of actual demand towards desired imports, leads to the following derived demand for paper and board products (Chou and Buongiorno 1984; Baudin and Lundberg 1987; FAO 1998):

$$\log Q_t = a + b \log \mathrm{GDP}_t + c \log P_t + d \log Q_{t-1},$$

where *a, b*, *c* and *d* are the estimated elasticities. The long-term elasticity for GDP may now be defined as

$$\overset{*}{b} = \frac{b}{1-d}$$

The model estimated in this study differs from the above in that we do not estimate value for the parameter *c*. After estimating the elasticities, the demand forecasts for the considered paper and board grades in different countries are calculated as follows (see FAO 2005).

The base year of the forecasts is 2005. The demand for paper and board products for the year are calculated as a 5-year average using 2005 as the centre year

[1] Although we do not use product prices as predictors of paper and board demand, the results of the model concur closely with the predictions of demand for paper and board products in European countries until the year 2020 as presented in FAO (2005).

(i.e. the average demand based on years 2003–2007). Because the objective is to build long-term projections, using the 5-year average for demand is preferred to the 'real' value since the average is expected to cancel major effects of business cycle variations.

The growth in demand from 2005 to 2010 may now be calculated with the following formula:

$$g(Q)_{2005-2010} = \overset{*}{b}{}^{*}\, g(\mathrm{GDP})_{2005-2010}.$$

The forecast for 2010 thus becomes

$$Q_{2010} = Q_{2005} * \left(1 + \overset{*}{b}{}^{*}\, g(\mathrm{GDP})_{2005-2010}\right)^{5}.$$

Demand for the years 2015, 2020, 2025, 2030, 2035, 2040, 2045 and 2050 is calculated by following the same principles.

After calculating the baseline forecasts for all the countries and paper and board product groups, we modify the results so that the paper and board demand starts to follow changes in population of the country after a certain level of GDP per capita and paper and board demand per capita has been reached. More specifically, we suggest that the demand starts to follow changes in population when (1) the GDP per capita of the country exceeds USD 20,000 (in constant year 2000 values) and the annual paper and board consumption per capita in the country exceeds 200 kg or (2) the paper and board consumption per capita in the country alone exceeds 200 kg. Based on this, countries for which the predictions follow changes in population already from the beginning of the analysis period include the USA, Germany, Japan, Finland and Sweden. In contrast, regions (and their respective countries) for which the predictions follow the classical model for the whole period include Africa, South America and some parts of Asia.

We present demand forecasts for the main paper and board product types for the following regions: Western and Northern Europe, Southern Europe, Eastern Europe, Northern America, South America, Africa, Eastern Asia, Southeastern Asia, Southern Asia and Western Asia. Regional forecasts are calculated based on country-level demand forecasts.[2] Table 12.2 presents regions and the respective countries for which the forecasts are calculated. The division of the countries by region is based on the division applied by FAO and the UN. As can be noted, we do not calculate forecasts for every country in the regions considered. This is mainly due to the lack of GDP forecast data and time-series data on paper and board demand for many countries. The countries for which data is missing, however, are mostly very small in population; thus, their contribution to the total regional demand would probably be negligible.

[2] Thus, we calculate forecasts separately for every country based on the regression model introduced above.

Table 12.2 Considered countries and their grouping to ten regions

Northern and Western Europe	Southern Europe	Eastern Europe
Austria	Croatia	Belarus
Belgium	Greece	Bulgaria
Denmark	Italy	Czech Republic
Estonia	Macedonia	Hungary
Finland	Portugal	Poland
France	Slovenia	Romania
Germany	Spain	Russian Federation
Ireland		Slovakia
Latvia		Ukraine
Lithuania		
Luxembourg		
Netherlands		
Norway		
Sweden		
Switzerland		
United Kingdom		

Northern America	South America	Africa
Canada	Argentina	Algeria
United States of America	Bolivia	Benin
	Brazil	Cameroon
	Chile	Congo
	Colombia	Egypt
	Ecuador	Democratic Republic of the Congo
	Guyana	Ghana
	Paraguay	Kenya
	Peru	Malawi
	Uruguay	Mozambique
	Venezuela	Rwanda
		Senegal
		South Africa
		Tunisia
		Uganda
		Zambia

Eastern Asia	South-eastern Asia	Southern Asia	Western Asia
China	Indonesia	Bangladesh	Bahrain
Japan	Malaysia	India	Israel
Republic of Korea	Philippines	Pakistan	Jordan
	Singapore	Sri Lanka	Kuwait
	Thailand		Turkey

It is also worth mentioning that we do not calculate own GDP demand elasticity parameters for every country. Own parameter estimates are only calculated for those European, North American and Asian countries for which long enough time-series data of paper and board demand exist (thus it is possible to estimate the values of the parameters reliably enough). For the other countries, the values of the parameters are calculated on regional level: for European countries, we follow the division used by FAO (2005) and for the other countries the groupings in Table 12.2. Thus, in these cases, the values of the parameters are assumed to be the same for every country in the respective group.[3]

12.3 Population and GDP Forecasts

12.3.1 Global Population: Its Growth and Geographical Distribution

The term *global population* refers here to the number of human beings living in the world at a given point in time. According to the US Census Bureau (2011a), the global population, as of March 2011, was about 6.9 billion people, growing monthly by about 6 million and annually by about 76 million (US Census Bureau 2011b). This is consistent with the most recent estimate by the United Nations (UN 2009). As is well known, the growth rate of the global population has historically accelerated: the global population reached one billion in 1804, two billion in 1927 (123 years later), three billion in 1960 (33 years later), four billion in 1974 (14 years later), five billion in 1987 (13 years later) and six billion in 1999 (12 years later) (UN 2004). As to the future, seven billion is forecast to be reached in 2011 (12 years later), eight billion in 2025 (14 years later) and nine billion in 2045 (20 years later) (UN 2008).

Thus, while the global population is still increasing, the rate of increase is slowing down. In fact, the highest annual growth rate was experienced in 1963, at 2.226%, while the rate in 2010 was 1.105% (US Census Bureau 2012). Nonetheless, the global population is forecast to peak in absolute terms in the year 2075 with about 9.2 billion, after which the global population will start to slightly decrease, settling at around 9 billion in the long term after that (UN 2004).

However, with regard to our projections for paper and board demand, the most interesting question is how this future global population will be distributed across geographical areas and countries.

In this regard the *de facto* authority on comprehensive country-specific population forecasting is the United Nations with its *World Population Prospects* series (later 'Prospects'). *Prospects* includes four different scenarios, labelled 'variants',

[3] A table of the country groupings is available from the authors on request. The same applies to the values of estimated elasticities.

Table 12.3 Distribution of global population by major regions, 2005–2050 (in millions)

	Africa	Asia	Europe	Latin America	Northern America	Oceania	World
2005	922	3,938	731	558	332	33	6,515
2010	1,032	4,166	730	594	349	35	6,907
2015	1,149	4,389	727	628	364	37	7,295
2020	1,271	4,596	722	660	379	39	7,667
2025	1,394	4,779	715	688	393	41	8,011
2030	1,518	4,931	707	713	405	43	8,318
2035	1,643	5,052	698	733	417	45	8,587
2040	1,765	5,148	687	750	427	46	8,824
2045	1,884	5,220	676	762	436	48	9,026
2050	1,998	5,266	664	769	445	49	9,191

which differ in their assumptions.[4] Of these, we have chosen to use the medium fertility variant (or medium variant for short), which is generally considered to be the most probable one. Moreover, our scenarios are based on the data presented in the 2006 revision of *Prospects* (UN 2006).

According to this data, the distribution of the global population is forecast to develop by major regions, until 2050 as presented in Table 12.3.

The table provides two immediate and noteworthy observations. First, the two major regions that are forecast to experience appreciable population growth by 2050 are Asia (about 1.3 billion or about 34%) and Africa (about 1.1 billion, or about 117%). And second, Europe alone is forecast to experience negative growth (i.e. reduction) in its population (67 million, or about 9%). Thus, by 2050 about 57% of the global population is forecast to live in Asia (about 60% in 2005) and about 22% in Africa (about 14% in 2005) thereby jointly encompassing about 79% of global population in 2050. Moreover, Africa is the only major region whose proportion of the global population is actually set to increase during the period 2005–2050.

Another perspective on the future distribution of global population is gained when examining the data based on developmental stages. Here, *Prospects* categorises countries into three groups: (1) more developed,[5] (2) least developed[6] and (3) less developed.[7]

[4] The variants are (1) low fertility, (2) high fertility, (3) medium fertility and (4) constant fertility. The main difference between the scenarios is how many babies a woman, on average, has during her lifetime in a country and how this number changes over time (see UN (2006) for a more detailed description of the assumptions for each variant).

[5] Japan, Australia, New Zealand and all countries in Europe and Northern America.

[6] Afghanistan, Angola, Bangladesh, Benin, Bhutan, Burkina Faso, Burundi, Cambodia, Central African Republic, Chad, Comoros, Democratic Republic of the Congo, Djibouti, Equatorial Guinea, Eritrea, Ethiopia, Gambia, Guinea, Guinea-Bissau, Haiti, Kiribati, Lao People's Democratic Republic, Lesotho, Liberia, Madagascar, Malawi, Maldives, Mali, Mauritania, Mozambique, Myanmar, Nepal, Niger, Rwanda, Samoa, São Tomé and Príncipe, Senegal, Sierra Leone, Solomon Islands, Somalia, Sudan, Timor-Leste, Togo, Tuvalu, Uganda, United Republic of Tanzania, Vanuatu, Yemen and Zambia.

[7] All countries not included in the two other categories.

Table 12.4 Distribution of global population by development categories, 2005–2050

	Developed (%)	Less developed (%)	Least developed (%)
2005	19	70	12
2010	18	70	12
2015	17	70	13
2020	17	70	14
2025	16	70	15
2030	15	69	15
2035	15	69	16
2040	15	69	17
2045	14	68	18
2050	14	68	18

Table 12.5 Ten fastest-growing and diminishing national populations, 2009–2050

Fastest growth	Population 2050 (thousands)	Change 2009–2050 (%)	Fastest decrease	Population 2050 (thousands)	Change 2009–2050 (%)
Niger	58,216	280.7	US Virgin Islands	75	−31.5
Timor-Leste	3,217	183.8	Bulgaria	5,392	−28.5
Uganda	91,271	179.0	Guyana	558	−26.8
Afghanistan	73,938	162.7	Niue	1	−25.1
Burkina Faso	40,830	159.1	Belarus	7,275	−24.5
Somalia	23,522	157.5	Moldova	2,734	−24.1
Tanzania	109,450	150.2	Ukraine	35,026	−23.4
Chad	27,776	147.9	Georgia	3,267	−23.3
Benin	21,982	146.0	Lithuania	2,579	−21.5
Occupied Palestinian territory	10,265	140.0	Bosnia and Herzegovina	3,008	−20.1
USA	403,932	2.4	USA	403,932	28.4

As Table 12.4 shows, the proportion of the global population living in developed countries, as currently defined, will constantly decrease between 2005 and 2050, whereas the opposite is true for the least developed countries. In other words, the global population is forecast to grow fastest in those countries that are currently the least developed.

While an exhaustive country-specific examination is not possible within the scope of this chapter, Table 12.5 lists ten countries whose population is forecast respectively to grow and diminish proportionately the most between 2009 and 2050. The table also includes the USA as a point of comparison.

When scrutinising Table 12.5, it seems that the countries experiencing fastest population growth and decline are, for the most part, relatively small countries. For this reason, it is informative also to see which countries are currently (as of 2009) and are forecasted to be the ten largest countries in the world as to their populations. This information is presented in Table 12.6.

Table 12.6 Ten largest national populations in 2009 and 2050 (in millions)

2009		Cumulative % of global population	2050		Growth 2009–2050 (%)	Cumulative % of global population
China	1,345,751	19.7	India	1,613,800	34.7	17.6
India	1,198,003	37.2	China	1,417,045	5.3	33.1
USA	314,659	41.9	USA	403,932	28.4	37.5
Indonesia	229,965	45.2	Pakistan	335,195	85.4	41.2
Brazil	193,734	48.1	Nigeria	289,083	86.8	44.4
Pakistan	180,808	50.7	Indonesia	288,110	25.3	47.5
Bangladesh	162,221	53.1	Bangladesh	222,495	37.2	49.9
Nigeria	154,729	55.3	Brazil	218,512	12.8	52.3
Russia	140,874	57.4	Ethiopia	173,811	109.9	54.2
Japan	127,156	59.3	Congo	147,512	123.4	55.8

Thus, the three most populous countries in the world will remain the same between 2005 and 2050: China, India and the USA, even though India will surpass China as the most populous country in the world. Other changes in the table in many cases concern countries changing their relative rankings. The countries that are replaced in the list are Russia (into rank 14, population change −17.6%), which is replaced by Ethiopia (from rank 15), and Japan (into rank 17, population change −20.1%), which is replaced by Congo (from rank 20). Nonetheless, the two most populous countries in 2050 are forecast to reside in Asia with a total population of over three billion with the USA retaining its third-largest position.

In addition to the distribution of the global population across different regions and countries, another important question concerning the current and future composition of the global population is its demographic characteristics. With regard to this paper, the main demographic properties are the average standard of living (i.e. gross domestic product *per capita*), the degree of urbanisation and the age distribution of a population. While the standard of living has clear and immediate implications with regard to the consumption of paper and board products, urbanisation usually equally implies changes in the structure of commerce and people's consumption patterns, for example (see, e.g. Zhang 2002; Talukdar et al. 2002). Correspondingly, the age structure of a population is of clear importance not only from a social and political point of view (see, e.g. Danigelis et al. 2007; Razin et al. 2002) but also economically (see, e.g. Börsch-Supan 2008; Bloom and Canning 2008).

Globally, urbanisation has consistently progressed from the 1950s onwards. Moreover, according to the United Nations, the year 2008 was a watershed year in world history because then the number of people living in urban areas surpassed that of rural dwellers (UN 2010). Furthermore, this development is forecast to increase such that by the year 2050 about 69% of the global population is forecast to reside in urban areas. Again, however, there are appreciable regional differences, as Table 12.7 shows.

As the table indicates, the population is and is forecast to be most urbanised in Europe and the Americas. However, urbanisation will increase most between 2005 and 2050, particularly in Africa and Asia, where also the less and least developed

Table 12.7 Urbanisation by major areas and developmental categories, 2005–2050

	Africa (%)	Asia (%)	Europe (%)	Latin America (%)	Northern America (%)	Oceania (%)	Developed (%)	Less developed (%)	Least developed (%)	World (%)
2005	38	40	72	78	81	70	74	46	27	49
2010	40	42	73	80	82	70	75	48	29	50
2015	42	45	74	82	83	70	77	50	32	52
2020	45	47	75	83	85	70	78	53	35	54
2025	47	50	77	84	86	71	79	55	38	57
2030	50	53	79	85	87	71	81	58	41	59
2035	53	56	80	86	88	72	82	61	44	61
2040	56	59	82	87	89	73	74	64	48	64
2045	59	62	83	88	89	74	85	66	51	66
2050	62	65	84	89	90	75	86	69	55	69

Table 12.8 Countries with highest and lowest median ages in 2050

Lowest			Highest			Selected countries	
	Country	Median age		Country	Median age	Country	Median age
1.	Niger	20.2	1.	Macau	55.8	USA	41.7
2.	Afghanistan	23.5	2.	Japan	55.1	China	45.2
3.	Somalia	23.6	3.	South Korea	53.7	India	38.4
4.	Uganda	24.2	4.	Singapore	53.5	Russia	44.0
5.	Chad	24.5	5.	Hong Kong	52.7	Great Britain	42.5
6.	Zambia	24.7	6.	Bosnia and H.	52.2	Pakistan	32.7
7.	Tanzania	24.8	7.	Cuba	51.9	Indonesia	41.1
8.	Guinea-Bissau	24.8	8.	Germany	51.7	Bangladesh	39.2
9.	Timor-Leste	25.0	9.	Antilles	51.1		
10.	Burkina Faso	25.1	10.	Poland	51.0		
	World	38.4					

countries are mostly located. Consequently, by 2050 the differences in the degree of urbanisation across major areas and developmental categories will be decidedly smaller than in 2005.

The age distribution of the global population has followed and will follow a pattern roughly similar to that for urbanisation: there is a general trend towards population ageing at the global level, but there are noteworthy differences across major areas and countries. Globally, the median age has risen from 23.0 years in 1980 to 28.9 years in 2009 and is forecast to rise to 38.4 years by 2050 (UN 2009). Table 12.8 lists the countries with forecast highest and lowest median ages in the year 2050 alongside some other countries as points of comparison.

As the table indicates, the countries with the youngest populations are those in Africa with two Asian exceptions (Afghanistan and Timor-Leste), which is to be expected because of all the continents, Africa is forecast to experience particularly strong population growth by 2050. However, it is noteworthy that on the list of the countries with the oldest population, there are only two European countries (Germany and Poland). Instead, many of those countries are in Asia, Japan and South Korea being probably the most notable ones. Moreover, with the exception of Pakistan, the median ages of the populations in the other countries listed in the table are at or above the global average. Thus, the three most populous countries in the world in 2050 are forecast to be at (India) or significantly above (USA and China) the global median age.

12.3.2 GDP Growth

Compared to forecasting population growth, forecasting the development of gross domestic product in a given country is relatively more complex and therefore uncertain undertaking. Partly for this reason there is no global authority on such

Table 12.9 Ten largest national economies in GDP, 2005 and 2050[a] (in billions of 2000 US dollars)

2005		2050		Annual growth[b] (%)
USA	11,200	USA*	38,100	2.8
Japan	5,170	China*	30,900	4.6
Germany	1,930	Japan	9,740	1.5
China	1,870	South Korea	6,870	4.1
Great Britain	1,620	India*	6,760	4.5
France	1,410	Great Britain	3,840	2.1
Italy	1,130	Germany	3,840	1.7
Canada	828	Philippines	2,750	6.1
Brazil	665	France	2,550	1.6
South Korea	643	Thailand	2,400	4.6

Source: Poncet (2006)

[a]Countries marked with an asterisk (*) in 2050 are also among the ten largest countries in the world in terms of their population

[b]With constant prices

forecasting comparable to the United States in population forecasting. Moreover, even though there are existing and publicly available GDP forecasts, none of them cover all the countries and other comparable areas in the world as exhaustively as the population forecasts by the United Nations.

In this chapter, we have chosen to use a global GDP forecast by Poncet (2006) for two primary reasons. First, unlike some other global GDP forecasts, Poncet's forecast extends to the year 2050, thus having the same temporal termination point as the population forecasts prepared by the United Nations. And second, Poncet's forecast is exceptionally inclusive in that it encompasses 103 countries in total (for comparison, otherwise corresponding forecasts by PriceWaterhouseCoopers (2008) and Goldman Sachs (2007) include 17 and 22 countries, respectively).

By looking into Poncet's forecast, one of the main interesting aspects is which will be the largest national economies (in terms of GDP) in 2050 compared to the present day. Table 12.9 presents this information.

As the table indicates, according to Poncet's forecast, the USA will retain its position as the world's largest national economy, but the GDP of China will be roughly comparable to that of the USA. Moreover, even though all the other national economies in the list are forecast to be appreciably smaller, it is still noteworthy that four out of the five largest national economies will be in Asia. Correspondingly, Poncet's forecast attributes significantly high annual growth rates in the list to Asian countries.

The preceding list does not, however, indicate the standard of living in terms of GDP *per capita*, which is summarised in Table 12.10.

Thus, according to this forecast, several of the ten countries projected to have the highest GDP *per capita* in 2050 are in Asia (although Hong Kong, which Poncet lists as a country, is actually a special administrative region of China), with an equal representation from Europe, particularly Scandinavia. The main observation from

Table 12.10 Ten countries with highest GDP per capita in 2005 and 2050,[a] in billions of 2000 US dollars

	2005		2050	Annual growth[b] (%)
Norway	40,697	South Korea†	147,897	5.4
Japan	40,563	Singapore	129,479	3.8
USA	36,854	Hong Kong	125,336	3.5
Switzerland	35,023	Norway	69,360	1.2
Iceland	34,409	USA* †	93,323	2.1
Denmark	31,584	Japan†	88,747	1.8
Sweden	30,739	Iceland	76,901	1.8
Ireland	30,430	Ireland	76,113	2.1
Hong Kong	27,151	Sweden	67,111	1.8
Great Britain	26,831	New Zealand	64,258	3.2

Source: Poncet (2006)

[a]Countries marked with asterisk (*) in 2050 are also among the ten largest countries in the world in terms of their population, and countries marked with daggers (†) are also among the largest national economies in terms of their GDP

[b]Poncet (2006), with constant prices

the table, however, is that the USA is the only country that is projected to be among the ten most populous, largest (GDP) and wealthiest (GDP *per capita*) countries. Thus, even though many of the forecasts discussed above generally point towards Asia (and in the case of population also to Africa), the USA seems to be in a major global position also in the future.

The GDP forecast by Poncet discussed above, however, includes only about half of the countries in the world and therefore, we can draw no substantive regional conclusions from it. For this reason let us consider another economic forecast prepared by Jackson and Howe (2008). This forecast also extends to the year 2050 but has a more regional focus. Table 12.11 illustrates, according to Howe and Jackson, how the total global GDP would be distributed among different regions of the world, from 2005 to 2050.

This figure lends support to the insights derived from Poncet's country-specific forecasts: the global GPD and thereby economic centre of gravity seems to be in the process of moving increasingly to Asia. Indeed, in the forecast by Howe and Jackson, the areas experiencing most significant *relative* economic growth are China and East Asia and India and South Asia, whereas the opposite is true particularly with regard to Western Europe and the USA.

As to the average living standards in different regions in the world, as measured in GDP *per capita*, Table 12.12 presents the respective forecast by Howe and Jackson.

While the forecast by Howe and Jackson probably estimates the GPD *per capita* of the USA somewhat higher than Poncet, the growth seems to be particularly strong in China and East Asia, followed by Eastern Europe and the Russian sphere. What is particularly noteworthy in this forecast is that the average living standard in

Table 12.11 Geographical distribution of global GDP by different areas, 2005–2050 (%)

	2005	2010	2020	2030	2040	2050
Sub-Saharan Africa	2	0	3	3	4	4
Arab World	4	4	4	4	4	4
Non-Arab Muslim Asia	5	5	5	6	6	6
China and East Asia	13	16	22	26	28	29
India and South Asia	6	7	9	10	12	14
Latin America	8	8	7	7	6	6
Russian Sphere	4	4	4	3	3	3
Eastern Europe	3	3	3	3	3	2
United States	22	22	20	19	18	17
Other English-speaking world	7	7	6	5	5	4
Western Europe	17	16	12	10	8	7
Japan	7	6	5	4	3	3
Total	100	100	100	100	100	100

Source: Jackson and Howe (2008); in 2005 US dollars, PPP

Table 12.12 Average GDP per capita, different areas, % of US GDP per capita, 2005–2050

	2005 (%)	2010 (%)	2020 (%)	2030 (%)	2040 (%)	2050 (%)
Sub-Saharan Africa	4	4	4	5	5	6
Arab World	16	16	15	15	16	16
Non-Arab Muslim Asia	9	9	9	10	10	11
China and East Asia	13	16	25	34	43	51
India and South Asia	6	6	8	10	12	13
Latin America	21	19	18	18	18	18
Russian Sphere	24	27	32	39	44	46
Eastern Europe	32	36	43	51	56	57
United States	**100**	**100**	**100**	**100**	**100**	**100**
Other English-speaking world	78	77	77	77	77	77
Western Europe	72	68	63	59	57	57
Japan	73	69	66	67	64	63

Source: Jackson and Howe (2008)

Western Europe and Japan, in contrast, is not forecast to approach that of the USA, but actually to be in a relative decline. Nonetheless, Howe and Jackson project that the world will, in terms of GDP *per capita,* consist of three broad groups: the USA and other English-speaking world at the top, followed by Japan, Europe (including the Russian sphere) and China and East Asia, with the rest of the world significantly below these two. Moreover, referring to Table 12.5, the areas of the world with the greatest population growth as forecast by the United Nations are also by and large those regions that Howe and Jackson forecast to be, in terms of GDP *per capita,* the poorest ones.

12.4 Demand Forecasts

Building on these population and GDP growth forecasts, in the following we present the paper and board demand forecasts for the main paper and board product groups for the ten regions considered. We begin by presenting forecasts for Europe. After Europe, we turn to North and South America, after which comes a forecast for Africa. Finally, we introduce demand forecasts for four regions in Asia.

12.4.1 Europe

Starting from Northern and Western Europe, Fig. 12.2a presents the demand forecasts for the region.[8] Taking into consideration the high standard of living in most of the countries within the region, the forecast builds strongly on population changes in these countries. The average annual growth rate for paper and board demand in the region during the period 2005–2050 is forecast to be only 0.2%. According to the forecast, the peak in demand will be reached around 2040 (demand being little over 68 million tons), after which it will start to decline. Despite the general trend, there are country level differences in the development of demand. For example, in the largest market of the region, Germany, the demand is predicted to decrease for the whole period (–0.2% per annum; from 20 million tons in 2005 to 18 million tons in 2050). In other large markets, like France (0.7% per annum) and the UK (0.3% per annum), the growth in demand is forecast to be slightly above the average. In general, growth spreads evenly over the product groups. Packaging materials (39% share of the total demand) and printing and writing papers (36% share of the total demand) remain the largest product groups for the whole forecast period.

As suggested by Fig. 12.2a, the paper and board product demand in Southern Europe is forecast to increase until 2035 (reaching 31 million tons) after which it will start to slowly decline. The average annual growth rate of paper and board demand is 0.4%. There exists heterogeneity with regard to development in demand in the countries of the region: for example, in Italy, the demand is forecast to already reach its peak in 2010 and decline after that by 0.2% per annum (from 12 million tons in 2005 to 11 million tons in 2050). In Spain and Portugal, the demand is forecast to increase until 2040 (average annual growth rate in Spain 0.6% and in Portugal 1.6%). Again, the growth will spread fairly evenly over the major product groups. Packaging materials (50% of the total demand) and printing and writing papers (30% of the total demand) are the largest product groups for the whole forecast period.

[8] See Appendix for further details on the demand figures for the considered regions and product groups.

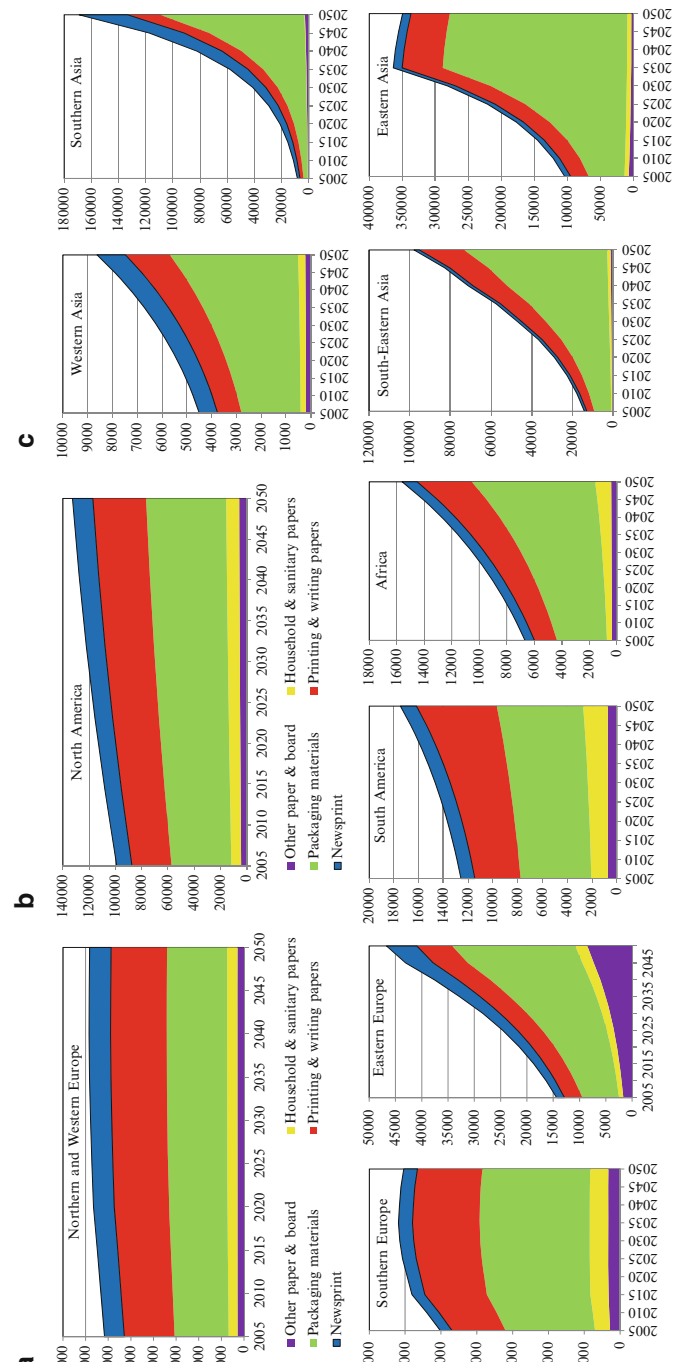

Fig. 12.2 Demand forecast for major paper and board product types in ten considered regions: (**a**) Europe, (**b**) Americas and Africa, (**c**) Asia; 2005–2050 (1,000 ton)

With respect to Eastern Europe (see Fig. 12.2a), the demand forecast mainly follows the results of the standard model; this is because the GDP per capita and paper consumption per capita in many Eastern European countries do not exceed the level after which the demand would start to follow changes in population before the end of the forecast period. In comparison to other parts of Europe, the rate of growth in paper and board demand is considerably higher in Eastern Europe (2.7% per annum). In particular, the growth in demand is strongest in newsprint (3.0% per annum) and packaging materials (2.7% per annum). Packaging materials is also the largest product group (accounting for some 50% of the total demand) and maintains its position for the whole forecast period. The largest country of the region, Russian Federation (accounting for 40–50% of the total demand of the region), experiences 3.3% annual growth in paper and board demand during the forecast period.

12.4.2 North and South America

Starting from North America (Fig. 12.2b), on average, the demand is predicted to grow 0.7% per annum (from 99 million tons in 2005 to 133 million tons in 2050). The growth rate is the same for all the major paper and board product groups. Thus, in contrast to some research studies that suggest a decline particularly in newsprint demand in the USA, this forecast predicts slow growth. This is mainly related to the differences in the modelling strategy: since our model assumes that the paper and board demand starts to follow changes in population after a certain level of GDP per capita and paper consumption per capita is reached (as has already taken place in the USA) and since the population in the USA has been predicted to grow during the analysis period, it is natural that we find the newsprint demand to grow. In general, the USA accounts for over 90% of the paper and board demand in the region (and Canada the rest).

The demand forecast for South America (Fig. 12.2b) follows the standard model for the whole analysis period due to slow growth and low enough level of GDP per capita and paper consumption in the countries considered during the analysis period. As suggested by the forecast, the average annual growth rate in paper and board product demand is 0.7% (from 12.6 million tons in 2005 to 17.5 million tons in 2050). The growth spreads unevenly with regard to the South American countries. For example, in the largest country of the region, Brazil (accounting for 50% of the paper and board consumption in the region in 2005 but only 30% in 2050), the paper and board demand is forecast to decrease by 0.3% per annum due to the predicted decrease in the GDP. In contrast, for example in Argentina (1.2% per annum), Bolivia (2.2% per annum) and Peru (3.0% per annum), the average growth rate is higher than the regional average. With regard to different paper and board products, the growth is most marked in printing and writing papers (1.3% per annum) and household and sanitary papers (0.9% per annum).

12.4.3 Africa

In a similar vein with South America, the demand forecast for Africa follows the predictions of the classical model for the whole forecast period. As suggested by Fig. 12.2b, the growth rate of paper and board demand is 1.9% per annum (demand grows from less than 7 million tons in 2005 to over 15 million tons in 2050). Again, the growth rates vary considerably by country. In the countries with the largest demand, South Africa (accounting for 44% of the total regional demand in 2005 and 34% in 2050) and Egypt (accounting for 18% of the total regional demand in 2005 and 34% in 2050), the respective growth rates are 1.3 and 2.9%. In some countries, the growth rates are considerably above the average (e.g. Algeria and Congo), whereas in other countries, the growth rate is even predicted to be negative (e.g. Benin, Mozambique and Mali). With respect to the product groups, the growth is most marked in household and sanitary papers (2.6%; accounting for only 5–7% of the total demand, however). The growth is also above average in packaging materials (2.0% per annum), accounting for some 55% of the total demand of the region for the whole forecast period and, in printing and writing papers (2.0% per annum), accounting for some 25% of the total regional demand for the whole period.

12.4.4 Asia

Starting from Southern Asia, Fig. 12.2c presents predictions for paper and board product demand for the analysis period. The forecast follows the classical model for the whole period. In total, the annual growth in demand is forecast to equal 6.9%. The growth rate is even higher in the largest country of the region, India (7.3% per annum), resulting in an increase in the share of the country of the total demand in the region from 60% in 2005 to over 70% in 2050. The growth is by far the greatest in packaging materials, 8.2% per annum. The share of packaging materials of the total demand is predicted to increase from some 35% in 2005 to over 70% in 2050.

Next, as regards Western Asia, the forecast again follows the classical model for the whole forecast period. In comparison to other regions in Asia, the average growth rate for the area is low, only 1.5% per annum (demand increases from 4.5 million tons in 2005 to 8.6 million tons in 2050). The growth rates vary considerably by country. For example, in the country that accounts for the largest share of demand in the region, Turkey (the share is over 70% in 2005 and over 80% in 2050), the rate of growth is 1.8% per annum. In Israel, on the other hand, the demand is forecast to decrease (by 2.0% per annum). It is again the packaging materials product group that has the highest growth rate, 1.7% per annum (the share of packaging materials of the total demand will increase from a little over 50% in 2005 to 60% in 2050).

Third, as suggested by Fig. 12.2c, the paper and board demand should grow 4.4% per annum in Southeastern Asia (from 14 million tons in 2005 to almost 100 million tons in 2050). The growth rates in demand, however, vary by country. With respect to the largest countries, the growth rate of demand in the Philippines equals 6.5%

per annum (the share of the country of the total demand in the region will increase from 10 to 25%), 4.5% in Indonesia (the country's share equals some 40% for the whole period) and 3.8% per annum in Thailand (the country's share of the total demand will decrease from 26 to 20%). Of the various paper and board products, the growth will be greatest in packaging materials (4.9% per annum). Packaging materials is also clearly the largest product group in the region; its share of the total demand equals 60% in 2005 and over 70% in 2050.

Finally, the predicted growth in demand for Eastern Asia (2.7% per annum) is largely driven by the growth of demand in China. Of the three countries considered, Japan and South Korea exceed the level of GDP and paper consumption per capita after which the forecast starts to follow changes in population already in 2005. As population in Japan is forecast to decrease during the forecast period, the forecast suggests that the paper and board product demand will decrease in the country at a rate of 0.5% per annum. The growth in demand in South Korea is also very slow, only 0.1% per annum. With regard to China, the country is predicted to reach a high enough level of GDP and paper consumption per capita in around 2035, after which the forecast starts to follow changes in population. As the population in China is predicted to decrease, this will also result in a decrease in paper and board demand. Nevertheless, the average annual growth rate of paper and board demand in China for the whole period equals 2.7%. According to the forecast, China becomes by far the largest consumer of paper and board products in the world around 2020. At its largest, around 2035, China is forecast to consume almost 330 million tons of paper and board. Although this figure may be considered high, it is important to note that the forecast is heavily based on the growth of the GDP of the country, forecast to be as high as 5.9% per annum during the analysis period (Poncet 2006).

Of the major paper and board product groups, packaging materials has the strongest rate of growth (3.6% per annum). The product group has also the highest share of the total demand (accounting for over 50% of the demand in the region in 2005 and almost 80% in 2050).

12.5 Regional Comparison

The growth in demand for paper and board products spreads rather unevenly over the different regions but also over product groups. First, Fig. 12.3 presents how the total paper and board demand, for the ten regions, spreads over the regions during the forecast period. Although at the beginning of the period the demand is fairly evenly distributed between Europe (29% of total demand), North America (29%) and Asia (37%), it is evident that most of the future growth will take place in different regions of Asia. In particular, it is Eastern Asia (and especially China) in which the growth will be greatest. According to the forecast, in 2025, Asia will already consume more than 50% of the total paper and board; at the end of the analysis period, the share will be over 65%. Although the demand will not decrease in absolute terms in either Europe or North America, the growth in demand will be far slower in these two markets than in Asia.

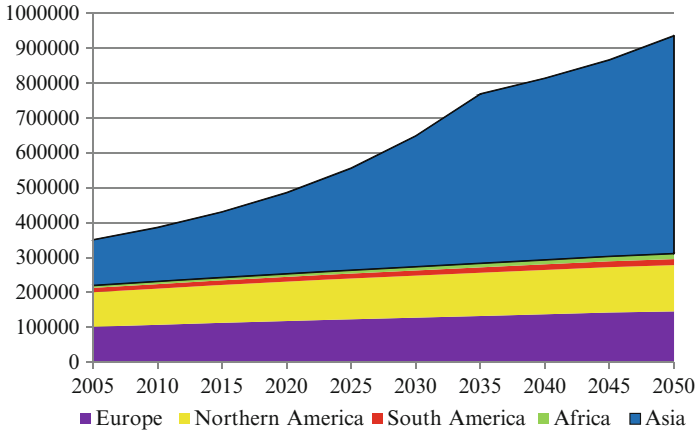

Fig. 12.3 Total paper and board demand in the considered regions during 2005–2050, 1,000 ton

Table 12.13 Average annual growth rate of paper and board demand in considered regions and product groups during 2005–2050

	Newsprint	Printing and writing	Packaging materials	Household and sanitary	Other paper and board	Total demand
Europe						
Northern and Western Europe	0.2	0.2	0.2	0.3	0.0	0.2
Southern Europe	0.3	0.4	0.4	0.4	0.3	0.4
Eastern Europe	3.0	1.5	2.7	2.3	3.7	2.7
Northern and South America						
Northern America	0.7	0.7	0.7	0.7	0.7	0.7
South America	0.3	1.3	0.4	0.9	0.0	0.7
Africa						
Africa	1.0	2.0	2.0	2.6	0.3	1.9
Asia						
Western Asia	1.0	1.4	1.7	0.8	0.2	1.5
Southern Asia	6.7	5.1	8.2	3.4	3.1	6.9
Southeastern Asia	1.7	4.1	4.9	3.3	2.2	4.4
Eastern Asia	0.8	1.7	3.6	−0.2	−1.8	2.7

Of the regions considered, the share of demand of Africa and South America of the total demand remains low for the forecast period. Although the demand increases in absolute terms in both regions (1.9% per annum in Africa and 0.7% per annum in South America), the share of Africa of the total demand decreases from 1.9% at the beginning of the analysis period to 1.7% in 2050 and the share of South America from 3.6% in the beginning of the analysis period to 1.9% in 2050.

Second, Table 12.13 presents the growth rates for the main product types in the considered regions. It seems that it is particularly packaging materials that has a

higher than average growth rate in many regions, particularly in different parts of Asia (the forecast growth rate is even as high as 8.2% per annum in Southern Asia). This is not surprising considering the significant increase in demand for packaging materials in Asia in recent decades (in China and India in particular), affecting the estimated future growth rate of the product group. In Europe and North America, where the growth in demand is generally low, the growth spreads rather evenly along with different product groups (an exception is Eastern Europe, in which the growth in demand is also stronger in general).

12.6 Discussion and Conclusion

Forecasting future is always risky. When multiple factors are simultaneously at work, the predicted trends may go in almost any direction if something totally unexpected happens. And predicting future consumption patterns is even more risky as we cannot logically deduce behavioural changes among individual consumers. These caveats expressed, we may state that our exercise is based on the two most reliable variables regarding future developments: demographic changes and historical consumption patterns. First, demographic trends (compared to other dynamics) are relatively safe starting points when predicting future consumption as any changes in the number of global population derive from the current situation. The volatility will be large but the overall trends are fairly trustworthy as long as we do not witness any global natural catastrophe (a meteorite hitting earth or the like). Thus, we may expect to have fairly reliable information on how many and what kinds of individuals will inhabit the globe during the next 50 years. Second, we do have historical knowledge that demonstrates (a) steady growth in the consumption of paper products relative to GDP growth until (b) a saturation point, after which paper consumption will cease to increase at individual level. That is, there is a natural limit to how much paper and paperboard an individual may consume.

Our consumption forecast highlights three trends in the future consumption of paper and paperboard consumption:

1. The demand for paperboard and hygiene products will globally continue to grow relative to printing papers.
2. Regional variation with respect to all kinds of products. Especially:
   (a) Highest growth patterns are estimated to be in Asia, Africa, South America and Eastern Europe.
   (b) Western Europe and North America are estimated to face slow growth patterns or even a slight decline in printing paper products yet a modest increase in the demand for packaging products.
3. Possible dramatic changes in China (due to the stabilising of population growth) and consumption patterns related to the ageing of consumers in Western Europe and North America.

The forecast continuation of urbanisation, most notably in Asia and Africa, may have implications concerning the demand for paper and paperboard products beyond what our modelling captures. Namely, as people migrate to urban areas, they are, on average, likely to gradually become better educated, have higher income levels and have increasing occupational specialisation. For these reasons urban dwellers are likely to be more 'mainstream consumers' than their rural counterparts, who engage more in primary production. Thus, continuing urbanisation is likely to increase the demand for pre-packaged consumer goods. Moreover, better-educated urban people may imply a greater demand for printed matter, such as newspapers and books.

However, it may be that technological advances – particularly in information and communication technology – will rapidly spread to the currently less developed regions and countries where urbanisation and population growth are forecast to be most pronounced. Consequently, it may be that certain intermediate stages in technological development will be shorter or bypassed altogether. For example, it may well be that the transition to online news broadcasting and electronic interpersonal messaging will be, relatively speaking, notably quicker in currently less developed regions and countries than it was (or is) in post-industrial Western countries. Thus, global technology transfer may significantly undermine the above-mentioned demand-stimulating effects of increasing urbanisation.

Population ageing, most notably in Western Europe, North America and some Asian countries such as Japan, may also affect the demand for paper and paperboard products. While such effects have not been extensively studied, one relatively well-established phenomenon that population ageing brings about is increased spending on health care services at the expense of mass-market consumer goods. Thus, it may be that population ageing will negatively affect demand for packaging material but may have an opposite effect on some specialised health care-related materials.

12.6.1 Strategic Implications

On global level, the strategic implications from our scenario exercise are fairly straightforward. First, firms may still seek market growth by (a) focusing on paperboard and hygiene products and/or (b) serving markets in developing regions (South America, Africa, etc.). The problem here is that as all global firms obtain the same option, new markets will saturate much faster than historically in Europe and North America. For example, when China's demographic growth most probably stops in the 2030s, it will equally hit all firms that rushed to the market in the 1990s and early 2000s. The logical effect will be that as profit margins go down, the firms will increasingly invest in other markets causing intensifying global competition.

Second, even if the demand for printing papers stabilises, there seems to a global market for new types of paperboard and hygiene products. The 'novelty' may mean entirely new products that fit consumption habits, especially in Africa, or technological change in what types of raw materials are used. Even if eucalyptus and other fast growing fibre material replace the traditional raw materials of the northern

hemisphere, these are still merely incremental advances on the old dominant design. Some dramatically new type of papermaking technology would revolutionise the entire market dynamics if it were based on some other types of raw materials.

Third, it seems highly likely that (a) new firms entering, especially the printing paper market, will be rare or at least they will come from the present and future growth markets (South America, Africa and parts of Asia), and (b) the existing firms must follow the following strategic archetypes:

1. Surfer strategy: just as surfers look for the best waves, firms with capabilities and financial resources may seek new growth markets simultaneously abandoning declining markets in developed regions. This option requires considerable size and flexibility as strategic moves from one region to another are costly and carry high risks.
2. Chameleon strategy: another option is to diversify to related businesses at least partly building on existing assets and capabilities. Typical examples are firms emphasising (bio)energy production, forest management or other parts of the value chain that previously served paper production. This option carries the risks typical for diversification (like compromises in long-term profitability due to the increasing administration costs and buffers against market competition).[9]
3. Specialist strategy: firms may choose one part of the value chain, and one specific region they serve while divesting themselves of other sometimes considerable businesses. The same applies to firms with a global focus on a narrow range of products and activities.
4. Landowner strategy: a phenomenon already witnessed in the USA are owners who abandon industrial production while retaining their forests and other land suitable for housing and other business activities.
5. Cash cow strategy: by maintaining a high level of productivity without investing in new strategic manoeuvres, it is possible to capture value from low profit margin markets for extended time periods. This option typically requires exit from the stock market and an extremely lean administration and marketing organisation.

12.6.2 Limitations

Finally, it is important to note a few limitations related to the model used and the forecasts generated. First, the assumption in the classical demand forecasting approach about the link between GDP and paper and board product demand may no longer hold in Western countries but may also break down at some point in time when it comes to forecasting demand in the developing countries (especially when the level of GDP in these countries reaches a high enough level). Our attempt

[9] We gratefully acknowledge the comment and idea by Kimmo Alajoutsijärvi.

to take this into consideration by suggesting that the link between GDP and paper and board demand breaks down after a country has reached a certain standard of living, brings us, however, to the second limitation: does the link between GDP and demand break down at the same point in every country and with regard to all different types of paper and board products, as we currently assume, or are there country level and paper and board product type differences with regard to this point? Although this possibility exists, at least no earlier studies have offered evidence of it.

Third, the forecasts we use for GDP, GDP per capita and population in the countries considered have their own limitations. In particular, since the GDP growth rate is used as the main predictor of the growth of paper and board product demand, the uncertainty related to the GDP forecasts may have a major effect on our results. Overall, the forecasts presented should be interpreted with caution. It is also obvious that the uncertainty with regard to the forecasts increases as a function of time.

12.7 Appendix

Table 12.14 Demand forecasts for major paper and board product types in the ten considered regions, 2005–2050

Demand/1,000 ton	2005	2010	2015	2020	2025	2030	2035	2040	2045	2050	Growth/%/a
Northern and Western Europe											
Newsprint	8,750	8,897	9,034	9,173	9,286	9,384	9,464	9,502	9,503	9,494	0.2
Printing and writing papers	22,210	22,844	23,487	24,166	24,408	24,605	24,748	24,802	24,777	24,722	0.2
Packaging materials	23,908	24,545	25,179	25,852	26,143	26,401	26,619	26,708	26,655	26,565	0.2
Household and sanitary papers	3,914	4,070	4,239	4,429	4,472	4,507	4,530	4,544	4,541	4,534	0.3
Other paper and board	2,855	2,870	2,879	2,887	2,905	2,918	2,924	2,926	2,915	2,902	0.0
Total demand	61,638	63,226	64,818	66,506	67,214	67,815	68,285	68,482	68,392	68,217	0.2
Southern Europe											
Newsprint	1,642	1,716	1,792	1,845	1,902	1,940	1,952	1,944	1,935	1,907	0.3
Printing and writing papers	7,468	8,038	8,662	8,902	9,149	9,300	9,355	9,281	9,189	9,062	0.4
Packaging materials	12,492	13,423	14,433	14,754	15,073	15,254	15,375	15,319	15,241	15,049	0.4
Household and sanitary papers	2,092	2,292	2,527	2,555	2,577	2,579	2,580	2,570	2,556	2,525	0.4
Other paper and board	1,409	1,516	1,633	1,648	1,658	1,670	1,667	1,665	1,661	1,642	0.3
Total demand	25,103	26,985	29,046	29,703	30,359	30,743	30,928	30,778	30,581	30,184	0.4
Eastern Europe											
Newsprint	1,503	1,749	2,040	2,386	2,799	3,291	3,881	4,476	5,247	5,772	3.0
Printing and writing papers	3,404	3,690	4,006	4,355	4,741	5,168	5,643	6,160	6,591	6,709	1.5
Packaging materials	6,960	7,988	9,192	10,604	12,264	14,220	16,528	18,965	21,773	23,426	2.7
Household and sanitary papers	820	925	1,047	1,188	1,352	1,542	1,763	1,970	2,175	2,269	2.3

Other paper and board	1,674	2,004	2,402	2,884	3,468	4,175	5,033	6,057	7,296	8,525	3.7
Total demand	14,361	16,356	18,688	21,418	24,623	28,396	32,848	37,628	43,083	46,701	2.7
Northern America											
Newsprint	11,576	12,142	12,688	13,207	13,685	14,118	14,512	14,869	15,195	15,501	0.7
Printing and writing papers	30,261	31,749	33,185	34,546	35,795	36,929	37,963	38,901	39,759	40,563	0.7
Packaging materials	45,589	47,835	50,002	52,054	53,936	55,646	57,206	58,623	59,917	61,130	0.7
Household and sanitary papers	7,420	7,785	8,137	8,471	8,777	9,055	9,309	9,539	9,749	9,946	0.7
Other paper and board	4,160	4,365	4,563	4,750	4,922	5,078	5,220	5,349	5,467	5,578	0.7
Total demand	99,007	103,876	108,575	113,028	117,115	120,826	124,210	127,281	130,087	132,718	0.7
South America											
Newsprint	1,124	1,141	1,157	1,175	1,194	1,213	1,233	1,254	1,276	1,299	0.3
Printing and writing papers	3,697	3,859	4,047	4,265	4,517	4,808	5,143	5,528	5,972	6,484	1.3
Packaging materials	5,708	5,814	5,928	6,050	6,180	6,319	6,468	6,626	6,795	6,975	0.4
Household and sanitary papers	1,345	1,385	1,431	1,484	1,544	1,613	1,692	1,782	1,884	2,000	0.9
Other paper and board	715	715	716	716	717	717	718	718	719	719	0.0
Total demand	12,589	12,913	13,279	13,690	14,152	14,671	15,254	15,909	16,647	17,477	0.7
Africa											
Newsprint	687	723	760	800	842	887	935	985	1,039	1,097	1.0
Printing and writing papers	1,640	1,798	1,975	2,172	2,392	2,639	2,916	3,226	3,574	3,966	2.0
Packaging materials	3,632	3,991	4,392	4,841	5,344	5,909	6,543	7,257	8,063	8,973	2.0
Household and sanitary papers	365	411	465	526	597	679	775	887	1,018	1,172	2.6

(continued)

Table 12.14 (continued)

Demand/1,000 ton	2005	2010	2015	2020	2025	2030	2035	2040	2045	2050	Growth/%/a
Other paper and board	347	352	358	364	370	376	382	388	394	401	0.3
Total demand	6,671	7,275	7,949	8,703	9,545	10,490	11,551	12,744	14,089	15,608	1.9
Western Asia											
Newsprint	740	769	801	838	878	922	971	1,024	1,082	1,146	1.0
Printing and writing papers	966	1,011	1,065	1,129	1,205	1,293	1,394	1,509	1,640	1,788	1.4
Packaging materials	2,379	2,554	2,756	2,988	3,251	3,550	3,887	4,267	4,695	5,176	1.7
Household and sanitary papers	210	215	221	228	236	246	256	268	281	296	0.8
Other paper and board	198	197	197	198	199	201	203	207	211	216	0.2
Total demand	4,493	4,746	5,041	5,381	5,769	6,211	6,710	7,274	7,908	8,622	1.5
Southern Asia											
Newsprint	1,901	2,618	3,614	4,998	6,920	9,595	13,318	18,503	25,730	35,806	6.7
Printing and writing papers	2,589	3,288	4,186	5,340	6,826	8,741	11,211	14,402	18,524	23,855	5.1
Packaging materials	3,080	4,464	6,519	9,581	14,160	21,030	31,361	46,932	70,446	106,009	8.2
Household and sanitary papers	96	112	132	156	185	218	258	306	363	432	3.4
Other paper and board	743	857	991	1,149	1,334	1,552	1,810	2,115	2,475	2,902	3.1
Total demand	8,408	11,340	15,443	21,223	29,425	41,136	57,958	82,258	117,539	169,004	6.9
South-Eastern Asia											
Newsprint	1,213	1,347	1,497	1,663	1,842	2,040	2,202	2,374	2,498	2,629	1.7
Printing and writing papers	3,647	4,617	5,852	7,427	9,414	11,953	14,116	16,806	19,082	21,950	4.1
Packaging materials	8,337	10,830	14,091	18,364	23,856	31,081	39,132	49,642	58,637	70,516	4.9
Household and sanitary papers	397	483	586	713	867	1,056	1,209	1,391	1,524	1,682	3.3
Other paper and board	419	474	537	608	689	781	878	989	1,052	1,122	2.2

Total demand	14,013	17,751	22,564	28,775	36,668	46,910	57,537	71,202	82,793	97,899	4.4
Eastern Asia											
Newsprint	8,982	9,552	10,168	10,844	11,595	12,437	13,387	13,202	12,967	12,696	0.8
Printing and writing papers	27,446	30,858	34,916	39,781	45,659	52,794	61,476	60,808	59,881	58,752	1.7
Packaging materials	54,046	68,383	88,152	115,505	153,424	206,030	279,053	276,879	273,419	268,923	3.6
Household and sanitary papers	6,442	6,449	6,443	6,424	6,395	6,355	6,307	6,221	6,112	5,985	−0.2
Other paper and board	7,224	6,207	5,394	4,742	4,214	3,781	3,420	3,357	3,284	3,206	−1.8
Total demand	104,139	121,448	145,074	177,296	221,287	281,396	363,643	360,467	355,664	349,562	2.7

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Chapter 13
The Evolution of the Global Paper Industry: Concluding Remarks

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13.1 Introduction

The introduction to this volume posed a fundamental question as to how we can understand similarities and differences in industrial evolution in various regions and countries. Even though there is a conceptual agreement on the life cycles of industries, namely, on the stages of nascence, growth, maturity, and decline, with certain metrics like number of active firms (Hannan and Freeman 1989; Klepper 1996, 2002; Murmann 2003; Nelson and Winter 1982), earlier studies usually concentrate on the issue only at the level of one country, analyzing either one or several branches of industry. The motivation of this volume is to present an analysis of industry dynamics concurrently in several countries over an extended period of time, focusing specifically on one industry: pulp and paper.

As the individual chapters in this volume demonstrate, industrial papermaking during the past 200 years offers an excellent opportunity to study industry evolution. First, the industry has gone through periods of growth, maturation, and decline in different segments, technology, and use of raw materials. Second, paper consumption and consequently production were already global in the nineteenth century – since then industry dominance has constantly varied among different countries and areas. Third, paper industry growth has evolved hand in hand with industrial and commercial development during the past 200 years (Chandler 1977, 1990). A general argument has been that until the 1990s there was a strong correlation between paper consumption and GDP per capita growth (Diesen 1998; Järvinen et al. 2012a). The importance of this line of business can be seen, for example, in the development of paper consumption in different countries. In Europe, for example, the growth of the

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J.-A. Lamberg et al. (eds.), *The Evolution of Global Paper Industry 1800–2050: A Comparative Analysis*, World Forests 17, DOI 10.1007/978-94-007-5431-7_13,

paper industry exceeded GDP growth during the last decades of the twentieth century and grew three times faster than in manufacturing industries on average (Diesen 1998; Rytkönen 2000). Fourth, the paper industry is an exceptionally important line of business for economic and societal development as a whole. One may argue that paper has been more important for global economic growth than the steam engine – although the latter has usually been emphasized in economic history (Kuisma 2008).

The pulp and paper industry as a whole does indeed have systemic properties that partially explain the variation between countries. First and foremost, the development of the paper industry in each country has been relatively incremental and predictable since the late nineteenth century. Even though major innovations, such as the beginning of the mechanical production of paper or the introduction of wood fiber as raw material, created revolutionary business opportunities, it took decades rather than years before these major innovations were implemented. Therefore, shifts in global industry dominance have been slow. The first industrializing countries like Britain, France, and Germany dominated paper industries at the very beginning of mechanized production. During the latter half of the nineteenth century, Northern Hemisphere countries (North America, the Nordic Countries) acquired dominance for the following century, whereas the dominance shifted around the turn of the millennium to the Southern Hemisphere and to the East Asia. By and large, the paper industry has followed the international trends of industrial globalization, though depending on specific raw materials and markets. Therefore, purely market factors such as demand and raw material supply explain a lot of the evolution of paper industries in the respective countries.

This concluding chapter summarizes the findings of the volume and combines those findings with more general, comparative life cycle analysis. In the following, we present a descriptive life cycle analysis to demonstrate how paper industry companies have emerged and exited in different countries. To answer *why* these changed have occurred, we will refer to the historical explanations provided in the analysis chapters.

Referring to the original research questions, we will in the following first analyze the industry structure and production volume by comparing certain case countries from an industry life cycle perspective. The aim is ascertain whether any international interdependencies in changes in industry structure can be found. Secondly, we will focus on the technology, raw materials, markets, and products as factors explaining changes in industry structure and dominance. An object of major interest is whether international dominance in the paper industry has followed the technological leadership – or does market emergence create opportunities to gain technological leadership among higher sales and profits. Thirdly, we analyze the institutional environment, namely, the governmental regulative policies – and informal institutional constraints such as cultural characteristics affecting paper consumption in each country. The institutional environment leads us to discuss to what extent the industry evolution is deterministic, that is, reliant upon the institutional structure. How individual companies have faced these technological, market, and institutional challenges is discussed in the country chapters and in our earlier volume in the World Forest series (Lamberg et al. 2006) which analyzed the strategies and organizational solutions of major pulp and paper companies.

13.2 Industry Structure and Dominance: Life Cycle Approach

The pulp and paper industry has experienced dramatic changes during the past 200 years. In the USA alone, the total industry capacity increased 20% between 1978 and 1992 (Pesendorfer 2003). After the emergence of machine-based paper production, the companies typically evolved following a path from the organizational form of one factory per company to companies owning several factories and more recently to multinational corporations. The concentration within the pulp and paper industry occurred relatively late and with accelerating speed after the 1960s. By analyzing how the number of firms and their relative sizes has evolved through time, we can begin to understand the life cycles of the pulp and paper industry in different countries. The major question in international comparisons is to see how and why the timing of industry emergence, growth, and shakeout evolved over time in different countries – and what it is that drives this particular development.

The analysis of industry life cycles over an extended period of time is a challenging task due to problems in identifying and correctly using historical sources. We analyze pulp and paper industry life cycles on global scale by comparing the entries and exits of new companies in each country during certain crosscutting years. The data used was mainly compiled from specific industry directories (Phillips 1910, 1950, 1971, 1974, 2000). These directories include, at least in theory, information on *all* paper industry companies in the world. Nevertheless, the data has its limitations. First, the data for these directories is based on questionnaires sent to the companies each year. Thus, the reliability depends on how precisely the companies responded to the questionnaires. Second, the data is given in factory-level format. Thus, to make a company-level analysis, we must first aggregate factories to company level, which may have given rise to mistakes in the course of the process. Third, the data from outside Western Europe and North America has shortcomings. For example, the data on the Chinese paper industry companies can hardly be regarded as reliable. Despite these shortcomings, the data is to large extent comparable, especially after numerous iterations and comparisons to other data sources (Lamberg and Ojala 2006).

The following analysis uses the data to understand the long-term development of the global pulp and paper industry and to scrutinize whether the industrial life cycle hypothesis is adequate in describing its secular trends (Lamberg et al. 2012). While the term life cycle has been used in several different contexts (Peltoniemi 2011; Van de Ven and Poole 1995, pp. 513–515), its meaning in industrial economics refers to a long-term path of organization population and a development shift from a high- to a low-growth stage (Utterback and Abernathy 1975, 1978). Although Van de Ven and Poole (1995) claim that there is an inbuilt determinism within the life cycle framework, Klepper (2002) has emphasized that differences in R&D expenditures can produce a pool of heterogeneous characteristics, from which the selection mechanism can ultimately produce an oligopolistic market structure.

Figure 13.1 presents a stylized model of the industrial life cycle process: markets emerge, grow, shrink, and ultimately die if a product is superseded by a successor (Fritsch 1996, p. 237). Research analyzing industrial turbulence has sug-

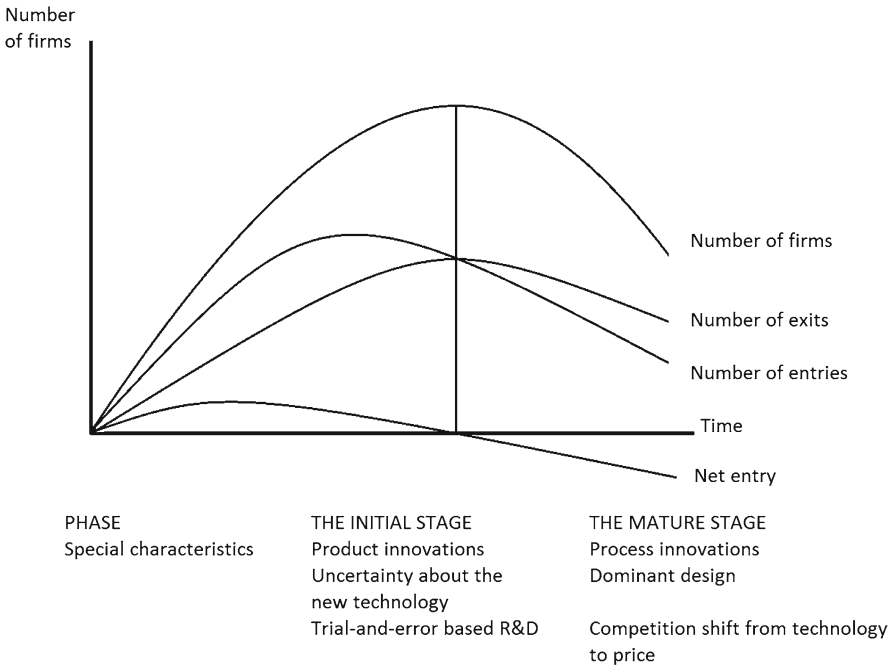

Fig. 13.1 Stylized paths in the number of entries and exits, and firms over the industry life cycle and characteristics of different development phases (Source: Fritsch 1996, p. 237; Klepper 1997, pp. 148–150)

gested that different stages of the industrial life cycle are associated with different kinds of entry and exit behavior. Klepper and Graddy (Baptista and Karaöz 2011; Klepper and Graddy 1990, p. 251) demonstrated empirically and explained theoretically that change in the mean number of firms goes from positive to negative as an industry passes through its life cycle. Another distinctive feature of the life cycle process is the changing nature of market turbulence, which is conventionally measured as a sum of firm entries and exits during a certain period divided by the number of firms in the population (Baptista and Karaöz 2011; Beesley and Hamilton 1984; Tervo and Niittykangas 1994). According to several empirical studies (Agarwal and Gort 1996; Baldwin and Gorecki 1991), the levels of turbulence should be highest during the early phases of the life cycle, leveling off toward industrial maturity. It is also emphasized that the structure of the turbulence changes from entry dominated to exit dominated (Agarwal and Gort 1996; Baldwin and Gorecki 1991; Klepper and Graddy 1990; Klepper and Miller 1995) and that exits based on trial (and ultimate error) at entry should diminish toward maturity (Baptista and Karaöz 2011, pp. 252–253).

How well does the life cycle predict the historical development witnessed in the pulp and paper industry? Or, more interestingly, when the industry does not follow

the path the theory assumes? Based on his work on extensive analysis of several industries, Klepper (1997, pp. 168–174) proposes that the higher the degree of specialization possible, the higher the entry rate at later stages and the lesser the so-called first mover advantage. Caves (1998, p. 1951) points out that corporate mobility (variation in sizes and market shares of the continuing firms) is largely independent of industry-level change. An important feature of industrial turnover not captured by the vast majority of earlier research is the possible differences in the development process across institutional setups. The data analyzed here afford insights to this intriguing question. The data consisting of cross-sectional information on pulp and paper industries' population variables from 15 countries spans from the early nineteenth century to the year 2000.

Figure 13.2 shows the country-level data. The sample can be divided into two groups: pioneers and latecomers. The pioneer group consists of those countries which experienced the initial stages of high turbulence prior to the First World War. Of the countries analyzed here, Finland and Sweden definitely belong to this group. According to the analysis by Klepper (1997, 2002), it can be claimed that the relatively few companies in Norway, France, and Great Britain surviving the period 1876–1910 should be assigned to the pioneer group – as is also witnessed in the country chapters in this volume. All these six countries experienced the entry-driven growth phase in the last quarter of the nineteenth century and during the first decade of the twentieth century. Most likely, the same applies to Russia and South Africa, but the data is not exhaustive enough to verify this assumption. The largest paper company population in continental Europe (Germany) grew during the period from 1911 to 1938 (Turunen 2012).

The second group, the latecomers, are countries experiencing the peak-population phase after the First World War. Of these countries, Italy and the Netherlands reached the population high between the years 1911 and 1938, Japan and China during the first decade after the Second World War, while for Brazil, Portugal, and Spain the maturity phases started after the 1970s. The similarities between Portugal and Spain are an interesting exception within the European framework, while the late surge in the Japanese pulp and paper population relates to the postwar reconstruction of the national economy (Kurosawa and Hashino 2012)

Using the data, it is possible to estimate the life cycle of the European paper industry during the past 200 years, although the country-specific variation is too wide to permit any reasonable estimate of the global paper industry. Figures 13.3 and 13.4 show an estimated overall population development of ten European countries included based on interpolated relative shares.

According to the estimate in Fig. 13.3, the population of the European pulp and paper industry grew until the start of the Second World War, although the highest rates of turbulence are measured during the period 1851–1875. As shown in Fig. 13.4, the entry proportion of the turbulence was considerably greater during the first half of the nineteenth century, followed by some 60 years of highly turbulent development, and the maturity stage settles in during the period 1939–1950. The rise of the exit component during the last period (1976–2000) can be explained by the mergers and acquisitions at the time (Ojala et al. 2006; Pesendorfer 2003).

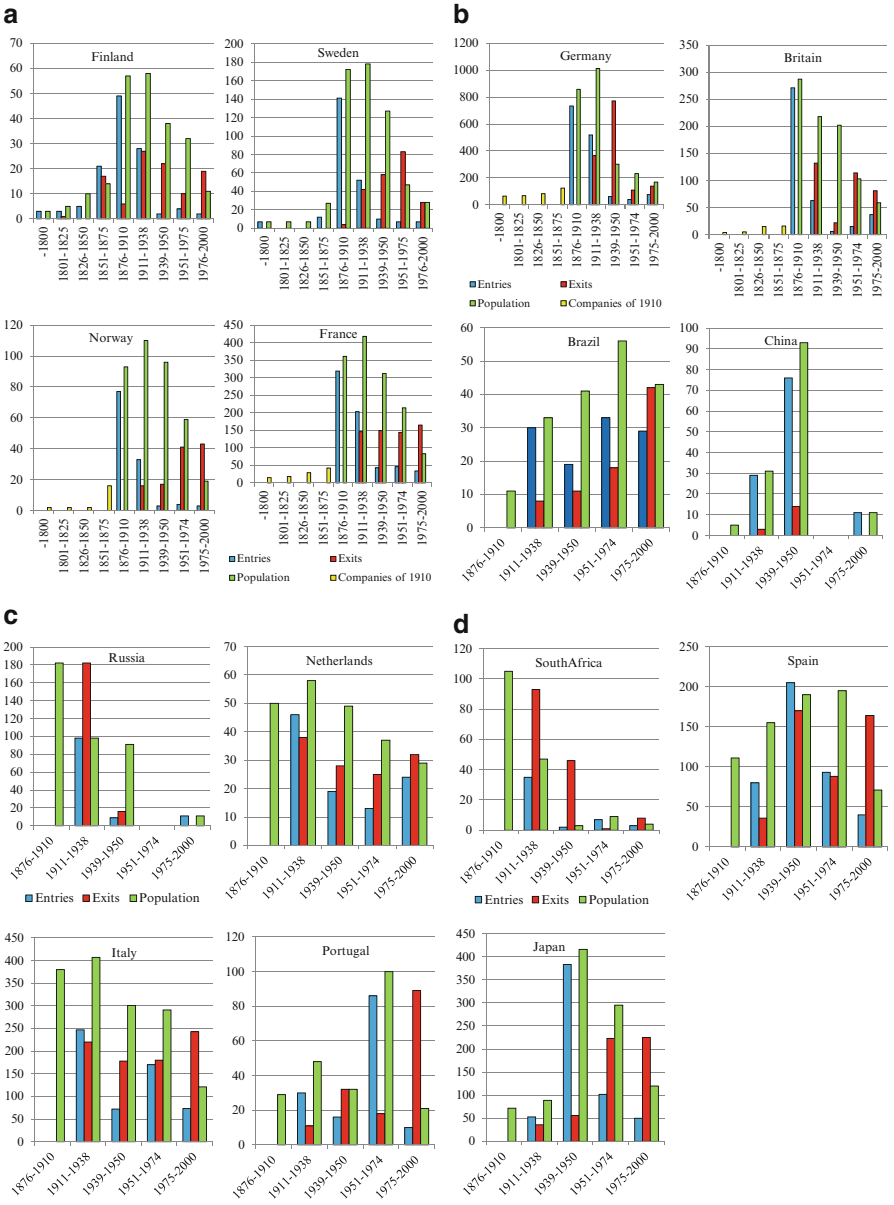

Fig. 13.2 Paper industry life cycles in selected countries: (**a**) Finland, Sweden, Norway, and France, (**b**) Germany, Britain, Brazil, and China, (**c**) Russia, the Netherlands, Italy, and Portugal, (**d**) South Africa, Spain, and Japan (Source: Dataset)

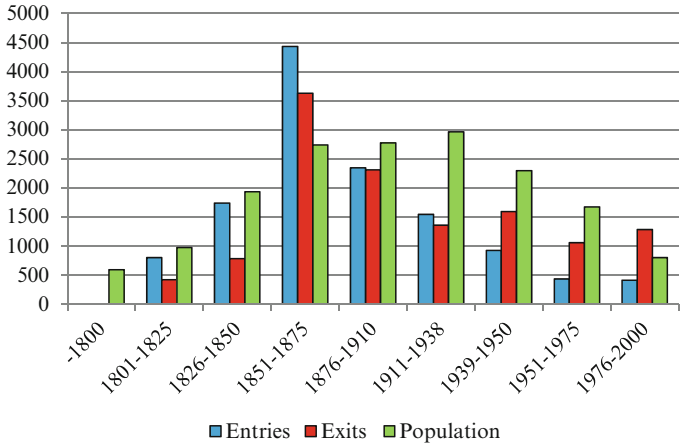

Fig. 13.3 Approximated pulp and paper industrial development in Europe 1800–2000 and its turbulence components

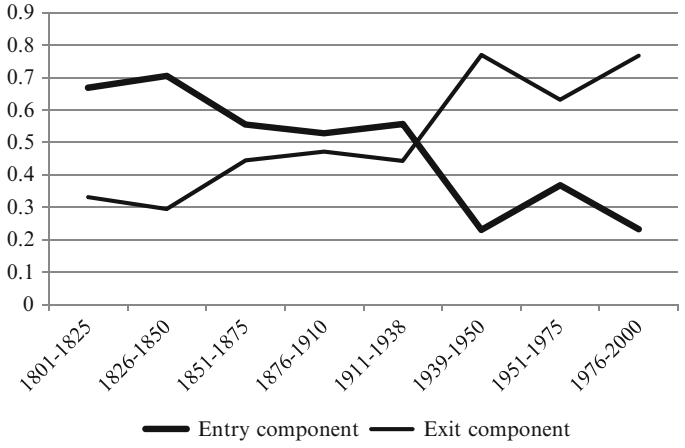

Fig. 13.4 Turbulence components in pulp and paper industrial development in Europe 1800–2000

On the basis of visual inspection, it is apparent that the worldwide pulp and paper industry population can be comprehended using the life cycle framework. The alteration in patterns of population dynamics may be due to institutional differences between countries, especially in terms of organizational "legitimacy," the extent to which a certain branch of industry enjoys institutional support, reducing selection pressure from its "natural level" (Singh and Lumsden 1990, p. 184). According to Baptista and Karaöz (2011), the mechanism of selection differs in the early and later stages of the industrial life cycle. The data used here is too sparse and covers the

early periods to superficially shed light on this hypothesis, but what it does show is that understanding these characteristics may require more in-depth knowledge concerning the nature of the industrial structure itself and the institutional and competitive framework driving the change. In the following, we return to reflect the findings of the book in the context of our original research topic.

13.3 Technology, Raw Materials, Markets, and Products

The life cycles of the paper industries described above are interrelated with the technology development, raw material acquisition, markets, and products produced at any given time and in any given country. In the Introduction (Lamberg et al. 2012), we asked how the availability of technology and raw materials, on the one hand, and demand characteristics on the other, affect national technological advances. In an international context, the relationships between technology transfer and leadership and raw material dependence and products vary globally. The crucial question is whether the international dominance in the pulp and paper industry is a function of technological leadership or if technological leadership is a coproduct of rapid market growth. Furthermore, we aim to analyze the tension between raw material availability and distance to market in determining the competitive advantage of nations in this particular line of business.

Pulp and papermaking technology, like numerous other technologies, has evolved incrementally (Cohen 1984; Magee 1997a, b, c; Mokyr 1990; Stier and Bengston 1992). The major technological change occurred in the early nineteenth century with the advent of machine-based papermaking. However, it took almost 100 years for machine-based papermaking to supersede traditional manual papermaking (Munsell 1980; Salzman 1911; Spicer 1907). The basic technology of making paper continuously has not changed dramatically in 200 years, although the size of the machines has increased. This, in turn, together with automation, has caused an enormous growth in productivity. The early twentieth century paper machine produced at best 200 m of paper per minute, while a century later the speed exceeded 1,800 m/min. At the same time, the width of the machines grew from 3–9 m (Diesen 1998; Lamberg and Ojala 2006).

The opportunities offered by the new technologies encouraged new firms to enter the pulp and paper industries. The industry emerged during the nineteenth century as a consequence of new technologies and enlarging markets. Besides the paper machine itself, a number of other important innovations were also implemented during the nineteenth century, such as the use of wood fiber as a source of pulp and sulfite and sulfate pulp technologies. One should also note the organizational and transport innovations followed by the general industrial development enabling large-scale industrial production, transportation, and distribution. The case of the United States paper industry (Toivanen 2012) is a prime example of processes of technological change. During the late nineteenth and early twentieth centuries, the

costs of new technologies were relatively low, encouraging new companies to enter the markets. During the twentieth century, however, economies of scale made pulp and paper production more capital intensive, vertical and horizontal integration resulted in industrial conglomerates, and mergers and acquisitions created the first multinational enterprises in the pulp and paper industry during the last decades of the twentieth century. Even though relatively small enterprises have succeeded in some niche products and local markets during the early third millennium, the bulk of the production is in the hands of multinational conglomerates (Berends and Romme 2001; Diesen 1998; Häggblom 1999; Ojala et al. 2009; Sajasalo 2003; Siitonen 2003).

Industry dominance has been closely linked to technology dominance in papermaking. The early technology development occurred in the Netherlands, France, and Britain and then spread to Germany and later to the USA (Bouwens 2004, 2012; Toivanen 2004, 2012; Turunen 2012). After the Second World War, the technological development has occurred especially in Nordic countries, most notably in Finland and in Germany (Järvinen et al. 2012c; Turunen 2012). Technological change can also lead to decline in paper industries, as was seen, for example, in the case of Norway (Järvinen et al. 2012c; Moen 1994; Peterson 1996, 2001; Toivanen 2004). Research and development intensity, however, has been relatively low in the pulp and paper industries; the process of R&D is largely outsourced to machinery production firms, while products are usually developed within the companies themselves (Alajoutsijärvi 1996; Chandler 1990; Hazley 2000; Jokinen and Heinonen 1987; Kettunen 2002; Ojala et al. 2006).

The availability of raw materials is probably the single most important determinant for the geographical location and dominance of the pulp and paper industries. During the early phase of mechanical papermaking, this line of business was dominated in the industrializing countries by Great Britain, Germany, and France. Besides technical capabilities and know-how, these countries also had relatively large markets for paper – and the raw material used in the early nineteenth century, namely, rags (Särkkä 2012; Turunen 2012). The mid-nineteenth century experiments with esparto grass were not successful enough, while at the time, Northern spruce or related woods proved to be both technically and economically the most suitable choice for large-scale papermaking. The use of wood as the raw material for industrial papermaking has for 150 years been the dominant solution in this area of business. The use of wood fiber changed the industry dominance for over 100 years to the Northern countries with their larger forest resources, namely, to the USA, Canada, and the Nordic countries (Järvinen et al. 2012c; Kuhlberg 2012; Toivanen 2012). With its vast forest resources, Russia and the Soviet Union never succeeded in gaining such a dominant position in the global pulp and paper industry (Mashkina 2012). Markets also played a role, and a lack of domestic raw materials could be compensated with pulp imports, as happened in Germany, Britain, and Japan (Kurosawa and Hashino 2012; Särkkä 2012; Turunen 2012). The lack of wood-based raw material is among the most important reasons for the decline of the British paper industries (Särkkä 2012).

The change from sulfite to sulfate pulp changed the geographical orientation in the USA, as southern pine forests could be used for papermaking (Lamberg 2005; Toivanen 2012). A more profound change in raw materials was yet to come, namely, the emergence of eucalyptus wood as a raw material for papermaking. Again, the technological change was a lengthy process starting with experimentation already during the early twentieth century. Since the early 1990s, the use of eucalyptus has moved the industry dominance to South America and Southern Europe (Gutiérrez-Poch 2012; Lima-Toivanen 2012).

Distance to market is an important determinant for global dominance in paper industries. For some of the countries analyzed in this volume, these markets have mainly been domestic ones, as in the case of Germany, Russia, USA, Britain, and Japan (Kurosawa and Hashino 2012; Mashkina 2012; Särkkä 2012; Toivanen 2012; Turunen 2012). For the Nordic countries and Canada especially, the export markets have been in a dominant position (Järvinen et al. 2012c; Kuhlberg 2012). To a certain extent, the lack or availability of raw materials can be compensated with distance and costs to market. Therefore, falling transport costs especially in overseas trade is a vital determinant for the creation of global paper markets and global production chains for paper products (Ojala and Kaukiainen 2012; Stopford 2009). Alongside global market changes, China and East Asia as a whole have emerged as the major paper consumption area – and also the fastest growing area for papermaking. The large markets for paper can in turn also be a source for raw materials, as the evolution of the use of recycled fiber in central European countries demonstrates (Bouwens 2012).

The markets have determined the demand for different kinds of paper products. For the demand for paper products, fairly simple variables are the most important ones: population growth, GDP per capita, consumption patterns, and literacy rate. Thus, demographic development does not alone explain paper consumption. Rise in income, witnessed in GDP per capita growth, led the way to modern consumerism that created various uses for paper products. Newsprint is usually taken as a primary example, but similar patterns can be seen, for example, in the rise of demand for packaging and hygiene paper products (Toivanen 2012). Bureaucratization and organizational changes during the twentieth century created markets for office papers and increased leisure, and new consumer needs are seen, in turn, in the demand for high-quality magazine papers. These basic factors seen in the historical development can also be harnessed for scenario building (Hetemäki and Obersteiner 2001; Järvinen et al. 2012a, b).

While newsprint was among the dominant products from the late nineteenth century until the late twentieth century, packaging materials and tissue papers have also grown in importance. In 1995 around 45% of paper consumption was used for communication (newsprint, printing, and writing papers), 40% for packaging, and 15% for miscellaneous products (such as tissues). Substitute materials have challenged certain paper industry products: plastics in packaging and digitalization, especially newsprint and writing papers. Developments in office technology and advertising expenditures explain the demand for certain paper industry products. Finnish and Swedish paper industry companies, for example, have concentrated since the 1980s on office and high-end coated magazine papers (Diesen 1998; Lamberg and Ojala 2006).

13.4 Regulation, Government Policy, and Cultural Characteristics

The industry life cycle in different countries is also determined by the institutional development, including governmental policies and regulation (Baker 2004; North 1990, 2005; Porter 1990). In turn, an unfavorable institutional environment may be an obstacle to the paper industry, as can be seen especially in the case of Germany (see Turunen 2012). The institutional environment affecting the pulp and paper industries includes roughly four key elements. First, the economic policies of the respective countries affected industry prospects. In countries in which the paper industry was a dominant line of business, attention was paid to creating a favorable regulatory environment, as the companies had bargaining power in governmental policies. The Nordic countries Finland and Sweden, and partly also Norway, are prime examples of favorable formal institutional environments for paper industries and the powerful role played by the forest industry companies in domestic legislation (Hazley 2000; Järvinen et al. 2012c; Kuisma 2008; Lamberg 2005). This favorable environment includes legislation affecting different stages of production from raw material acquisition, energy regulation, production, labor regulation, and investment regulation to transport and trade agreements with other countries. In Canada, in turn, the key role played by the provincial government in the control of timber and hydropower resources was crucial for the development of the pulp and paper industries (Kuhlberg 2012). Russia and partly also Germany are cases where the unstable institutional environment was detrimental to the further progress of the pulp and paper industry, although both countries have traditionally had fairly strong paper industries operating mainly in domestic markets (Mashkina 2012; Turunen 2012).

Second, the environmental legislation, partly enforced by the environmental nongovernmental organizations, affecting the opportunities to exploit raw materials has grown in importance globally during the last decades of the second millennium. Nevertheless, forest regulation has been widely debated issue since the late nineteenth century, especially in countries with vast forest resources and consequently important forestry industries (Lehtinen et al. 2004; Palo and Lehto 2012; Sonnenfeld 2002). In emerging pulp and paper industry countries, most notably in South America, a lot of attention has been paid to environmental regulation (Lima-Toivanen 2012) which is a new and different phenomenon than any faced by the first entrants in the nineteenth century.

Third, the end use of forest products is also under specific regulation. This can be seen especially in the freedom of the press, which has affected the demand for newsprint production. Furthermore, the lowering of taxes affecting newspaper industries has also had an impact on paper production (Guthrie 1941). The freedom of the press and press taxation regulation explain, at least partly, the rise of paper industries first in Britain and certain other European countries, together with the development in North America (Kuhlberg 2012; Särkkä 2012; Toivanen 2012). As a curiosity, the rapid growth of Finnish paper industries during the

turn of the twentieth century can mainly be explained by the rising demand for newsprint in Russia, where liberal policies gave rise to newspaper industries (Heikkinen 2000; Järvinen et al. 2012c; Kuisma 1993; Mashkina 2012). Domestic regulation, however, does not alone explain the evolution of paper industries in different countries. Regulation in the main market areas has also been important for major paper exporting countries such as the Nordic countries and Canada (Järvinen et al. 2012c; Kuhlberg 2012).

Fourth, informal institutional structure has also affected markets for paper. Religion and culture as a whole may have a significant impact on paper consumption. This is particularly apparent in the case of Japan, where for centuries the traditional handmade paper has retained its importance (Kurosawa and Hashino 2012)

13.5 Conclusion: Lessons Learned from the Evolution of the Global Paper Industry

What can we learn from the evolution of the global pulp and paper industry relative to industry evolution across industries? The Introduction to this volume (Lamberg et al. 2012) noted that we still lack an understanding of two key issues in industry evolution: (a) to what extent are evolutionary explanations geographically and temporally universal causing similar patterns in different types of countries? And (b) what kinds of causal relationships are there between industrial decline in one geographic region and rise in another? The case of the pulp and paper industry enables us, at least partly, to answer these fundamental questions.

The evolutionary reasons for the rise and fall of pulp and paper industries in the countries analyzed in this volume are summarized in Table 13.1 below. The universality of evolutionary explanations over time and geographic region can be summarized in the factors described above, namely, raw materials, markets, technological capabilities, and institutional factors. However, decline in one region does not necessarily lead to a rise of that industry elsewhere unless several or all these factors are involved in this transfer of industry.

When comparing pulp and paper industry development in the analyzed countries with a historical perspective, we may observe two major issues that add value to our understanding of industry evolution and competitive advantage. These two issues are (1) the fundamental effect of market growth on all other aspects in industry evolution and (2) the ways globalization has changed the mechanisms and processes causing changes in industry dominance.

First, having a time perspective of almost 200 years allows us to witness several changes in industry dominance defined as the agglomeration of production capacity, technological knowledge, and management and marketing capabilities (cf. Chandler

Table 13.1 Country-specific examples of evolutionary explanations for paper industry life cycles

Country	Industry structure and dominance	Technology, raw materials, and markets	Regulation and government policy
Nordic countries	Emergence from the late nineteenth century, regional dominance, and international presence during the late twentieth century	Pioneering with modern technology, technology leadership late twentieth century Pine and spruce resources Export orientation	Favorable institutional environment for forest industries, cartelization
USA	Emergence in the turn of the nineteenth and twentieth century, regional dominance, and international presence throughout the twentieth century	Technology lead throughout the twentieth century Changes in raw material base Domestic markets	Nonregulated markets, specific regulative changes affecting forest industries
Germany	Long tradition in papermaking, early emergence of factory scale production and dominance	Technology lead from the early nineteenth century Challenging raw material situation Domestic markets	Institutional shakeouts and external shocks, cartelization
Canada	Emergence during the turn of the twentieth century, dominance until the late twentieth century	Technology follower Favorable raw material situation Export markets	Regional institutional constraints, regulation in major export area (USA)
Japan	Emergence from the early twentieth century, regional dominance on domestic markets	From technology follower to leader during the latter part of the twentieth century Imported raw materials Domestic markets	Favorable institutional environment
Britain	Pioneering country with early emergence and industrial dominance	Technology leadership throughout the nineteenth century Dependence on imported raw materials Large domestic markets	Nonregulated markets, changes in trade policy affecting paper industry
Netherlands	Long tradition and early dominance	Early technology leadership (late eighteenth century) Imported raw materials and recycled fibers Mainly domestic markets	…

(continued)

Table 13.1 (continued)

Country	Industry structure and dominance	Technology, raw materials, and markets	Regulation and government policy
Southern Europe	Traditional papermaking dominant for long time, late emergence, acquiring dominance	Technology follower Long search for suitable raw material base Mainly domestic markets	Favorable institutional environment
South America	Latecomer advantage, acquiring dominance	Active innovation policies to acquire technology leadership Vast raw material sources Global markets	Favorable institutional environment
Russia	Slow and fluctuating evolution	Technology follower Vast raw material resources Domestic markets	Institutional shakeouts

1990; Murmann 2003). According to research in this volume and related projects, we identify the major changes in industry dominance as follows:

From the UK to the USA	(Beginning of the twentieth century)
From the UK to Germany	(Beginning of the twentieth century)
From the USA and Germany to Canada and Japan	(Mid-twentieth century)
From the USA and Germany (and Canada) to Nordic countries	(The 1980s and 1990s)
From Nordic countries to China	(Early 2000)
From Nordic countries to South America	(Early 2000)

When focusing on similarities between the transitions, two issues emerge as necessary causes. First, dominance has always shifted to the region with the highest market potential in terms of population size and speed of economic growth. The markets may be domestic or export oriented, as has been the case with the Nordic countries and Canada (Järvinen et al. 2012c; Kuhlberg 2012). Second, industrial growth and the accumulation of technological knowledge require a certain maturity of political systems, regulation, and organization of research and development. Likewise, similarities between regions that lose their competitive advantage are characterized by saturation of demand, thereby weakening incentives to invest in production capacity, which is subsequently detrimental to the whole value network. In a recent network analysis (Järvinen et al. 2012b), for example, the relative decline of the pulp and paper clusters in the USA and Japan is characterized by ever rarer network connections, meaning fewer business deals from the perspective of supporting industries such as machinery and chemical industries.

Transitions are also different in one important dimension: the major resource on which firms may build their strategic position. Germany, Japan, China, and the USA are examples of countries with huge market potential in terms of proximity of potential customers. Likewise, the Nordic countries, Canada, and to some extent South America represent settings in which the main competitive advantage is the availability of forests suitable for harvesting and use in industrial production. This difference affects many aspects in industrial evolution: focus of research and engineering knowledge, organization of market activities, and structure of industrial populations. For example, the fact that Nordic firm populations have been small and characterized by the large size of major companies signals the need to have advanced marketing and organizations capabilities that have allowed expansion to potentially hostile markets in Germany and UK (Jarvinen et al. 2009). Also, as can be seen from Table 13.1, industry dominance and technology leadership are closely interlinked (Alajoutsijärvi 1996; Murmann 2003)

Transitions of competitive advantage from one region to other regions used to be comprehensive: as a result of changing market dynamics, new firms emerged in regions, local producers catalyzed new types of technological inventions, and so the dominance shifted regularly and predictably. In a metaphorical sense, economic

regions were like isolated islands each witnessing the evolution of pulp and paper industry clusters as predicted in the life cycle literature. In this sense, dominance shifts were primarily the function of industry evolution occurring at different times in different places. Globalization has radically changed this dynamic. First, although economic activity and the demand for pulp and paper products may decline, this no longer means that firms fade away as was the case, for example, in the UK paper machine industry in the early twentieth century. Due to globalization and increasing demand somewhere especially, technology firms always have markets although their "domestic" customers may be in trouble. Second, the evolution of regional firm populations takes a different shape than it has historically, as we have increasing number of multinational corporations that may expand to any emerging market, thus bypassing the nascent domestic firms. The same has also happened in mature markets, as the Dutch case witnesses (Bouwens 2012). As a consequence, the total sum of global firms does not grow. In the distant future, we may witness the dominance of a few multinational pulp and paper firms, saturation of technological progress, and ultimately the emergence of a totally different type of industry producing different products than today.

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J.-A. Lamberg et al. (eds.), *The Evolution of Global Paper Industry 1800–2050: A Comparative Analysis*, World Forests 17, DOI 10.1007/978-94-007-5431-7,

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