#### CHAPTER TWO

***FINANCIAL ANALYSIS AND APPRAISAL OF PROJECTS***

***Introduction: Scope & Rationale***

***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.

#### 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 the chapter on Demand and Market Study)
			2. Initial investment costs distributed over the implementation of the project; (from the chapters on Engineering, Site Development as well as Materials and Inputs);
			3. Operating costs of the envisaged operational unit/firm/ over its operating life. (from the chapters on Engineering, Site Development as well as Materials and Inputs);

The issues and concerns of financial analysis are:

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

#### Planning Horizon and Project Life

Planning is understood as a consciously programmed activity having as its focus the objective consideration of the future. The anticipations and assumptions about the future need to be explicit and should be analyzed in order to find the optimal development path.

The project planning horizon of a decision maker may be defined as the period of time over which he/she decides to control and manage his/her project-related business activities, or for which he/she formulates his/her investment or business development plan. The planning horizon must consider the life time of a project.

The economic life, that is, the period over which the project would generate net gains, depends basically on the technical or technological life cycle of the main plant items, on the life cycle of the product and of the industry involved, and on the flexibility of a firm in adapting its busines

activities to changes in the business environment.

#### Identification of Relevant 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. 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.

It is evident that the economic life of a project can never be longer than its technical life or its legal life; in other words it must be less than or equal to the shorter of the latter.

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Whatever the nature of the project, its implementation will always reduce the supply of inputs (" consumed" by the project). Without the project, the supply of these inputs and outputs to the rest of the economy would have been different. (Examining this difference between the availability of inputs and out puts with and without the project is the basic method of identifying its costs and benefits.) In many cases the Situation without the project is not simply a continuation of the status quo, but rather the Situation that is expected to exist if the project is not under taken, because some increases in output and costs are often expected to occur any way. Different participants in a project have many and different objectives.

#### Classification of Costs and Benefits

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

1. Tangible and
2. Intangible once

### 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
	* Buildings for auxiliary services (steam supply, workshops, laboratory, water supply)
	* 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
* ***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/***

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…) 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.

* ***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:

1. raw materials;
2. stores and spares;
3. work-in-process;
4. finished goods inventory;
5. Debtors/accounts receivable/;
6. 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*: This 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.
* *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 who much land is need 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 costs estimates are assume that there will be no relative changes in domestic or international prices and no inflation during the investment period or there will no be any 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.
* *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 repayment 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.

***Tangible Benefits***

Tangible benefits can arise either from increased production or form 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
* Cost reduction through technological advancement
* Reduced transport costs
* Loses avoided
* Other kinds of tangible benefits

#### Intangible costs and Benefits

There may be some costs and benefits that are intangible. These may include the creation of new employment opportunities, better health and reduced infant mortality as a result of more rural clinics, better nutrition, reduced incidence of waterborne diseases, national integration, or even national defense. Such intangible benefits. However, do not readily lend them to valuation. Under such circumstances one may have to resort to the least cost approach instead of the normal benefit cost analysis.

Although the benefits may be intangible most of the costs are tangible. Construction costs for schools, hospitals, pipes for rural water supply, etc are all quantifiable. However, cost such as the disruption of family life, the increased pollution as a result of the project, ecological imbalances as the result of the project, etc, are difficult to capture and quantify. But effort should be made to identify and quantify wherever possible.

#### The Valuation of Financial Costs 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.
4. **Market Vs 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 Vs 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.

#### Financial Appraisal Criteria of Projects and Selection of Investments

 A wide range of criteria have been suggested for choosing investment proposals, which are suitable for both financial and economic analysis. These criteria may be classified into two categories:

1. Non-discounting criteria, including:
	* Ranking by inspection
	* Urgency;
	* Payback period;
	* Proceeds per unit of outlay
2. Discounting criteria, including:
	* Net present value/NPV/
	* Internal rate of return/IRR/

#### Non-Discounted Measures of Project Worth

Projects, which are powerful means of development, have to be appraised by multiple criteria. In order to appraise a project idea we need operational criteria applicable in evaluating alternatives. Technical criteria are used to compare the merits of alternative technical solutions. It should be noted that there might be no one best technique for estimating project worth although some may be better than others. We should also note that these are only tools to improve decision-making. There are other non-quantifiable and non-economic criteria for making project decisions. The tools are only used to improve the decision making process. Before we discuss the discounted project appraisal criteria we need to consider some common undiscounted measures.

#### Ranking by Inspection

It is possible, in certain cases, to determine by mere inspection which of two or more investment projects is more desirable. There are two cases under which this might be true.

1. Two investments have identical cash flows each year up to the final year of the short-lived investment, but one continues to earn cash proceed (financial results or profits) in subsequent years. The investment with the longer life would be more desirable.

|  |  |  |  |
| --- | --- | --- | --- |
| **Investment (Project)** | **Initial cost** | **Net cash proceeds per year** | **Total Proceeds** |
| **Year I** | **Year II** |
| A | 10,000 | 10,000 | - | 10,000 |
| B | 10,000 | 10,000 | 1,100 | 11,100 |
| C | 10,000 | 3,762 | 7,762 | 11,524 |
| D | 10,000 | 7,762 | 3,762 | 11,524 |

Accordingly, project B is better than investment A, since all things are equal except that B continues to earn proceeds after A has been retired. More analysis is required to decide between C & D,

1. Two investments have the same initial out lay (the total net value of incremental production may be the same), the same earning life and earn the same total proceeds (profits) but one project has more of the flow earlier in the time sequence, we choose the one for which the total proceeds is greater than the total proceeds for the other investment earlier. Thus investment D is more profitable than investment C; Since D earns 2000 more in year 1 than investment C, which does not make up the difference until year 2.

#### Urgency

According to this criterion projects which are deemed to be more urgent get priority over projects which are regarded as less urgent.

The problem with this criterion is: how can the degree of urgency be determined? In certain situations it may not be practically difficult to determine the urgency of a certain project proposal. For instance the project could be bottleneck alleviation bottleneck of an ongoing operation/firm/ etc.

Since it is not a systematic decision, this is not something that can be encouraged. Rather it is a practice that should be discouraged.

#### The Payback Period

The payback period also called the payoff period is one of the simplest and apparently one of the most frequently used methods of measuring the economic value of an investment. Since it addresses the prime concern of an investor in terms of reclaiming/recovering the initial outlay, it is frequently used method of project evaluation. The recovered money can be reinvested in something else. If the investor recovers its initial outlay, then in a way it is minimizing the risk it faces in the subsequent operation of the project.

The payback period is defined as the length of time required for the stream of cash proceeds produced by the investment (project) to be equal to the original cash outlay required by the investment (capital investment). It is defined as the number of years it is expected to take from the beginning of the project until the sum of its net earnings (receipts minus operating costs) equals the cost of the projects initial capital investment. It is the period of time that the investor recovers its initial total outlay. This criterion is most often used in the business enterprises. However, its use in agricultural projects is limited.

**Example**: if a project requires an original outlay of Birr 300 and is expected to produce a stream of cash proceeds of Birr 100 per year for 5 years, the payback period would be 300/100 = 3 years.

**Note**: if the expected proceeds are not constant from year to year, then the payback period must be calculated by adding up the proceeds expected in successive years until the total is equal to the original outlay.

**Example**: consider the previous project C. 10,000 − 3762 = 6238. Then 6238 = 0.8 So the

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Payback period is 1.80 years. Similarly, for the other projects:

|  |  |  |
| --- | --- | --- |
| Investment (project) | Payback period (in years) | Ranking of projects using the paybackperiod criteria |
| A | 1 | 1 |
| B | 1 | 1 |
| C | 1.8 | 4 |
| D | 1.7 | 3 |

Investment A and B are both ranked as 1, since they both have shorter payback periods than any of the other investments, namely 1 year. But investment B which has the same rank as A will not only earn 10,000 Birr in the first year but also 1,100 Birr a year later. Thus investment B is superior to A. But a ranking procedure such as the payback period fails to disclose this fact.

#### Proceeds per Unit of Outlay

Under this method, investments are ranked according to their total proceeds divided by the amount of the corresponding investments. In other words the total net value of incremental production divided by the total amount of the investment gives us the proceeds per unit of outlay.

***Example:***

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Investment | Total proceeds | Investment | Proceeds perUnit of outlay | Ranking |
| A | 10,000 | 10,000 | 1.00 | 4 |
| B | 11,100 | 10,000 | 1.11 | 3 |
| C | 11,524 | 10,000 | 1.15 | 1 |
| D | 11,524 | 10,000 | 1.15 | 1 |

Accordingly project C and D must be implemented. However, both projects are given the same rank. Although we know by inspection that project D is superior because D generates Birr 2000 of proceeds in year 1.

This method is again deficient because it still **fails to consider the timing of proceeds**. In other words, the method considers that 1 Birr of proceeds received in year 2 is equal to 1 Birr received in year 1. This is inconsistent with the generally accepted economic principle that 1 Birr today is more valuable than 1 Birr at some future date.

#### Discounted Project Appraisal Criteria

The undiscounted measures discussed so far share common Weakness. They fail to take into account adequately the timing of benefits. Thus, it is an accepted principle in economics that inter-temporal variations of costs and benefits influence their values and a time adjustment is necessary before aggregation. Therefore a time dimension should be included in our evaluation.

***Discounting:*** is a technique or a process by which one can reduce future benefits and costs to their present worth or present value. This is the method used to revalue future cost and benefits are discounted by a factor that reflects the rate at which today's value of a monetary unit decreases with the passage of every time unit.

Any costs and benefits of a project that are received in future periods are discounted, or deflated by some factor, r, to reflect their lower value to the individual (society) than currently available income. The factor used to discount future costs and benefits is called the discount rate and is usually expressed as a percentage. Hence, discounting is very important for project analysis. The discount rate is usually determined by the central authorities.

Note that in order to clearly understand the principles of discounting it will be helpful to have a clear understanding of the principle of compounding. Compounding is the technique of calculating the future worth (F) of a present amount (P) at the end of some period T at a given interest rate. On the other hand finding the present worth of a future Stream of value is called discounting.



 The term **(1+r)t in the denominator or (1+r)-t** in the numerator is referred to as **discounting factor**, a factor used to estimate the present value of a stream of future values. The ‘r’ in this term is referred to as **discounting rate. So the discount factor tells us how much Br 1 at a future date is worth today at a certain discount rate.**

1. ***The Net Present Value (NPV)***

The most widely used and straightforward discounted measure of project worth is the net present value (NPV). This value is obtained when a stream of cost and benefits accruing over a period of time are discounted to the present is called the present value of the stream. The NPV is defined as the difference between the present value of benefits and the present value of costs. The NPV can be obtained by discounting separately for each year, the difference of all cash outflows and inflows accruing throughout the life of project at a fixed, pre-determined interstate rate.

The discounted rate should be equal either to the actual rate of interest on long term loans in the capital market or to the interest rate paid by the borrower. However, since capital market does not usually exist in developing countries, the discount rate should reflect the opportunity cost of capital i.e. the possible return of capital invested elsewhere. This is the minimum rate of return below which the planner considers that is does not pay for him to invest.

The discounting period should normally be equal to the life of the project. This period is the economic life of the project and varies from project to project.

Having set the discount rate, an investment project is deemed acceptable if the discounted net benefits (benefits minus costs) are positive. The economic criterion of project appraisal is to accept all projects that show positive NPV at the predetermined discount rate and reject all projects that show Negative NPV. Thus, the decision is to accept if NPV > 0. We can also discount benefits and costs separately, and if B>C then NPV >0.

**Example:** Consider the following Discounted Cash Flows for a Fertilizer Project in million Birr

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Year | Costs | Benefits | Net benefits (Cash flow)= ***(2-1)*** | Discounted factors(10 %) = 1( 1+O.1O) t | Discounted Net benefits (Net cash flow) (10%)=***(3\*4)*** | Discounted factor(20%) = 1( 1+O.2O) t | Discounted Net benefits (Net cash flow)(20%)=***(3\*6)*** |
| 0 | 20 | 0 | -20 | 1/(1+0.10) 0=1.00 | -20.0 | 1/(1+0.20) 0=1.00 | -20.0 |
| 1 | 10 | 14 | 4 | 1/(1+0.10) 1=0.909 | 3.64 | 1/(1+0.20) 1=0.833 | 3.33 |
| 2 | 10 | 14 | 4 | 1/(1+0.10) 2=0.826 | 3.30 | 1/(1+0.20) 2=0.694 | 2.78 |
| 3 | 10 | 14 | 4 | =0.751 | 3.00 | =0.579 | 2.32 |
| 4 | 10 | 14 | 4 | =0.683 | 2.73 | =0.482 | 1.92 |
| 5 | 10 | 14 | 4 | =0.621 | 2.48 | =0.402 | 1.61 |
| 6 | 10 | 14 | 4 | =0.564 | 2.26 | =0.335 | 1.34 |
| 7 | 10 | 14 | 4 | =0.513 | 2.05 | =0.279 | 1.12 |
| 8 | 10 | 14 | 4 | =0.467 | 1.87 | =0.233 | 0.93 |
| 9 | 10 | 14 | 4 | =0.424 | 1.70 | =0.194 | 0.78 |
| 10 | 10 | 14 | 4 | 1/(1+0.10) 10=0.386 | 1.54 | 1/(1+0.20) 10=0.162 | 0.65 |
| ***NPV*** |  |  |  |  | **4.57** |  | **-3.21** |

**Note**: the values for discount factors for r = 10% and r = 20% can be obtained from any standard set of discount tables.

Since discounting the cash flow at 10 percent produces a positive NPV of 4.57 million Birr we conclude that the project should be undertaken. Suppose now that the cost of capital were to be raised to 20 percent, the project produces a negative NPV of 3.21 million Birr. In this event the project would have to be rejected. This shows that the NPV is critically dependent upon the level of the discounting rate, r.

It is also possible to discount costs and benefits separately (individually) and now the decision rule becomes that the discounted benefits should exceed the discounted costs, i.e., B > C and NPV = B - C >0.

**Example 2**: what would be the present value of 1000 Birr received five years in the future assuming a 9 percent discount rate?

We consider the discount factor for the 5th period under the 9 percent table. The discount factor is 0.6499. Then we multiply the amount due by the discount factor.

1000 \* 0.6499 = 649.90 Birr

***NPV and Decision Rule for Independent Projects***

Independent projects are projects that are not iany way substitutes for each other. In such cases the decision rule is to accept the project if the NPV is greater than 0 (approve any project for which **NPV>0**). If two projects have positive NPV and there is no budget constraint both should be accepted and you do not need to choose the one with higher NPV.

For example, if two independent projects road and fisheries development projects in different locations are being considered and both have a positive NPV, then both should be undertaken. Both will increase community’s welfare if they were undertaken and hence both should be undertaken. If there is resource constraint and the decision maker is forced to make choices, then one will have to choose the project with the highest NPV.

***Decision Rule for Mutually Exclusive Projects***

A mutually exclusive project is defined as a project of that can only be implemented at the expense of an alternative project as they are in some sense substitutes for each other. The decision rule for such projects is to accept the project with the highest NPV.

Example: Consider two hypothetical dams, which may be proposed for one prime site in a locality in a fast flowing river (in million birr). All the benefits and costs are discounted figures.

|  |  |
| --- | --- |
| Alternative Projects | ***Years*** |
| ***Dam A*** | ***1*** | ***2*** | ***3*** | ***4*** | ***5*** | ***6*** | ***7*** | ***8*** | ***9*** | ***10*** |
| Cost | 5 |  |  |  |  |  |  |  |  |  |
| Benefits | 0 | 0.5 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Net benefits | -5 | 0.5 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| ***NPV=3.50*** |
| ***Dam B*** | ***1*** | ***2*** | ***3*** | ***4*** | ***5*** | ***6*** | ***7*** | ***8*** | ***9*** | ***10*** |
| Cost | 500 |  |  |  |  |  |  |  |  |  |
| Benefits | 0 | 50 | 50 | 50 | 50 | 100 | 100 | 100 | 100 | 100 |
| Net benefits | -500 | 50 | 50 | 50 | 50 | 100 | 100 | 100 | 100 | 100 |
| ***NPV=200*** |

Which one of the two dams do you choose? Why?

If the two projects were independent and there was no budget constraint, the country could therefore construct both, and then it should do so as they both have positive NPVS. However, since the projects are mutually exclusive the dam with the higher NPV should be selected, that is dam B.

***Advantages of NPV method***

Conceptually sound, the net present value selection criteria have considerable merits:

* It is simple to use and does not rely on complex conventions about where costs and benefits are netted out.
* It is the only selection criteria that can correctly be used to choose between mutually exclusive projects, without further manipulation
* It takes in to account the time value of money

***Limitations of the Net present value method***

* Some projects could be deferred from implementation although they show positive NPV, due to scarcity of funds. Thus passing the NPV test may be a necessary condition but not a sufficient condition
* If some projects were mutually exclusive then the implementation of one would naturally exclude the execution of the other. This will lead both the central authorities and the sponsoring agency in to a dilemma which project should be implemented. If funds are unlimited then both could be implemented, but this is not always the case
* It does not show the exact profitability rate of the project.

#### The Internal Rate of Return of a Project (IRR)

This is a second measure of the long- term profitability of an investment. It is also called the **Yield of an Investment Method** or simply the **Yield Method**. The IRR of a project is probably the most commonly used assessment criterion in project appraisal. This is because the concept of an IRR is in some way comparable to the **long-term profit rate of a project** and is therefore easily conceivable for non-economists. In fact, IRR is defined as the “**earning rate of a project**”.

Unlike NPV, it does not rely on the selection of a predetermined discount rate. The method utilizes present value concept but seek to avoid the arbitrary choice of a discount rate. Hence an attempt is made to find that discount rate, which, just make the net present value of the cash flow equal to zero. It is possible to think a level of interest rate that could result in NPV of zero. This rate of interest rate is termed as the *Internal Rate of Return (IRR).* The IRR is the rate of discount, which makes the present value of the benefits exactly equal to the present value of the costs. Thus, it is the discount rate at which it is worthwhile doing the project. This is the interest rate that a project could pay for the resources used if the project is to recover its investment and operating cost and still can be at the break-even point. Denoting it by R, it is the solution to the definition of the NPV when the latter is set to zero,



For financial analysis it would be the maximum interest rate that the project could afford to pay on its funds and still recover all its investment and operating costs. While calculating the NPV we have used a pre-determined discount rate and a table. But the calculation of the IRR amounts to Searching for the discount rate that gives a zero NPV. This is achieved through trial and error using the standard discounting table. This rate if determined will represent the exact profitability of the project.

If the IRR is computed for financial appraisal in which all values are measured in market prices, it is called the *financial internal rate of return* (FIRR). When economic prices are used instead, it will be termed as *economic internal rate of return* (EIRR).

###### Calculation of IRR

The calculation procedure begins with the preparation of a cash flow table. Estimated discount rate is then used to discount the net cash flow to the present value. If the NPV is positive a higher rate is applied. If it is negative at this higher rate the IRR must be between those two rates.

By **iterations** it is possible to determine the discount rate that just makes the project’s NPV equal to zero. This rate is the IRR of the project. Fortunately spreadsheet programs such as Lotus 123 and excel can calculate the IRR of project’s net benefit flow once starting value for the iteration is provided.

***Example:*** To illustrate the calculation of internal rate of return, consider the cash flows of a road project (million Birr):

|  |  |
| --- | --- |
| Year | Cash flow |
| 0 | -100,000 |
| 1 | 30,000 |
| 2 | 30,000 |
| 3 | 40,000 |
| 4 | 45,000 |

The internal rate of return is the value of r, which satisfies the following equation

0   100,000  30,000  30,000  40, 000  45,000

(1 *r*)0 (1 *r*)1 (1 *r*)2 (1  *r*)3 (1 *r*)4



We try different values of r till we find that the right-hand side of the above equation is equal to 100,000. Let us, to begin with, r = 12 percent.

30,000  30,000  40, 000  45,000  107,773

(1.12)1 (1.12)2 (1.12)3 (1.12)4

Since this is more than 100,000, we have to try a higher value of r. (In general, a higher r lowers the right-hand side value and a lower r increases the right-hand side value.) Let r = 14%

30,000  30,000  40, 000  45,000  103,046

(1.14)1 (1.14)2 (1.14)3 (1.14)4

Since this value is higher than the target value of 100,000, we have to try a still higher value of r. Let r = 15%

30,000  30,000  40, 000  45,000  100,802

(1.15)1 (1.15)2 (1.15)3 (1.15)4

This value is a shade higher than our target value, 100,000. So we increase the value of r from 15% to 16%. The right-hand side becomes:

30,000  30,000  40, 000  45,000  98,641

(1.16)1 (1.16)2 (1.16)3 (1.16)4

Since this value is now less than 100,000, we conclude the at the value of r lies between 15 percent and 16 percent

At 15 percent, the present value is 100,802 At\_? Percent, the present value is 100,000

At 16 percent, the present value is 98,641

1 percent difference (between 15 percent and 16 percent) corresponds to difference of 2, 161=

(100802-98641). The difference between 100,802 (present value at 15 percent) and 100,000

(target present value) is 802= (100,802-100,000). This difference will correspond to a percentage

difference of:

802

2161

*x*100  0.37

*percnet*

Adding this number to 15 percent, we get the interpolated value as **15.37 percent**.

***Note:*** If the positive and negative NPVs are close to zero, a precise and less time consuming way to arrive at the IRR is using the following interpolation formula.

# IRR = I1

+ Pv(I1 − I2)

Pv + Nv

Where: I1 = the lower discount rate

I2 = the upper discount rate

Pv=NPV (positive) at the lower discount rate of I1 Nv = NPV (negative) at the higher discount rate of I2

Note: I1 and I2 should not differ by more than one or two percent.

## *IRR* 15 802 (16 15)  15

802

##  15.37%

802 1359

2161

Another approximate solution to IRR is to plot the NPVs corresponding to several discount rates to give what we call the NPV curve. The present values are plotted on the Y - axis and the discount rates on the x-axis. A curve is then drawn to connect the various points on the graph. The point at which the curve cuts the x-axis represents the rate at which the present value of the investment is equal to zero.

***Example:*** By experimenting with discount rates between 10 and 20 in our hypothetical project, the IRR for the project is fractionally above 15%. The simplest way of getting this is by plotting the NPV (y-axis) against different level of discount rates (x-axis); three points are usually sufficient. The point at which this curve (called the NPV curve) crosses the x - axis provides the IRR value.

###### Decision rule for independent projects in IRR

According to the IRR Version of economic criterion we implement all projects that show an IRR greater than the predetermined discount rate (opportunity cost of capital), i.e. accept all independent projects having an IRR greater than the opportunity cost of capital (cut off rate). The reference discount rate, which is also called the target rate, is predetermined by the central bank. Once the IRR is identified, the decision rule is accept the project if the IRR is greater than the cost of capital, say r. Note also that:

When NPV > 0 then IRR > r NPV = 0 then IRR = r NPV < 0 then IRR < r

All projects with an internal rate of return greater than some target rate of return r, should be accepted. The target rate is usually the same rate used as the financial or social discount rate employed in the computation of the projects net present value.

###### Comparison of the NPV and IRR

Form the foregoing discussions it is clear that both the NPV and the IRR methods can and do rank investment projects in more rational manner than the other methods previously considered. Thus it is advisable to calculate these measures so that easily understandable information is provided to the authorities. In general it can be said that the NPV method is simpler, easier, and more direct and more reliable.

In some situations both the NPV and the IR criteria give the same accept- reject decision. However, there are two probable reasons why all acceptable projects cannot be under taken. One is that inventible funds (capital funds) may be limited. The second real problem is that the discount rate has not been set correctly.

When the capital requirements of all acceptable projects exceed the available funds, the central authorities should raise the discount rate up to that level where the projects passing the test are just enough to exhaust the available funds. But if too few projects are acceptable then the discount rate should be reduced. Hence as long as capital funds are "unlimited" it is argued that NPV should be the relevant criterion. But the function of the discount rate is to ration capital in such a manner, as eventually to pass just sufficient projects as well use up available investment resources. Hence the argument is not whether NPV or IRR should be preferred as a criterion, but whether planners have set the discount rate correctly.

The IRR and NPV might suggest different projects for similar level of discount rate.

***Advantages of the IRR***

1. The IRR is used in many projects
2. It is the only measure of project worth that takes account of the time profile of a project but can be calculated without reference to a predetermined discount rare.
3. It is a measure that could be understood by non-economists since it is closely related to the concept of the return on investment
4. It is a pure number and hence allows projects of different size to be directly compared.

***Problems with the IRR***

1. The IRR is inappropriate to use for mutually exclusive projects and independent projects when there is a single period budget constraint.
2. A project must have at least one negative cash flow period before it is possible to calculate its internal rate of return. This is because the NPV will always be positive to matter how high the discount rate used to discount it, unless the project has at least one negative cash flow period.
3. Certain cash flows can generate NPV = 0 at two different discount rates. If a project has more than one IRR, then neither can be reliably used and another decision rule such as the NPV must be used rather than the IRR.