

## Chapter II: Financial Analysis and Appraisal of Projects

### 2.1 Scope and Rationale for Financial Analysis of Projects and Concepts Involved

#### A. Introduction: What is financial analysis and when is such analysis is required?

##### ☞ What is commercial/financial analysis?

Every project has to be first analyzed in terms of its **timely implementation and financing**.

Commercial profitability analysis or financial analysis of a project amounts to reviewing it from the angle of the **entity (private or public) that will be responsible for its execution**. The necessity to determine the financial profitability of a project to the project implementer calls for undertaking financial analysis. It aims at verifying that under prevailing market conditions the project will become and remain viable. It is concerned with assessing the feasibility of a new project from the point of view of its financial results. It will be worthwhile to carry out a financial analysis if the output of the project can be sold in the market or can be valued using market prices. The project's direct benefits and costs are, therefore, calculated in pecuniary terms at the prevailing (expected) market prices. This analysis is applied to appraise the soundness and acceptability of a single project as well as to rank projects on the basis of their profitability.

In other words, the financial analysis is all about the assessment, analysis and evaluation of the required project inputs, the outputs to be produced/generated/ and the future net benefits, (expressed in financial terms) with the aim of determining the viability of a project to the private investor or the executing entity public body.

The commercial analysis deals with two issues:

1. Investment profitability analysis, with different methods of analysis;

a. Simple methods of analysis of rate of return/static methods/ non-discounted techniques/. This include:

- ✓ Simple rate of return;
- ✓ Pay-back period;

b. Discounted-cash-flow methods/dynamic methods

- ✓ Net Present Value/NPV/;
- ✓ Internal Rate of Return/IRR/

2. Financial analysis/ ratio analysis/.

- ✓ Liquidity analysis;
- ✓ Capital structure analysis (debt-equity ratio).

The two types of analysis are complementary and not substitutable. In fact in the relevant literature commercial analysis and financial analysis are used interchangeably. Whatever the terminology, the investment profitability analysis is **the measurement and assessment of the** *Development Planning and Project Analysis II*

**profitability of the resources put into a project, more directly the return on the capital no matter what the sources of financing.** Thus, investment profitability analysis is an assessment of the **potential earning power of the resources committed to a project without taking into account the financial transactions occurring during the project's life.**

On the other hand, financial analysis (ratio analysis) has to take into account the financial features of a project to ensure that the disposable finances shall permit the **smooth implementation and operation of the project.**

#### ☞ **Why one undertakes Financial Analysis? Or when to undertake financial analysis?**

Commercial/financial analysis applies to private and public investments. A private firm will primarily be interested in undertaking a financial analysis of any project it is considering and seldom will it undertake an economic analysis.

The issue of financial sustainability of a public project justifies the need for undertaking financial analysis.

But commercially oriented government authorities that are selling output such as railway, electricity, telecommunications, etc., will usually undertake a financial and an economic analysis of any project it is undertaking. Even non-commercially oriented government institutions may sometimes wish to choose between alternative facilities on the basis of essentially financial objectives. In the case of a hospital service the management of the hospital may be required to provide the cheapest services. Under such circumstances a cost minimization or cost effectiveness exercise will be undertaken.

Commercial profitability analysis is the first step in the economic appraisal of a project. A comprehensive financial analysis provides the basic data needed for the economic evaluation of the project and is the starting point for such evaluation. In fact economic analysis mainly involves of adjustments of the information used in financial analysis and of a few additional ones. The procedure and methodology in financial analysis is basically the same with that of economic analysis. Yet one has to recognize and realize the differences between the two.

It has to be noted that the financial analyst should be able to communicate and know what to ask from the different team members to collect relevant information on:

1. Revenue, both forecasted sales and selling price; (from Demand and Market Study)
2. Initial investment costs distributed over the implementation of the project; (Engineering, Site Development as well as Materials and Inputs);
3. Operating costs of the envisaged operational unit/firm/ over its operating life. (on Engineering, Site Development as well as Materials and Inputs);

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The issues and concerns of financial analysis are:

1. Identification of required data;
2. Analysis of the reliability of data;
3. Analysis of the structure and significance of costs and benefits/incomes/;
4. Determination and evaluation of the annual and accumulated financial net benefits; expressed as profitability, efficiency or yield of the investment;
5. Consideration of the spread of flows of the costs and benefits over time, the economic life of the envisaged economic unit/firm/public entity/;
6. Costs of capital over time;

## **2.2 Identification and Analysis of the Estimates of Costs and Benefits**

In project analysis, the identification of costs and benefits is the **first step**. This involves the specification of the costs and benefit variables for which data should be collected, identification of the sources of information, collection of the same and then assessment of the quality and reliability of the collected information.

### **Objectives and the Identification of Costs and Benefits**

The costs and benefits of a project depend on the objectives the project wants to achieve. So, the objectives of the analysis provide the standard against which cost and benefits are defined. A cost is anything that reduces an objective, and a benefit is anything that contributes to an objective. However, each participant in a project has many and different objectives.

- For a farmer, a major objective of participating may be to maximize family income. But this is only one of his/her objectives. She/He may also wish her/his children to be educated, which reduces the available labor force for farm work. Taste preferences may force the farmer to continue growing a traditional variety although a new and high yielding variety may be available. She/He may also wish to avoid risk and thus continue cropping a variety, which she/he knows well.
  - For a private business firm or government corporations a major objective is to maximize net income, yet both have significant objectives other than simply making the highest possible profit. Both will want to diversify their activities to reduce risk. A bus public corporation may for instance decide to maintain services even in less densely populated areas or at off peak hours and thereby reduce its net income.
  - A society as a whole will have as a major objective increased national income, but it clearly will have many significant, additional objectives. One of the most important of these is income distribution. Another may be to increase the number of productive job opportunities so that unemployment may be reduced - which may be different from the objective of income
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distribution itself. Another objective may be to increase the proportion of saving for future investment. Or there may be other broader objectives such as increasing regional integration, raising the level of education, improve rural health, or safeguard national security. Any of these may lead to the choice of a project that is not the alternative that would contribute most to national income narrowly defined.

**No formal analytical technique could possibly take into account all the various objectives of every participant in a project.** Some selection will have to be made. Most often the maximization of income is taken as the **dominant objective** of the firm because the single most important objective of an individual economic agent is to increase income and increased national income is the most important objective of national economic policy. Anything that reduces national income is a cost and anything that increases national income is a benefit. Thus anything that directly reduces the total final goods and services is obviously a cost, and anything that directly increases them is a benefit. The task of the economic analyst will be to estimate the amount of the increase in national income available to the society i.e., to determine whether, and by how much, the benefits exceed the costs in terms of national income.

**Quantification:** once costs and benefits are enumerated the next step is accurate prediction of the future benefits and costs which then be quantified in monetary units/Birr/. Thus, quantification involves the quantitative assessment of both physical quantities and prices over the life span of the project.

The financial analysis of projects is typically based on accurate prediction of market prices, on top of quantity prediction. It is worth thinking about the impact of the project itself on the level of prices; and the independent movement of prices due to other factors. The same principle applies in the case of economic analysis the only difference being the price needs to be changed to reflect net efficiency benefits to the nations at large. One widely accepted ‘efficiency’ measure is its actual or potential value as an import or export; similarly the opportunity cost of any input is related to the question of its potential contribution to (or claims on) foreign exchange. In other words world price are considered as efficiency price indicators compared to domestic prices. However, to take account of the distribution impact of projects further adjustment of such price is required. This lends itself to the social cost benefit analysis.

### **2.3 Classifications of Cost and Benefits**

There are alternative ways of classifying costs and benefits of a project. One is to categorize both costs and benefits into:

- tangible and
- intangible once.

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Another classification is in terms of:

1. Total investment costs;
2. Operational/running costs;

Another classification:

1. Total investment costs including:
  - a. Initial investment costs;
    - Fixed investment costs;
    - Pre-Production expenditures;
  - b. Investment required during plant operation / rehabilitation and replacement investment costs/
  - c. Net working capital
2. Operating costs/costs of goods sold

### **Tangible costs of a project**

In almost all project analyses costs are easier to identify (and value) than benefits. In examining costs the basic question is whether the item reduces the net benefit of a farm or the net income of a firm. The prices that the project actually pays for inputs are the appropriate prices to use to estimate the project's financial costs. These prices may include taxes, tariffs, monopoly or monopsony (seller monopoly) rents, or be net of subsidies. Some of the project costs are tangible and quantifiable while many more are intangible and non quantifiable. The costs of a project depend on the exact project formulation, location, resource availability, or objective of the project. In general, the cost of a project would be the sum of the total outlays on the following items.

### **Initial Fixed Investment costs**

The initial fixed investments constitute the major resources required for constructing and equipping an investment project.

These include the following **tangible** initial fixed investments.

1. The cost of land and site development
  - Land charges
  - Payment for lease
  - Cost of leveling and development
  - Cost of laying approach roads and internal roads
  - Cost of gates
  - Cost of tubes wells
2. The cost of buildings and civil works
  - Buildings for the main plant and equipments

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- Buildings for auxiliary services (steam supply, workshops, laboratory, water supply, etc.)
- Warehouses and show rooms
- Non factory buildings like guest house, canteens, residential quarters, staff rooms
- Silos, tanks, wells, basins, etc.
- Garages and workshops
- Other civil engineering works

### 3. Plant and machinery

- Cost of imported machinery which might include the FOB value, shipping freight and insurance costs, import duty, clearing, loading, unloading, and transportation costs
- Cost of local or indigenous machinery
- Cost of stores and spares
- Foundation and installation charges

### 4. Miscellaneous fixed assets

- Expenses related to fixed assets such as furniture, office machines, tools, equipments, vehicles, laboratory equipments, workshop equipments

### **Pre-production Expenditures**

Another component of the initial investment cost which includes both tangible and intangible costs is the pre-production expenditures. In every project, certain expenditures are incurred prior to commercial production/ inauguration and commencement of service delivery for public service rendering projects/.

This includes the following investment cost items.

1. Intangible assets; these assets represent expenditures which yield benefits extending over a long time period. These include:

a. Patents, licenses, lumpsum payments for technology, engineering fees, copy rights, and goodwill.

b. Preparatory studies, like feasibility studies, specific functional studies and investigations, consultant fees for preparing studies, supervision costs, project management services, etc.

2. Preliminary expenses; these costs include preliminary establishment expenses, (registration and formation expenses), legal fees for preparation of memorandum and articles of associations and similar documents. In addition it includes costs of advertisements, brokerage for mobilizing resources, shareholders, expenses for loan application and its processing.

3. Other Pre-operation expenses. These include:

- Rents, taxes, and rates

- **Trial runs, start-ups and commissioning expenditures** (raw materials and other inputs consumed immediately before commercial operation);
- Salaries, fringe benefits and social security contributions of personnel engaged during the pre-production period;
- Pre-production marketing costs, promotional expenses, creation of sales network, etc;
- Training costs, including all fees, travel, living expenses etc;
- Traveling expenses interest and commitment charges on borrowings
- Insurance charges
- Mortgage expenses interest on differed payments,
- Miscellaneous expenses

There are two approaches in allocating of pre-production expenditures.

1. All pre-production expenditures may be capitalized and amortized over a period of time that is usually shorter than the period over which equipment is depreciated, say five years;
2. A part of the pre-production expenditures may be initially allocated where attributable to the respective fixed assets and the sum of both amortized/depreciated/ as a the fixed asset, machinery and/or equipment.

### **Plant and Equipment Replacement Costs**

Every machinery and equipment does not have equal economic life. There are machineries and equipment that productively be operated for many years, 20 years in the case of industrial technologies, about 50 years in the case of agricultural and infrastructural works. On the other hand there are equipments, machinery components and parts which need to be regularly replaced for smooth operation of the same technology. So sound project planning work should adequately provide for replacement of components and parts. In fact the first thing to do would be to identify such items and then estimate the costs for replacement and then the same should be reflected in the financial and economic analysis.

### **Terminal Values/End-of-Life Costs/Salvage Costs/**

#### **Exit is not free and perfect!!**

Though firms may be institutionally organized to live and operate for unlimited period of time and hence unlimited age, technologies, machineries and equipment do have limited operational/economic/ life. During the end of the economic life of a good(machinery, equipment, building, etc) there is some salvaged value and the salvation may involve incurring of costs. The costs of associated with the decommissioning of fixed assets at the end of the project life, minus any revenues from the sale of the assets, are end-of-life costs. Major costs are the costs of dismantling, disposal and land reclamation.

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## **Net Working Capital**

Net working capital is part of the total investment outlays. It is defined to embrace current assets (the sum of inventories, marketable securities, prepaid items, accounts, receivable and cash) minus current liabilities (accounts payable). This investment is required for financing the operation of the plant. Any change in the current assets and/or current liabilities will have an impact on the net working capital requirements.

Any increase in net working capital/NWC/ corresponds to a cash outflow to be financed, and any decrease would set free financial resources (cash inflow for the project). Working capital is generally categorized into gross working capital and net working capital (NWC).

The gross working capital consists of all the current assets, including:

- a. raw materials;
- b. stores and spares;
- c. work-in-process;
- d. finished goods inventory;
- e. Debtors/accounts receivable/;
- f. Cash and bank balance.

Net working capital is defined as gross working capital less current liabilities. Current liabilities consist of creditors, provisions, accrued expenses, and short-term borrowings. For the purpose of financial analysis and even financial management of operational firms, it is net working capital which is the center of decision makers.

## **Costs of Goods Sold**

Once the project idea has been accepted and the project is being implemented the cost of production may be worked out: For instance, for an agricultural project the following may be necessary:

- **Material cost** which comprises the cost of raw materials, chemicals, components, fertilizer and pesticides for increasing agricultural production, concrete for irrigation canal construction, material for the construction of homes etc and consumable stores required for production. It is not the identification that is difficult in this case but the problem of finding out how much is needed from each.
- **Utilities** consisting of power, water, and fuel are also important cost components.
- **Labor:** this is the cost of all manpower employed in the enterprise. it will not be difficult to identify and quantify the labor required for the production process. From the highly skilled manager to the unskilled factory worker the labor input can easily be identified. Problems in the case of valuing unskilled labor and family labor might arise in the economic analysis of projects.

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- **Factory Overhead:** the expense on repairs and maintenance, rent, taxes, insurance on factory assets, etc. are collectively referred to as factory overheads.
  - **Land** to be used for the project can also be easily identified and quantified. It will not be difficult to know how much land is needed and about the location. Yet problems might arise in valuing land because of the special kind of market conditions that exist when land is transferred from one owner to another.
  - **Contingency allowances** are usually included as a regular part of the project cost. In general project cost estimates assume that there will be no relative changes in domestic or international prices and no inflation during the investment period or there will be no modification in design, no exceptional conditions such as unanticipated environmental conditions (flood, landslides, or bad weather). It would be unrealistic to base project cost estimates only on these assumptions of perfect knowledge and complete price stability. Sound project planning requires that provision be made in advance for possible adverse changes in physical conditions or prices that would add to the baseline cost. Contingency allowances may be divided into those that provide for physical contingencies and those for price contingencies. In turn price contingencies comprises two categories, those for relative changes in price and those for general inflation. Physical contingency allowances and price contingency allowances for relative changes in price are expected and form part of the cost base when measures of project worth are calculated. To avoid the problem of inflation on the other hand it is advisable to work with constant prices instead of current prices. This approach assumes that all prices will be affected equally by any rise in the general price level. So contingency allowances for inflation will not be included among the costs in project accounts other than the financing plan.
  - **Taxes:** payment of taxes including tariffs and duties is treated as a cost to the project implementer in financial analysis. But they are considered as transfer payments in economic analysis.
  - **Debt service:** the same approach applies to debt service - the payment of interest and the payment of capital. Both are treated as an outflow in financial analysis. In economic analysis debt service is treated as a transfer payment within the economy even if the project will actually be financed by a foreign loan and debt service will be paid abroad.
- Sunk costs** - sunk costs are those incurred in the past and upon which the proposed new investment will be based.

Such costs cannot be avoided however, poorly advised they may have been. When we analyze a proposed investment, we consider only future returns to future costs; expenditures in the past, or sunk costs do not appear in our account.

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## **Tangible Benefits**

Tangible benefits can arise either from increased production or from reduced costs. The specific forms, in which tangible benefits appear, however, are not always obvious and valuing them might be difficult. In general the following benefits can be expected

- Increased production
- Quality improvement
- Changes in time of sale changes in location of sale
- Changes in product form (grading and processing)
- Cost reduction through technological advancement
- Reduced transport costs
- Losses avoided
- Other kinds of tangible benefits

### **2.4. The Valuation of Financial Cost and Benefits**

This is an issue of pricing/valuing/ of the project's inputs and outputs. The inputs and outputs of a project appear in physical form and prices are used to express them in value terms in order to obtain common denominator.

Ideally, for the purpose of the feasibility study prices should reflect the real economic values of project inputs and outputs for the entire planning horizon of the decision makers.

The financial benefits of a project are just the revenues received and the financial costs are the expenditures that are actually incurred by the implementing agency as a result of the project. If the project is producing some goods and services for sale the revenue that the project implementer expects to receive every year from these sales will be the benefits of the project. The costs incurred are the expenditures made to establish and operate the project. These include capital costs, the cost of purchasing land, equipment, factory buildings vehicles, and office machines, working capital as well as its ongoing operating costs; for labor, raw material, fuel, and utilities.

In financial analysis all these receipts and expenditures are **valued as they appear in the financial balance sheet of the project**, and are therefore, measured in **market prices**. Market prices are just the prices in the local economy, and include **all applicable taxes, tariffs, trade mark-ups and commissions**. Since the project implementers will have to pay market prices for the inputs and will receive market prices for the outputs they produce, the financial costs and benefits of the project are measured in these market prices. In a freely perfectly competitive market, without taxes or subsidies the market price of an input will equal its competitive supply

price at each level of production. This is the price at which producers are just willing to supply that good or service. The supply curve will reflect the opportunity cost, or the value in their next best alternative use, of the resources used to produce that input. In equilibrium the supply price of an input will equal to its demand price at the market-clearing price for that input.

The financial benefit from a project is measured in terms of the market value of the project's output, net of any sales taxes. If the project's output is sold in a competitive market with no rationing or price control for the good concerned, and the project is small and does not change the good's price, its market price will equal its competitive demand price. This is a minimum measure of what people are willing to pay for a unit of the good or service (produced by the project, at each level of output demanded).

Prices may be defined in various ways, depending on whether they are:

1. Market/explicit/ or shadow/imputed/ prices;
2. Absolute or relative prices;
3. Current or constant prices.

#### **Market/Shadow prices:**

Market or explicit prices are those present in the market, no matter whether they are determined by supply and demand or by the government. They are the prices at which the firm will buy the inputs and sell the outputs. In financial analysis market prices are applied. In economic analysis we raise the question whether market prices reflect real economic value of project inputs and outputs. In economic analysis, if the market prices are distorted, then shadow or imputed prices will have to be used for economic analysis.

#### **Absolute/relative prices:**

Absolute prices reflect the value of a single product in an absolute amount of money, while relative prices express the value of one product in terms of another. For instance, the absolute price of 1 tone of coal may be 100 monetary units and an equivalent quantity of oil may be 300 monetary units. In this case the relative price of coal in terms of oil would be 0.33, meaning that the relative price of oil is three times the price of coal. The level of absolute prices may vary over the lifetime of the project because of inflation or productivity changes. This variation does not necessarily lead to a change in relative prices, in other words, relative prices may sometimes remain unchanged despite variations in absolute prices. Both absolute and relative prices can be used in financial analysis.

#### **Constant Vs Current prices**

Current and constant prices differ over time due to inflation, which is understood as a general rise of a price levels in an economy. If inflation can have a significant impact on project inputs and output prices, such an impact must be dealt with in the financial analysis. Wherever relative input and output prices remain stable, it is sufficiently accurate to compute the profitability or yield of an investment at constant prices. Only when relative prices change and project input prices grow faster (or slower) than output prices, or vice versa, then the corresponding impacts on net cash flows and profits must be included in the financial analysis. If inflation impacts are negligible, the problem of choosing between current and constant prices does not exist, since they are equal and the planner may use either.

➤ **The Treatment of Transfer Payments in Financial Analysis**

Some entries in financial accounts represent shifts in claims to goods and services from one entity in the society to another and do not reflect changes in national income. So the definition of costs and benefits might be confusing. These payments are called direct transfer payments. These direct transfer payments include taxes, subsidies, loans, and debt services.

**Taxes:** taxes that are treated as a direct transfer payment are those representing a diversion of net benefit to the society. A tax does not represent real resource flow; it represents only the transfer of a claim to real resource flows. In financial analysis a tax is clearly a cost. When a firm pays taxes its net income reduces. But the payment of taxes does not reduce national income. Rather it transfer income from the firm to the government so that this income can be used for social purposes presumed to be more important to the society than the increased individual consumption (or investment had the firm retained the amount of the tax. So, in economic analysis taxes will not be treated as a cost in project account.

No matter what form a tax takes, it is still a transfer payment - whether a direct tax or an indirect taxes such as sales tax, an excise tax, or tariff or duty on an imported input for production. Whether a tax should be treated as a transfer payment or as a payment for goods and services needed to carry out the project or merely a transfer, to be used for general purposes, of some part of the benefit from the point to the society as a whole.

**Subsidies:** are simply direct transfer payments that flow in the opposite direction from taxes. Direct subsidies represent the transfer of a claim to real resources from one enterprise, sector or individual to another. Subsidies may be open or disguised and are provided on the input or output side. On the input side subsidies reduce costs to the project, e.g. subsidies to fertilizers. If the subsidy is granted on the output side i.e., increase the revenue of the project; we should deduct the amount of the subsidy from the revenue that includes subsidy. If a firm is able to purchase an input at a subsidized price that will reduce his costs and thereby increase his net

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benefit, but the cost of the input in the use of the society's real resources remains the same. The resources needed to produce the input or to import it from abroad reduce the national income available to the society. Hence, for economic analysis of a project we must enter the full cost of the input.

Again it makes no difference what form the subsidy takes. One form is that which lowers the selling price of the input below what otherwise would be their market price. But a subsidy can also operate to increase the amount the owner receives for what he sells in the market, as in the case of a direct subsidy paid by the government that is added to what he receives in the market. A more common means to achieve the same result does not involve direct subsidy. The market price may be maintained at a level higher than it otherwise would be by, say levying an import duty on competing imports or forbidding competing imports altogether. Although it is not a direct subsidy, the difference between the competing imports that would prevail without such measure does represent an indirect transfer from the consumer to the producer.

**Credit Transactions:** these are the other major form of direct transfer payments. A loan represents the transfer of a claim to real resources from the lender to the borrower. When the borrower repays loans or pays interest he is transferring the claim to the real resource back to the lender - but neither the loan nor the repayment represent in itself, use of the resources. From the standpoint of the producer, receipt of a loan increases the production resources he has available; payment of interest and repayment of principle reduces them. But from the standpoint of the national economy loans do not reduce the national income available. It merely transfers the control over resources from the lender to the borrower. The loan transaction from one enterprise to another would not reduce the national income; it is rather, a direct transfer payment. Repayment of a loan is also a direct transfer payment.

## **2.5 Investment Profitability Analysis**

### **2.5.1. Non-discounting (traditional) measures of project worth**

- 1) Payback Period (PBP)
- 2) Accounting Rate of Return (ARR)

### **2.5.2. Discounted Cash Flows (DCF) measures of project worth**

- a) Net Present Value (NPV)
- b) Internal Rate of Return (IRR)
- c) Profitability Index (Benefit-cost ratio)

#### **2.5.1 Non-discounting (traditional) criteria**

##### **1) Payback Period (PBP)**

Payback period refers to *the length of time it takes to recover initial investment* of the project. Depending on the nature of net cash flows, payback period may be computed in two ways.

- a) When cash flow is in **annuity form (even cash flows)**

Annuity refers to *equal amount of cash flows that occur every period over the life of the project.*

$$PBP = \frac{\text{Initial Investment}}{\text{Annual Net Cash Flows}}$$

To illustrate the computation of payback period, assume that a project requires an initial investment of Br. 24,000 and annual after tax cash flows of Br. 6000 for five years. How long it takes the company to recover its initial investment?

$$PBP = \frac{24,000}{6000} = \underline{4 \text{ years}}$$

It is expected to take the company four years to recover the project's initial investment of Br. 24,000

b) When cash flows are **not in annuity form (Uneven cash flows)**

When net cash flows are not annuity, payback period is obtained by adding net cash flows for successful years until the total is equal to initial investment.

$$\square \text{ PBP} = \text{Years before full recovery} + \frac{\text{Un recovered cost}}{\text{Cash flow during the next year}}$$

To exemplify, assume that a project requires an initial investment of Br. 60,000. The after taxes cash flows (or net cash flows) are as follows:

$$\begin{array}{lll} \text{Year 1} = 8000 & \text{Year 3} = 22,000 & \text{Year 5} = 20,000 \\ \text{Year 2} = 15,000 & \text{Year 4} = 20,000 & \end{array}$$

The payback period is computed as follows:

$$PBP = 3 \text{ years} + \frac{15,000}{20,000} = \underline{3.75 \text{ years}}$$

In the above example, if the 1<sup>st</sup> three years' net cash flows are added, the sum is equal to Br. 45,000. But the initial investment is Br. 60,000. If the fourth year net cash flows (Br. 20,000) is added to Br. 45,000, the sum is Br. 65,000 which is greater than the initial investment. Thus, the payback period is between year 3 and year 4. To find the exact payback period, we take the three years and divide the remaining cash flows by the fourth year net cash flows. If the exact payback period is needed in months the fraction can be computed as follows:

$$\begin{aligned} PBP &= 3 \text{ years} + \frac{15,000}{20,000} (12 \text{ months}) \\ &= \underline{3 \text{ years and 9 months}} \end{aligned}$$

### Decision Rule for Payback Period

- i. Accept the project if its payback period is less than or equal to the required payback period (standard)
- ii. Reject the project if its payback period exceeds the required payback period. The shorter the payback period, the more desirable the project.

### Advantages of Payback Period

1. It is simple both in concept and application
2. It is a rough and ready made method for dealing with risk
3. It may be a sensible criterion when the firm is pressed with problems of liquidity

### Disadvantages of Payback Period

1. It fails to consider time value of money

2. It ignores cash flows beyond the payback period
3. It is a measure of the project's capital recovery, not profitability.
4. It does not indicate the liquidity position of the firm as a whole.

## 2) Accounting Rate of Return (ARR)

Also called the average rate of return on investment, the accounting rate of return is a measure of profitability which relates net income to investment. Both net income and investment are measured in accounting terms. Although there are several methods of computing ARR, the most common method is shown below:

$$\text{ARR} = \frac{\text{Average annual net income}}{\text{Average investment}}$$

$$\text{Average Investment} = \frac{\text{Original costs} + \text{salvage value}}{2}$$

To illustrate, assume that a project has original investment of Br. 70,000, life of 4 years, and salvage value of Br. 6000. Straight-line method of depreciation is used. Income before depreciation and taxes for each of the four years are as follows: year1, Br. 40,000; year 2, Br. 42,000; year 3, Br. 36,000; and year 4, Br. 50,000. Income tax rate is 40%.

$$\text{Depreciation} = \frac{70,000 - 6000}{4} = 16,000$$

Before ARR is determined, it is necessary to compute net income for each of the four years as follows:

	<u>Year 1</u>	<u>Year 2</u>	<u>Year 3</u>	<u>Year 4</u>
Income before depreciation tax	40,000	42,000	36,000	50,000
Less: Depreciation	<u>16,000</u>	<u>16,000</u>	<u>16,000</u>	<u>16,000</u>
Income before taxes	24,000	26,000	20,000	34,000
Less: Taxes (40%)	<u>9600</u>	<u>10,400</u>	<u>8000</u>	<u>13,600</u>
Net income	<u>14,400</u>	<u>15,600</u>	<u>12,000</u>	<u>20,400</u>

$$\text{Average Net income} = \frac{14,400 + 15,600 + 12,000 + 20,400}{4} = 15,600$$

$$\text{Average Investment} = \frac{70,000 + 6000}{2} = 38,000$$

$$\text{ARR} = \frac{\text{Average Annual Net Income}}{\text{Average Investment}}$$

$$= \frac{15600}{38000} = 41\%$$

The ARR for a proposal shall be compared with a required rate of return or risk-free interest rate (normal saving interest rate). Therefore, if we compare the ARR of the project proposals in our example, say with an interest rate of 36%, the proposal is good for implementation.

## Decision Rule for Accounting Rate of Return

- i. Accept the project if ARR exceeds the required rate of return.
- ii. Reject the project if ARR is less than the required rate of return.

## Advantages of ARR

1. It is simple to calculate

2. It is based on accounting information, which is readily available and familiar to businessmen.
3. It considers benefits over the entire life of the project.
4. It facilitates post-auditing of capital expenditures.

### Limitations of ARR

1. It is based upon accounting profit, not cash flow.
2. It does not take into account the time value of money.
3. Since there are numerous measures of accounting rate of return, this may create controversy, confusion, and problems in interpretation.
4. Accounting income is not uniquely defined because it is influenced by various methods, such as depreciation methods, inventory costing method etc.

### 2.5.2 Discounted Cash Flows (DCF) measures of project worth

#### 1) Net Present Value Method

The net present value of project is the difference between the present value of net cash inflows and present value of initial investment. In formula,

$$NPV = \sum_{t=1}^n \frac{C_t}{(1+r)^t} - I_0$$

Where:

NPV = Net present value

$C_t$  = Net cash flows at the end of year t

n = Life of the project

r = Discount rate

$I_0$  = Initial investment

Net present value can also be determined as follows:

$$NPV = PV \text{ of NCF} - I_0$$

Where: **PV = Present value and NCF = Net cash flows**

To illustrate, assume that a project is expected to have initial investment and life of Br. 40,000 and five years respectively. The annual after tax net cash flow is estimated at Br. 12,000 for each of the five years. The required rate of return is 10%. Net present value is determined as follows:

$$NPV = PV \text{ of NCF} - I_0$$

$$= 12,000 \left( \frac{1 - \frac{1}{(1+0.10)^5}}{0.10} \right) - 40,000$$

$$= 12,000 (3.791) - 40,000$$

$$= 45,492 - 40,000 = \underline{5492}$$

In the above formula,  $\frac{1 - \frac{1}{(1+0.10)^5}}{0.10}$  represents the discount factor and its value is equal to

3.791. This discount factor can be taken from the present value of annuity of 1 table from the intersection of  $i = 10\%$  and  $n = 5$ . It can also be determined using your calculator.

In the above example, net cash flows are annuity. The same procedure can be followed if net cash flows are not in annuity form. To illustrate the computation of NPV when net cash flows are not annuity, suppose the project has initial investment and useful life of Br. 30,000 and four years respectively. Its annual cash flows are as follows: Year 1, Br. 10000; Year 2, Br. 8000;



year 3, Br. 15000; and year 4, Br. 12,000. If the required rate of return is 10%, NPV is determined as follows:

Year	Net cash flows	Discount factor (10%)	Present value
1	10,000	0.909	9090
2	8000	0.826	6608
3	15,000	0.751	11,265
4	12,000	0.683	<u>8196</u>
Present value of NCF			35,159
Less: Initial investment			<u>30,000</u>
NPV			+ <u>5159</u>

What does NPV represent? NPV represents the amount by which the value of (wealth of) the firm will increase if the project is accepted.

### Decision Rule for NPV

1. If NPV is greater than zero ( $NPV > 0$ ), the project is considered desirable.
2. If NPV is less than 0, the project is considered undesirable.

### 2) Internal Rate of Return (IRR)

Internal Rate of Return is the discount rate which equates the project NPV equal to zero. It is the discount rate at which the present value of Net cash flows is equal to the present value of initial investment. In other words, IRR is the rate of return on investments in the project. The determination of IRR is purely based on project cash flows. Mathematically, at IRR,

$$\sum_{i=1}^n \frac{C_t}{(1+r)^t} = \text{Initial investment}$$

IRR is determined using trial and error: the complexity of determining IRR is greater if net cash flows are not in annuity form. This section illustrates the determination of net cash flows when cash flows are annuity as well as non-annuity.

#### a) Determination IRR when NCFs are annuity.

Assume that the project has initial investment of Br. 40,000, and useful life of five years. the annual net cash flows is estimated at Br. 12000 for five years. The required rate of return is 10%. The following steps can be followed to determine IRR.

Step1: Compute the leading discount factor (payback period)

$$PBP = \frac{\text{Initial Investment}}{\text{Annual net cash flows}} = \frac{40,000}{12,000} = 3.333$$

**Step 2.** From the present value of annuity table, find two discount factors and their corresponding interest rates closest to the computed leading discount factor. If we look in the PV of annuity table on  $n = 5$  years row (horizontally), the leading discount factor (3.333) is found between 15% and 16%.

Interest rate	15%	16%
Discount factor	3.352	3.274

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**Step 3:** Compute the actual IRR using the following formula

$$IRR = r - \left( \frac{PBP - DFr}{DFr_L - DFr_H} \right)$$

Where:

r = either of the two interest rates (15% or 16%)     DFr = Discount factor for the taken interest rate

DFr<sub>L</sub> = Discount factor for the lower interest rate     DFr<sub>H</sub> = Discount factor for the higher interest rate

Let's take r = 15%, IRR is determined as follows:

$$\begin{aligned} IRR &= 15\% - \left( \frac{3.333 - 3.352}{3.352 - 3.274} \right) \\ &= 15\% - (-0.24) \\ &= \underline{15.24\%} \end{aligned}$$

If we take r = 16%, the computation of IRR looks like the following:

$$\begin{aligned} IRR &= 16\% - \left( \frac{3.333 - 3.274}{3.352 - 3.274} \right) \\ &= \underline{15.24\%} \end{aligned}$$

**b) Determination of IRR when net cash flows are non-annuity**

The steps followed in the preceding section are equally applicable for non-annuity cash flows. However, one step is added at the beginning to determine the weighted average net cash flow, which will be used to determine the leading discount factor. To illustrate, assume that a project has initial investment of Br. 40,000 and the following net cash flows: year 1, Br. 15,000; year 2, Br. 10,000; year 3, Br. 10,000; year 4, Br. 15,000; and year 5, Br. 15,000. The discount rate is 15%. The following steps can be used to compute IRR:

**Step 1.** Compute the weighted average net cash flows.

Year	Net cash flows	Weight	NCF X weight
1	15,000	5	25,000
2	10,000	4	40,000
3	10,000	3	30,000
4	15,000	2	30,000
5	15,000	<u>1</u>	<u>15,000</u>
Total		15	190,000

*Note that the weight is assigned in the reverse order of the project's useful life.*

$$\text{Weighted average NCF} = \frac{190,000}{15} = \underline{12,667}$$

**Step 2:** Compute the leading discount factor (PBP)

$$\begin{aligned} PBP &= \frac{\text{Initial Investment}}{\text{Weighted average NCF}} \\ &= \frac{40,000}{12,667} = \underline{3.158} \end{aligned}$$

**Step 3:** From the present value of annuity table, find the starting rate (a good 1<sup>st</sup> guess) by looking for the closest interest rate and discount factor. In this case, the nearest rate is 18%.

**Step 4:** Compute NPV at the 1<sup>st</sup> guess (18%)      NPV (18%)

Year	NCF	Discount factor (18%)	Present value
1	15,000	0.847	12,705
2	10,000	0.718	7180
3	10,000	0.609	6090
4	15,000	0.516	7740
5	15,000	0.437	<u>6555</u>
Present value of net cash flows			40,270
Less: Initial Investment			<u>40,000</u>
NPV			+ <u>270</u>

Since, at IRR, NPV is equal to zero, 18% is not the exact IRR. Thus, another rate should be tried. Which rate should be tried next? Generally as we go down (in rate decreasing direction), discount factor increases. Now we need to find a rate at which NPV = 0. Thus, we should try a higher rate. The next (2<sup>nd</sup>) guess could be 19%. Then NPV should be computed at 19% using the above procedure.

NPV at 19%:

Year	NCF	Discount factor (19%)	Present value
1	15,000	0.840	12,600
2	10,000	0.706	7060
3	10,000	0.593	5930
4	15,000	0.499	7485
5	15,000	0.419	<u>6285</u>
Present value of net cash flows			39,360
Less: Initial investment			<u>40,000</u>
NPV			<u>-640</u>

At 19% NPV is negative, this implies that IRR lies between 18% and 19%. Thus, such iteration process ends when two neighboring rates, at lower rate NPV is positive and at higher rate is negative. To find the exact IRR, steps 4 and 5 will be followed:

**Step 4:** Obtain the absolute sum of the two present values

$$\begin{aligned} \text{Sum} &= |+270| + |-640| \\ &= 270 + 640 \\ &= 910 \end{aligned}$$

**Step 5:** Divided the NPV of the smaller rate by the absolute sum and add to the smaller rate

$$\begin{aligned} \text{IRR} &= 18\% + \frac{270}{910} \\ &= \underline{18.30\%} \end{aligned}$$

### Decision Rule for IRR

Accept: If the IRR is greater than the discount rate

Reject: If the IRR is less than the discount rate

### 3) Profitability Index (PI)

The profitability index, also called benefit - cost ratio, is the ratio of the present value of net cash flows and initial investment.

$$\text{PI} = \frac{\text{Present value of NCF}}{\text{Initial investment}}$$

To illustrate, assume that a project is expected to have initial investment and useful life of Br. 90,000 and four years respectively. Annual net cash flows amounted to Br. 40,000. The discount rate is 10%. Profitability index can be computed as follow:

$$\begin{aligned} \text{PI} &= \frac{\text{Present value of NCF}}{\text{Initial investment}} \\ &= \frac{40,000(3.170)}{90,000} \\ &= \frac{126,800}{90,000} = \underline{1.41} \end{aligned}$$

### Decision rule for profitability Index

- ii. Accept if the project's profitability index is greater than 1
- iii. Reject if the project's profitability index is less than 1

### 2.6 Sensitivity Analysis

A method popularly used for analysis of risk is called *sensitivity analysis*. Sensitivity analysis is a techniques applied to uncertainties. These uncertainties are factors affecting project outcomes, which cannot be quantified. **The purpose of sensitivity analysis is to tell us the factors, which are liable to have the greatest influence over project success and failure.** Once these factors have been identified it is then possible to deign appropriate mitigation measures. Sensitivity analysis (sometimes called 'what if' analysis) shows how the NPV or other criterion of merit changes with variations in the value of any variable (sales volume, selling price per unit, cost per unit etc.). This consists varying key parameters (individually or in a combination) and assessing the impact of such changes or manipulation on the project's net present value. It consists of testing the sensitivity of the NPV or IRR to changes of basic variables and parameters that enter the project's input and output streams. It is the process of seeing what changes in the value of the dependent variable is consequent on a change in the value of one or more of the variables that determine it. It generally involves considering the effect on the NPV of plausible variations in some of the assumptions made. The common practice is to vary them by fixed percentage such as 10% (instead of say by +-1SD). Such measures give us no information about the probability.

The purpose of the sensitivity analysis is:

- ☞ To enhance our understanding of the structure and working of the project;
- ☞ To guide us in the design of the project so that high NPV or IRR are obtained;
- ☞ To suggest areas and means by which risk can be reduced.

The variables for sensitivity test should be selected on the basis of:

- (a) The degree of uncertainty associated with the variable; and
- (b) The importance of the variable in determination of the NPV and IRR.

Hence it is not advisable to spend time in testing for sensitivity of a variable that has an insignificant effect on the NPV and IRR. The key variables whose variations should be studied will be different from project to project, but a number of standard test will normally be considered. The variable that is most commonly varied in sensitivity analysis is the **discount rate** because of the considerable uncertainty that often attaches to the estimated discounting rate. But total **investment costs**, **implementation times**, **output levels** and **prices**, the **volume of demand**, the **level of capacity**, and **operating cost** are commonly varied by amounts or percentages that seem reasonable on the basis of past experiences.

There are two approaches in conducting sensitivity analysis.

The first is that a range of estimates can be made where, a variable might be tested using three different values:

- A 'best estimate'
- An 'optimistic' value
- A 'pessimistic' value

These values could be determined by the **likely order of variation** of the variable being tested. Such an approach is useful in defining the possible impact of changes in a particular parameter but, without further analysis, **such tests do not provide any additional information and it is difficult to make comparisons of sensitivity to changes in different variables if the percentage variations are different.** Pessimistic and optimistic values will be tried and checked. This is done to determine the sensitivity of the estimated NPV to changes in these variables. In some circumstances a group of key variables may be varied together, to form a low case scenario and the impact of these scenarios on the NPV may be measured to determine the robustness of the project under these circumstances.

A second approach is to **choose a fixed percentage variation and to test each important variable for that percentage change.** This approach has the advantage that it is possible to **compare the sensitivity of the project to changes in different variables and therefore to determine which variables are most important in determining project profitability.**

This method has *disadvantage that it says nothing about the likelihood of the assumed change or the size of potential variations.*

Another problem of this approach is that the variables **are not usually varied by standard amounts such as one standard deviation.** This is because the probability distribution of the variables is frequently unknown. Rather variables are usually varied by random selected percentage values such as 10 percent or 20 percent, etc. if the NPV of the project turns negative when relatively small and plausible changes are made in the values ascribed to such variables, it is an indication that the project may be rather marginal. If the NPV is positive even after the changes then it can be considered quite robust in the face of plausible risks.

We change the values of key variables, one at a time or in combination by a certain percentage and calculate again the NPV or IRR. A comparison between the previous and new values of the NPV and IRR shows their sensitivity to value changes in the variable involved.

Some changes in variables have a **linear relationship** to the NPV while others do not. To apply these tests the following points have to be considered:

- ☞ Set up the relationship between the basic underlying factors (such as the quantity sold, unit selling price, or the unit cost of major cost items) and net present value (or some other criterion of merit).
- ☞ Estimate the range of variation and the most likely value of each of the basic underlying factors.
- ☞ Study the effect on net present value of variations in the basic variables.

Where a linear relationship exists between the variable concerned and the NPV the following formula can be used to calculate a **switching value** that is **the change in the value for the variable concerned required reducing the NPV of the project to zero.** This can be done for both economic and financial analysis, but care must be taken to ensure that the test being undertaken is relevant to the type of analysis being done. For example a change in the actual wage rate for unskilled labour affects the financial analysis, but it is a change in the shadow wage rate that affects the economic analysis.

When,  $NPV_1$  is the base value for the project NPV and  $NPV_2$  is the new resulting from an assumed change in price (or quantity) from  $P_1$  to  $P_2$ , the switching value (SV) for the item being tested is given by:

$$SV = \frac{NPV_1}{NPV_2 - NPV_1} - \frac{P_1 - P_2}{P_1} * 100\%$$

Sensitivity analysis allows for the identification of those critical areas that will influence the success or failure of the project. This should provide those planning and managing projects with ideas about the areas that need to be studied in more depth or where actions may be required to protect the project. The application of switching values in sensitivity analysis can be illustrated, taking the Hides and Skins Project as follows.

**Scenario I:** Assume that the sales revenue of a Hides and Skins Project goes down by 10% while the total cost of the project remains the same. The NPV of the project at a discount rate of 10% is reducing from 1,321,800 to - 3,654,000. To reduce the NPV to zero would therefore require a change in sales revenue of:

$$\frac{1,312,800}{-3,616,700 - 1,312,800} * 10\% = -2.7\%$$

a reduction in sales revenue of 2.7% would therefore be sufficient to reduce the NPV at 10% discount rate to a marginal figure. This illustrates how sensitive projects with a single output are to changes in the sales price.

**Scenario II:** Assume that there is a 10% increase in the Raw Material Costs (hides and skins). This necessitates changing the value of the item in the operating costs table and also in the working capital schedule (stocks of materials, stocks of final goods and accounts payable). A 10% increase in the costs of hides and skins reduces the NPV at a discount rate of 10% from 1,312,800 to - 1,459,800. To reduce the NPV to zero would therefore require an increase of:

$$\frac{1,312,800}{-1,459,800 - 1,312,800} * 10\% = 4.8\%$$

The project is very sensitive to an increase in the cost of hides and skins, but it is not as critical a factor as fluctuation in sales revenue (2.7% increase sufficient to reduce NPV to zero at a discount rate of 10%).

**Scenario III:** Assume that the production level achieved by the project is 10% below the level expected. This involves changing the sales value and all the variable costs items as well as the associated working capital items. A 10% reduction in the level of production reduces the NPV to -6,700 (i.e., to just below zero). To reduce the NPV to zero would therefore require a decrease of:

$$\frac{1,312,800}{-6,700 - 1,312,800} * 10\% = 9.95\%$$

The project is less sensitive to changes in production level than it is to changes in the price of the main raw material. This is because the cost of unprocessed hides and skins is over 50% of the sales value and so when the production goes down the costs go down significantly as well as the benefits. It is quite common for agro – processing industries to be less sensitive to production levels than to the price of the main raw material.

**Scenario IV:** The discount rate used for calculating NPV is an uncertain variable. For this reason a project's NPV should be tested at rates which are both above and below the best estimate for the discount rate. For the Hides and Skins Project, the NPV at various discount rates is as follows:

Discount Rate	Total NPV (Birr)
5%	5,480,800
10%	1,321,800
15%	-5572,700

These data show that the project's NPV will be negative if the actual discount rate is 15%. The project will have a positive NPV up to a discount rate of 13.1% (the project's IRR). It can be seen that the IRR is also a switching value. However the relationship between the NPV and the discount rate is not linear. Care should therefore be taken to ensure that the interval between the two discount rates used in calculating is not too high (no more than 5% and preferably less) and the two NPVs used contain one negative value and one positive value. There are two major limitations of sensitivity analysis. These are:

- ☞ **It is partial.** When we change the value of one or more variable and re-calculate the NPV and IRR we assume that "all other things are equal". The study of the impact of variation is normally undertaken one factor at a time, holding other factors constant. This may not be very meaningful when the underlying factors are likely to be interrelated. Some variables are interrelated and their value tends to move together. There are limits to the number of combinations of changes that can be tested even where more than one variable is tested to provide manageable results.
- ☞ It says **nothing about the likelihood** of the tested changes happening. Any judgments about likelihood will necessarily be qualitative.