A Note On The Financial Evaluation Of Projects

INTRODUCTION

The project evaluation process involves more than just determining a project's expected revenues and profitability; it also involves a study of the key factors that affect a project and their financial impact on the project. In addition, a project evaluation includes strategic evaluation, economic evaluation and social impact evaluation (Refer Exhibit I).

While the financial evaluation of a project aims at ascertaining the most efficient strategy for delivering the desired output, the strategic evaluation ensures that the project is consistent with the output objectives of the firm. The economic evaluation of the project, however, seeks to ensure that the delivered output is benefiting the public at large. The evaluation of social impact aims at ensuring that the consequences of a project (in terms of employment, output, savings and so on) are beneficial to the public. The financial appraisal is the most important part of the evaluation because the project cannot be successful if it is financially unviable, even though it may be technically and commercially feasible.

DEFINING THE TERMS

Projects, by their definition, have a defined start and end date. A project is defined as "a collection of linked activities, carried out in an organized manner with a clearly defined start point and finish point, to achieve some specific results that satisfy the needs of an organization as derived from the current business plans."[1]

Projects are characterized by pre-determined goals, defined scope, limited resources, sequenced activities and a specific end result. While discussing the evaluation of a project, it is important to understand some other terms that are often used.

Cost of capital refers to the rate of return which must be earned by a firm in order to satisfy the expectations of the investors who provide the funds for the firm.

It is measured as the weighted arithmetic average of the cost of various sources of finance obtained by the firm. Expected return is the arithmetic mean or average of all possible outcomes where those outcomes are weighted by the probability of their occurrence. The legal, printing, postage, underwriting brokerage costs, and other costs of issuing securities, are known as floatation costs. Incremental cash flow is the difference in cash flows of a firm with and without a project. It can also be defined as the change in the future cash flows of a firm as a direct consequence of undertaking a project. The value of a future stream of payments or receipts from a project when discounted at a given rate to the present time it is known as the present value of a project. Projects are said to be mutually exclusive when the acceptance of one will necessarily mean the rejection of others.

The net present value of a project is the present value of future payments reduced by the present value of costs. The rate of discount at which the net present value of an investment is zero is called the internal rate of return. Benefit cost ratio measures the present value of returns per rupee of investment. Sensitivity analysis is a risk analysis technique used for studying the responsiveness of net present value to changing a variable in the profitability equation. It is akin to 'what if'analysis. For example, we can know the impact of reduction in the costs of raw materials by 10 % on NPV of a project.

FINANCIAL EVALUATION

The financial evaluation of a commercial project mainly involves estimating the return on investment and the profitability of the project. However, the financial evaluation of non-commercial projects involve the identification of the most efficient way of delivering the desired project outputs and ensuring that the project outputs result in significant benefits to the community.

Financial appraisal includes the compilation of the list of alternative projects and the associated streams of costs and benefits. The financial evaluation is conducted using the cash flow rather than accounting profits method[2]. The accuracy of the evaluation will ultimately depend on:

- The quality of the estimates on which the cash flows are based
- The identification of all relevant cash flows and
- The exclusion of all non-cash items.

FACTORS FOR MEASURING PROJECT CASH FLOWS

When calculating the financial costs and project cash flows, the following factors must be kept in mind – incremental analysis, sunk costs, accrual accounting and cash flows, incidental effects and opportunity costs.

INCREMENTAL ANALYSIS

According to this principle, the cash flows have to be measured in incremental terms. Only those revenues or expenditures that are likely to occur as a direct result of the project should be included when determining the cash flows. A project's incremental cash flows should be ascertained through the 'with and without[3]'principle, i.e. to determine the cash flows of the firm including and excluding the project.
Project Cash Flow Cash flow for the firm Cash flow for the firm
for year (T) = with the project for year without the project for the year (T)–(T)

The idea behind the incremental analysis concept is to illustrate only the additional impact created by a project. Cash flows that would have occurred irrespective of the project are extraneous to the analysis and should be excluded.

Example

If a department currently owns a vehicle fleet and is considering selling it and leasing vehicles instead, the incremental costs and benefits of doing so can be compared. If the net present value of the proposal is positive, then the proposal should be accepted. If the current situation is being compared with more than one alternative, the proposals can be ranked by dividing the net present value by the initial investment. The proposal which should be accepted is that with the highest ratio of net present value to Investment.

SUNK COSTS

Sunk costs refer to non-recoverable costs incurred in the past or committed before the evaluation of a project. These costs have to be ignored when conducting a financial evaluation of a project.

Example

Firm A has hired a consultant to assess the viability of outsourcing its credit collections and to list the possible agencies to which it can outsource its collections. Firm A spent $121,000 on consultant's fees prior to the evaluation of proposals. It further estimated that other costs like legal fees, stamp duty etc. for setting up an outsourcing contract would be $240,500 and the present value of cost savings from outsourcing will be $320,450. On the basis of the available information, the management of the company argued that since it had already incurred $121,000 for assessing the viability of the project, it would be a waste not to proceed with outsourcing, while the staff argued that the firm should not proceed further because the project would never recover the initial outlay of $121,000. In this case, both the arguments are invalid, as $121,000 is the sunk cost and thus irrelevant for calculating the project costs. The outsourcing project will have an NPV of $79,950 ($320,450 – $240,500).

OPPORTUNITY COSTS

Each and every resource utilized by a project entails a cost, irrespective of whether the resource is purchased for the project or already owned by the firm. If the resource is already owned by the firm, the opportunity cost of the resource must be charged to the project. The opportunity cost of a resource is the present value of net cash flows that can be derived from it if it were to be put to its best alternative use. Suppose a project requires land that is already owned by the firm. Though the cost of the land is a sunk cost and needs to be ignored, its opportunity cost, i.e., the income it would have generated had it been put to its next best use must be considered.

ACCRUAL ACCOUNTING AND CASH FLOWS

All costs and benefits are to be measured in terms of cash flows than

in terms of accrual accounting whereby income and expenditure are recognized when the transaction is entered into rather than when payment or receipt takes place. This implies that all non-cash charges like depreciation and provisions that are deducted for the purpose of determining profit after tax must be added back to profit after tax to arrive at the net cash flow.

INCIDENTAL EFFECTS

All incidental effects of a project on the rest of the firm's activities must be considered. The proposed project may have a beneficial or detrimental effect on the revenue stream of other product lines of the firm. Such impact must be quantified and considered when ascertaining the net cash flows.

POST TAX PRINCIPLE

For the purpose of appraisal, the cash flows of a project must be defined in post tax terms. Cash flows can be defined in three ways. Each of the methods of cash flow estimation depends on different viewpoints regarding who provides the capital for a project whether it is only equity shareholders or both equity shareholders and long term lenders or the total fund providers (including long term and short term). The post tax cash flows under the three viewpoints would be different.

CASH FLOWS FROM LONG TERM FUNDS POINT OF VIEW

This method is based on the assumption that funds invested in a project come from both equity shareholders and long term lenders. When calculating net cash flows using this method, the interest paid on long term loans is excluded. The rationale for this approach is that the net cash flows are defined from the viewpoint of suppliers of long term funds. Hence, the post tax cost of funds is used as the interest rate for discounting. The post tax cost of long term funds obviously includes the post tax cost of long term debt. Therefore, if the interest on long-term debt is considered for the purpose of determining net cash flows, an error due to double counting would occur. The following illustration shows how the error occurs.

More...

CASH FLOWS FROM LONG TERM FUNDS POINT OF VIEW Contd..

Example

Suppose a project has the following cash outlays and sources of finance:

(Rs.[4] in millions)

Plant & Machinery	230
Working Capital	126
Sources of Finance	
Equity	135
Long term loans	120
Trade Credit	44
Commercial Banks	57

The life of the project is 8 years. Plant & Machinery is to be depreciated on a written down value method at the rate of 15% per annum. Annual sales are expected to remain constant over the period at Rs. 340 million. Cost of sales (including depreciation but excluding interest) is expected to be Rs. 180 million a year.

The company is under the 40% tax bracket. At the end of the 8 years, plant & machinery will fetch a value equal to their book value and the investment in working capital will be fully recovered. The rate of interest on long-term loans is 15% p.a. The loans are repayable in six equal installments starting from the end of the third year.

Short term advances from commercial banks which will carry an interest of 16% p.a. will be maintained at Rs. 57 million. They will be fully liquidated at the end of 8 years. Trade credit would also be uniformly maintained at Rs. 44 million and will be fully paid at the end of 8 years.

Cash Flows (Long-term Point of View)

Year	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Initial Investment	-255								
Sales		340	340	340	340	340	340	340	340
Op. costs		145.5	150.68	155.07	158.81	162	164.7	167	168.94
Depreciation		34.5	29.32	24.93	21.19	18	15.3	13	11.06
Int. Long Term		18	18	18	15	12	9	6	3
Int. WC		9.12	9.12	9.12	9.12	9.12	9.12	9.12	9.12

PBT		132.88	132.88	132.88	135.88	138.88	141.88	144.88	147.88
Tax		53.15	53.15	53.15	54.35	55.55	56.75	57.95	59.15
PAT		79.73	79.73	79.73	81.53	83.33	85.13	86.93	88.73
Op. Flow*		125.03	119.85	115.46	111.72	108.53	105.83	103.53	101.59
NSV[5] of Fixed Assets									62.7
Net Recovery of WC Margin									25
Terminal Flow									87.7
NCF	-255	125.03	119.85	115.46	111.72	108.53	105.83	103.53	189.29
(Rs. in millions)									

* PAT + Depreciation + Interest on long-term (1-T) As per long-term funds point of view,

Operating flow = Profit after tax (PAT) + Depreciation + Other non cash charges + Interest on long term (1 – T)

Terminal Flow = Net salvage value of fixed assets + Net recovery of working capital margin

CASH FLOWS FROM LONG TERM FUNDS POINT OF VIEW Contd..

Depreciation Schedule

Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Written down value	230	195.5	166.18	141.25	120.06	102.06	86.76	73.76
Depreciation @ 15%	34.5	29.32	24.93	21.19	18	15.3	13	11.06

Calculation of Interest on long term loans

Year	1	2	3	4	5	6	7	8
Amount Outstanding	120	120	120	100	80	60	40	20
Interest @ 15%	18	18	18	15	12	9	6	3
Amount Repaid	0	0	20	20	20	20	20	20

CASH FLOWS FROM EQUITY FUNDS POINT OF VIEW

When cash flows are computed from the equity funds point of view, only the funds contributed by the equity holders towards the project are considered as an initial investment. The operating cash flow includes profit after taxes, depreciation, other non-cash charges and preference dividend. The terminal flow will be equal to the net salvage value of fixed assets and the net salvage value of current assets minus repayment of term loans, redemption of preference capital, repayment of working capital advances, and retirement of trade credit and other dues. Consider the same example given above. The net cash flows from the equity point of view would be

Cash Flows (Equity Funds Point of View)

Year	0	1	2	3	4	5	6	7	8
Investment	-135								
Initial flow									
Sales		340	340	340	340	340	340	340	340
Op. costs		145.5	150.68	155.07	158.81	162	164.7	167	168.94
Depreciation		34.5	29.32	24.93	21.19	18	15.3	13	11.06
Int. LT		18	18	18	15	12	9	6	3
Int. WC		9.12	9.12	9.12	9.12	9.12	9.12	9.12	9.12
PBT		132.88	132.88	132.88	135.88	138.88	141.88	144.88	147.88
Tax		53.15	53.15	53.15	54.35	55.55	56.75	57.95	59.15
PAT		79.73	79.73	79.73	81.53	83.33	85.13	86.93	88.73
Op. Flow*		114.23	109.05	104.66	102.72	101.33	100.43	99.93	99.79

NSV of F. Assets									62.7
Net Salvage value of current assets									126
Repayment of T.L				20	20	20	20	20	20
Repayment of STBB**									57
Repayment of creditors									44
Terminal Flow									67.7
NCF	-135	114.23	109.05	84.66	82.72	81.33	80.43	79.93	167.49
(Rs. in millions)									

*Operating Flow = PAT + Depreciation – Repayments on long and short-term loans
** Short term bank borrowings

CASH FLOWS FROM TOTAL FUNDS POINT OF VIEW

When cash flows are computed from the total funds point of view, the funds contributed by all the suppliers of funds towards the project are considered for the calculation of the initial investment. The operating cash flows are calculated by adding profit after taxes, depreciation, non-cash charges, interest on long term borrowing (1-T) and interest on short term borrowing (1-T). The terminal flow will be equal to the net salvage value of fixed assets and net recovery of WC margin. Consider the same example given above. The net cash flows from the total funds point of view will be

Cash Flows (Total Funds Point of View)

Year	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Investment	-356								
Initial flow									

Sales		340	340	340	340	340	340	340	340
Op. costs		145.5	150.68	155.07	158.81	162	164.7	167	168.94
Depreciation		34.5	29.32	24.93	21.19	18	15.3	13	11.06
Int. LT		18	18	18	15	12	9	6	3
Int. WC		9.12	9.12	9.12	9.12	9.12	9.12	9.12	9.12
PBT		132.88	132.88	132.88	135.88	138.88	141.88	144.88	147.88
Tax		53.15	53.15	53.15	54.35	55.55	56.75	57.95	59.15
PAT		79.73	79.73	79.73	81.53	83.33	85.13	86.93	88.73
Op. Flow*		130.5	125.32	120.93	117.19	114	111.3	109	107.06
NSV of F. Assets									62.7
Net Recovery of WC margin									25
Terminal Flow									87.7
NCF	-356	130.5	125.32	120.93	117.19	114	111.3	109	194.76
(Rs. in millions)									

*Operating Flow = PAT + Depreciation + Interests on long and short-term loans (1 – T)

CHOICE OF DISCOUNT RATE

The next step in the financial evaluation phase is the determination of an appropriate discount rate. The determination of an appropriate discount rate is necessary for establishing the financial feasibility of a project. Most of the appraisal criteria used these days are time adjusted or discounted criteria, like net present value (NPV), benefit cost ratio (BCR) and internal rate of return (IRR). All these require the use of a risk-adjusted discount rate to determine the actual returns from the project (Refer Exhibit II). The most commonly used method for determining the discount rate makes use of theoretical models like the capital asset pricing model (CAPM)[6] and the weighted-average cost of capital (WACC) model. The CAPM is used to ascertain the relevant cost of equity for a given level of risk. This is then combined with the cost of debt funds in proportion to their respective

weights in the total funds used to finance the project. This combined approach is known as the WACC.

$$WACC = \frac{S}{V} \times K_e + \frac{D}{V} \times K_d \times (1-T_c)$$

Where:
Ke = Cost of Equity
Kd = Cost of Debt
S = the market value of the firm's equity
D = the market value of the firm's debt
V = S + D
S/V = percentage of financing in terms of equity
D/V = percentage of financing in terms of debt
Tc = the corporate tax rate

APPRAISAL CRITERIA

After determining the cash flows of a project, one must assess its viability. This can be achieved through the use of discounted criteria or non-discounted criteria.

Time adjusted or discounted criteria include

- Net present value.
- Internal rate of return.
- Benefit-cost ratio or profitability index.

Traditional or Non-discounted criteria include

- Accounting rate of return.
- Payback period.

Certain assumptions are made when appraising projects using the criteria given above. They are:

- The risk of all project proposals under consideration does not differ from the risk of the existing projects of the firm.

- The firm has certain criteria for evaluating the projects. Based on the criteria, the investment decision will be either to accept or to reject the proposal.

DISCOUNTED CASH FLOW/TIME ADJUSTED TECHNIQUES

This method requires cash flows to be discounted at a certain rate known as the cost of capital. This technique recognizes the fact that cash flows occurring at different time periods and in different amounts can be compared only when they are expressed in terms of a common denominator i.e. present value. Thus, in this method, all the cash inflows are discounted at an appropriate discount rate and the present value so determined is compared with the present value of cash outflows.

NET PRESENT VALUE

$$NPV = -\frac{CF_0}{(1+K)^0} + \frac{CF_1}{(1+K)^1} + \frac{CF_2}{(1+K)^2} + \cdots + \frac{CF_n}{(1+K)^n} = \sum_{t=0}^{n} \frac{CF_t}{(1+K)^t}$$

Where,

NPV = Net present value
CFt = Cash flow at the end of year (t = 0……n)
(cash inflow has a positive sign and cash outflow has a negative sign)
n = Life of the project (number of years)
k = Discount rate

The decision rule associated with NPV criteria is to accept all proposals with an NPV greater than zero. This indicates accepting all projects that add value after providing a return, consistent with the cost of capital and risk. Where two or more projects are mutually exclusive, then the project with the highest NPV should be chosen. The following example will make the concept clearer:

Example:

The cash flow stream of a construction project is estimated as follows:

Year	Cash Flow
0	-155,000
1	38,000
2	44,000
3	49,000
4	54,500
5	60,000

$$NPV = -\frac{155000}{(1+0.14)^0} + \frac{38000}{(1.14)^1} + \frac{44000}{(1.14)^2} + \frac{49000}{(1.14)^3} + \frac{54500}{(1.14)^4} + \frac{60000}{(1.14)^5}$$

The net present value of the above project at the cost of capital of 14% would be,

= -155000 + 33333.33 + 33856.57 + 33073.60 + 32268.38 + 31162.12

= 8694.00

Since the NPV of the project is greater than zero it can be accepted.

Merits of NPV criterion

The merits are:

•It recognizes the importance of the time value of money.
•It takes into consideration the benefits accruing over the entire life of the project.
•It follows the principle of shareholder's wealth maximization.

Demerits of NPV criterion

The main drawbacks of this method are:

•In some cases it may be difficult to determine the appropriate discount rate. The choice of an appropriate discount rate is important because the relative desirability of the project will change with the change in discount rate.
• This method favors the project with the higher NPV. In some cases, the project with a higher NPV may involve a higher initial outlay which may exceed the budgeted investment outlay for the project.
•This method may not give satisfactory results when the two projects in question have different economic lives.

One of the basic assumptions of NPV is that all the intermediate cash flows are re-invested at a rate equal to the cost of capital. However, if this assumption is invalid, the net present value has to be modified taking into account the re-investment rate. The steps involved in the calculation of the Modified Net Present Value are given below.

a)The terminal value of intermediate cash flows calculated at the new re-investment rate:
Where,

$$TV = \sum_{t=0}^{n} CF_t(1+r')^{n-t}$$

TV = Terminal Value
CFt = Cash inflow at year end
r'= re-investment rate

b)The Modified Net Present Value is calculated in the following manner:

Where,

$$NPV_n = \frac{TV}{(1+k)^n} - I$$

NPVn = Modified net present value
TV = Terminal Value
k = Cost of capital
I = Investment outlay

Example:

Consider the same example illustrated above. The net present value of a construction project at the cost of capital of 14% is Rs. 8694. However, the underlying assumption of the present value of annuity is that all the intermediate cash flows are re-invested at the same rate of discount i.e. 14%. If the re-investment rate is different from the discount rate, then the modified net present value will be different from the net present value of Rs. 8694. Considering re-investment rates of 18% and 12%, the modified net present value would be:

More...

Re-investment Rate of 18%

Year	Cash Flow	FVIF @18%	Future Value
0	-155,000		
1	38,000	1.939	73682
2	44,000	1.643	72292
3	49,000	1.392	68208
4	54,500	1.18	64310
5	60,000	1	60000
			338492

$$\text{Modified NP} = \frac{338492}{1.14^5} - 155000 = 20802.14$$

Re-investment Rate of 12%Year

Year	Cash Flow	FVIF @12%	Future Value
0	-155,000		

1	38,000	1.574	59812
2	44,000	1.405	61820
3	49,000	1.254	61446
4	54,500	1.12	61040
5	60,000	1	60000
			304118

$$\text{Modified NP} = \frac{304118}{1.14^5} - 155000 = 2949.36$$

It can be inferred from the above calculations that the modified net present value is greater than the net present value if the re-investment rate is greater than the discount rate. However, it is less than the net present value when the re-investment rate is less than the discount rate.

The drawback of the modified net present value method is determining the rate of interest at which the intermediate cash flows will be re-invested.

NET PRESENT VALUE Contd..

The evaluation criteria used by the NPV method are:

- The project is accepted when the NPV is positive.
- The project is rejected when the NPV is negative.
- The project reaches the point of indifference when the NPV is zero.

For more than one mutually exclusive project, the one with the highest NPV must be selected.

BENEFIT-COST RATIO

The Benefit Cost Ratio (BCR) is a time-adjusted capital budgeting technique. Also known as the profitability index, it measures the present value of returns per rupee invested. BCR is defined as the ratio of the present value of benefits to the initial investment. It is represented as follows:

$$BCR = \frac{PVB}{I}$$

Where,

BCR = Benefit-cost ratio
PVB = Present value of benefits
I = Initial investment

The decision rule associated with BCR criteria is to accept all proposals with a BCR greater than one. If the BCR is equal to one, the firm is indifferent to the project. If two or more projects are mutually exclusive, then the project with the higher BCR should be chosen.

There is another measure - Net Benefit Cost Ratio (NBCR) linked to BCR. It is the ratio between NPV and initial investment

$$NBCR = \frac{NPV}{I} = \frac{PVB - I}{I} = \frac{PVB}{I} - 1 = BCR - 1$$

Three decision rules associated with NBCR criterion are
- If NBCR is greater than zero, the project is accepted.
- If the NBCR is equal to zero, the firm is indifferent to the project.
- If the NBCR is less than zero, the project is rejected.

Example

Consider the two mutually exclusive projects X and Y with the following cash flow streams. The cost of capital for both the projects is 14%.

http://www.icmrindia.org/free%20resources/casestudies/A%20Note%20On%20The%20Financial%20Evaluation%20Of%20Projects11.htm

NET PRESENT VALUE Contd..

Year	**Project X**			**Project Y**		
	Cash Flow	PVIF @14%	Present value	Cash Flow	PVIF @14%	Present value
0	-155,000			-48000		
1	38000	0.877	33326	13500	0.877	11839.5
2	44000	0.769	33836	14700	0.769	11304.3

3	49000	0.675	33075	17300	0.675	11677.5
4	54500	0.592	32264	18800	0.592	11129.6
5	60000	0.519	31140	20500	0.519	10639.5
			163641			**56590.4**

The BCR of both the projects is calculated as follows:

Project X = Present Value / Initial Investment
= 163641/155000 = 1.05575

Project Y = Present Value / Initial Investment

= 56590.4/48000 = 1.17896

Though the BCR of both the projects is more than 1, Project Y should be accepted as it has a higher BCR than Project X.

Merits of BCR Criterion

BCR, like NPV criterion, also considers the time value of money when evaluating projects. It also takes into account all the benefits accruing over the life of the project. It is superior to the NPV measure in the sense that it evaluates the project in relative terms rather than absolute terms.

Demerits of BCR Criterion

This criterion may assign a similar ranking to two different projects.

The evaluation criteria used by the BCR method are:

- The project is accepted when the BCR is greater than one.
- The project is rejected when the BCR is less than one.
- The project reaches the point of indifference when the BCR is equal to one.

For more than one mutually exclusive project one with the highest BCR must be selected.

INTERNAL RATE OF RETURN METHOD

The second time-adjusted criterion for the appraisal of a project is the internal rate of return. This refers to the rate of return that is earned by a project. It equals the

present value of cash inflows with the present value of cash outflows i.e. it is the discount rate at which the NPV of the project is zero.

If the IRR of a project is greater than the cost of capital, the project should be accepted. In this case, the cost of capital is also called the hurdle rate. The IRR is represented by the following formula:

$$0 = \sum_{t=0}^{n} \frac{CF_t}{(1+r)^t}$$

Where CFt = Cash inflows at different time periods
r = internal rate of return
n = Life of the project

To develop a better understanding of the calculation of the IRR, take a look at the following examples:

Firm XYZ Ltd. is planning to invest Rs 65,000 in its new project. This project is expected to last for 5 years. Its estimated cash flows are Rs 12,500, Rs 15,300, Rs 16,700, Rs 13,400 and Rs 14,300 for the year one, two, three, four and five respectively.

The IRR can be calculated using the following formula:

$$Rs\,65{,}000 = \frac{12500}{(1+r)^1} + \frac{15300}{(1+r)^2} + \frac{16700}{(1+r)^3} + \frac{13400}{(1+r)^4} + \frac{14300}{(1+r)^5}$$

Using the trial and error method[7], different rates are substituted in the formula to find out which value can equalize the two sides of the formula. Let us first substitute "r" with 4%; then the left hand side of the equation changes to:

$$Rs\,64273 = \frac{12500}{(1+1.04)^1} + \frac{15300}{(1+1.04)^2} + \frac{16700}{(1+1.04)^3} + \frac{13400}{(1+1.04)^4} + \frac{14300}{(1+1.04)^5}$$

By using 4%, the value derived after solving the equation is less than Rs 65000. Hence, we take 3%.

$$Rs\,65490 = \frac{12500}{(1+1.03)^1} + \frac{15300}{(1+1.03)^2} + \frac{16700}{(1+1.03)^3} + \frac{13400}{(1+1.03)^4} + \frac{14300}{(1+1.03)^5}$$

By using 3%, the value derived after solving the equation is more than Rs 65000. It is therefore clear that the actual IRR lies somewhere between 3% and 4%. Using interpolation[8], we find out a single value of IRR. The actual IRR calculated using

interpolation is 3.67%. When the payback period is given, the IRR can be calculated as follows:

$$IRR = r - \frac{PB - DF_r}{DF_rL - DF_rH}$$

Where PB = Payback period
DFr = Discount factor for interest rate r
DFrL = Discount factor for lower interest rate
DFrH = Discount factor for higher interest rate.

NET PRESENT VALUE Contd..

Suppose a project's payback period is 3.52 years. Its initial investment is Rs 75000 and its average annual cash flows are Rs 21300. Then discount factors closer to 3.52 are 3.605 at 12% and 3.517 at 13%. From this we can assume that the IRR is between 12% and 13%. We can calculate the actual IRR with the help of the above formula.

$$IRR = 12 - \frac{3.52 - 3.605}{3.605 - 3.517} = 12.96\%$$

$$IRR = 13 - \frac{3.52 - 3.517}{3.605 - 3.517} = 12.96\%$$

The merits of this criterion are:

•It takes into account the time value of money.
•It considers all cash flows.

Drawbacks of this method are:

•It involves complicated calculations.
•It gives multiple rates of return when there is a series of changes in cash flows i.e. cash inflows and outflows.

•In case of mutually exclusive projects, the IRR method might accept a project with higher IRR but with a relatively low NPV. This is because the IRR assumes that all

the cash inflows are again invested in the project at the internal rate of return.

The evaluation criteria for the project using the IRR method are:

•The project is accepted when the IRR is greater than the cost of capital or required rate of return.
•The project is rejected when the IRR is less than the cost of capital or required rate of return.
•The project reaches the point of indifference when the IRR is equal to the cost of capital or the required rate of return.
•When there are mutually exclusive projects, the one with the highest IRR must be selected.

MULTIPLE RATES OF RETURN

Projects do not always have cash inflows every year. Sometimes, negative cash flows or cash outflows occur, particularly when projects involve heavy investments or have long gestation periods. This situation is the basic reason for the realization of multiple rates of return.

Example:

Consider a project which has following cash flow streams and calculate internal rate of return:

Year	**Cash flow**
0	-1000
1	7000
2	-12000

Let IRR be r. Equation to calculate internal rate of return for the cash flow streams given above will be

$$0 = -1000 + \frac{7000}{(1+r)} + \frac{(-12000)}{(1+r)^2}$$

$= -(1 + r)^2 + 7(1 + r) - 12 = 0$
=

$$-r^2 - 2r - 1 + 7r + 7 - 12 = 0$$

$= r^2 - 5r + 6 = 0$
$= (r - 2)(r - 3) = 0$
$= r = 2$ or 3

As there are changes in signs, there are two roots of the equation. So, there are two internal rates of return for the project. Which one should be taken for the appraisal becomes difficult for appraiser to difficult?

MODIFIED INTERNAL RATE OF RETURN (MIRR)

Even though NPV is a better method conceptually than the IRR method, most managers prefer IRR over NPV since IRR is a percentage measure. A percentage measure that overcomes the shortcomings of regular IRR is known as modified internal rate of return (MIRR).

The procedure for calculating MIRR is given below:

Step 1: Calculate the present value of the costs (PVC) associated with the project, using the cost of capital (r) as the discount rate:

$$PVC = \sum_{t=0}^{n} \frac{\text{Cash Outflow}_t}{(1+r)^t}$$

Step 2: Calculate the terminal value (TV) of the cash inflows expected from the project:

$$TV = \sum_{t=0}^{n} \text{Cash Inflow}_t (1+r)^{n-t}$$

Step 3: Obtain MIRR by solving the following equation:

$PVC = TV/(1 + MIRR)^n$

$$MIRR = \left(\frac{TV}{PVC}\right)^{\frac{1}{n}} - 1$$

The following examples demonstrate the calculation of MIRR.

Example I

Pentagon Limited is evaluating a project that has the following cash flows:

YEAR 0 1 2 3 4 5 6

Cash flow (Rs. in million) -120 -80 20 60 80 100 120

The cost of capital for Pentagon is 15 percent. The present value of costs is:

120 + 80/(1+0.15) = 189.6

The terminal value of cash inflows is:

20(1.15)4 + 60(1.15)3 + 80(1.15)2 + 100(1.15)1+ 120

= 34.98 + 91.26 + 105.76 + 115 + 120 = 467

The MIRR is obtained as follows:

189.6 = 467/(1+MIRR)6

(1+MIRR)6 = 2.463

1 + MIRR = (2.463)1/6 = 1.162

MIRR = 0.162 = 16.2%

Example II

Calculate the MIRR for projects C and D, which have an initial investment of Rs 1,000,000 and Rs 150,000 respectively. The cost of capital is 10%.

	Project C		**Project D**	
End of year	Cash flows	Future value of cash flows at the end of 5th year	Cash flows	Future value of cash flows at the end of 5th year
1	Rs 250000	366025	Rs 65000	95167
2	Rs 250000	332750	Rs 65000	86515
3	Rs 250000	302500	Rs 65000	78650
4	Rs 250000	275000	Rs 65000	71500
5	Rs 250000	250000	Rs 65000	65000
Total		Rs 1526275		Rs 396832

NET PRESENT VALUE Contd..

$$\text{For project C, } (1+\text{MIRR})^5 = \frac{1526275}{1000000} = 1.5262 \text{ and MIRR} = (1.5262)^{1/5} - 1 = 8.8\%$$

$$\text{For project D, } (1+\text{MIRR})^5 = \frac{396832}{150000} = 2.6455 \text{ and MIRR} = (2.6455)^{1/5} - 1 = 21.48\%$$

The MIRR method is superior to the IRR method. MIRR assumes that the project cash flows are reinvested at the cost of capital whereas the regular IRR assumes that the project cash flows are reinvested at the project's own IRR. Since reinvestment at the cost of capital (or some other explicit rate) is more realistic than reinvestment at IRR, MIRR reflects the true profitability of a project. In addition, the problem of multiple rates does not exist with MIRR. However, for choosing among mutually exclusive projects of different size, the NPV method is better than the MIRR method because it measures the contribution of each project to the value of the firm.

The evaluation criteria under the MIRR method are:

- The project is accepted when the MIRR is greater than the cost of capital or the required rate of return.
- The project is rejected when the MIRR is less than the cost of capital or the required rate of return.
- The project reaches the point of indifference when the MIRR is equal to the cost of capital or the required rate of return.
- When there are mutually exclusive projects, the one with the highest MIRR must be selected.

TRADITIONAL OR NON-DISCOUNTED CRITERIA

When evaluating a project's viability, traditional or non-discounted criteria generally use accounting profits rather than cash flows.

AVERAGE RATE OF RETURN METHOD

This method is also known as the accounting rate of return as it considers the accounting profits of a firm over a period of time. ARR is represented as follows: ARR = average annual income x 100/average investment throughout the life of the project

$$\text{Whereas average investment} = \frac{(\text{Initial Cost of Machine} - \text{Salvage Value})}{2}$$

Consider the following example:

Two machines, P and Q, with an estimated salvage value of Rs 2500 have an initial cost of Rs 36500 and an estimated life of 5 years. Depreciation is charged on the basis of the straight line method. The estimated income of the machines over a period of 5 years is given in the table below. The average rate of return of the machines is calculated as follows:

Year	**Annual estimated income of machine P**	**Annual estimated income of machine Q**
1	Rs 3540	Rs 4920
2	Rs 4635	Rs 6025
3	Rs 5820	Rs 8132
4	Rs 6210	Rs 7565
5	Rs 5575	Rs 2560
Total	**Rs 25780**	**Rs 29202**
Average income	Rs 5156	Rs 5840
Average investment	Rs 17000	Rs 17000
ARR	**30.33%**	**34.35%**

The merit of this criterion is that it is easy to calculate and understand. However, the demerit of this method is that it uses accounting profits instead of cash flows.

The evaluation criteria using this method are:

•The project is accepted when the actual ARR is greater than the required ARR.
•The project is rejected when the actual ARR is less than the required ARR.
•When there are mutually exclusive projects, the one with the highest ARR but more than the cut off ARR must be selected

PAYBACK PERIOD METHOD:

This is the most commonly and widely used method for the appraisal of capital investment decisions regarding projects. This criterion evaluates a project on the basis of the speed with which it recovers its initial investment. It can be computed in two ways: When the cash inflows after tax (CFAT) are the same every year the following formula is used:

Payback period = Initial investment /CFAT

Example:

Consider two mutually exclusive projects X and Y. Project X is expected to earn a CFAT of Rs 9800 every year for 6 years. Its initial investment is Rs 35000. Project Y is expected to generate a CFAT of Rs 11200 every year for 6 years. Project Y's initial investment is Rs 35000. Calculate the PB period for both the projects.

	Project X	**Project Y**
Initial Investment	Rs 35000	Rs 35000
CFAT	Rs 8750	Rs 11200
Payback period	4 yrs	3.12yrs

When cash inflows after tax are constantly changing from year to year, the method for calculating PB period is calculated in the following manner:

	Project X		**Project Y**	
Year	CFAT	Cumulated CFAT	CFAT	Cumulated CFAT
0	-155,000	-	-48000	-
1	38000	38000	13500	13500
2	44000	82000	14700	28200
3	49000	131000	17300	45500
4	54500	185500	18800	64300
5	60000	245500	20500	84800
Payback period	3.129 yrs		3.038 yrs	

Project X will recover Rs 131,000 of its initial investment in the first three years. In the fourth year, it will recover the balance, i.e., (155000 – 131000 = 24000). The payback period in the fourth year is computed as follows 24000/185500 = 0.129. Therefore, the investment in project X can be recovered in 3.129 years. Similarly, the initial investment in project Y can be recovered in 3.038 years.

The major advantages of this criterion are:

•Like ARR it is easy to calculate PB.
•It takes into account cash flows (and is hence superior to ARR).
•It helps identify projects which can earn quick returns (useful in industries where rapid technological change is common).

This criterion has the following drawbacks:

•It does not consider the cash flows after the payback period.
•It does not consider the timing of cash flows.
•It does not show whether or not the project that has been accepted is going to maximize the wealth of the stakeholders.

The evaluation criteria for this method are:

•The project is accepted when the actual payback period is less than the required or predetermined payback period.
•The project is rejected when the actual payback period is greater than the required or predetermined payback period.
•When there are mutually exclusive projects, the one with the lowest payback period but less than cut off payback period must be selected.

DISCOUNTED PAYBACK PERIOD METHOD

Unlike the payback method, this criterion takes into account the discounted cash flows of a project. In this method, cash flows are discounted at the cost of capital, which shows the time value of money as well as the riskiness of the cash flows.

The decision rule for this criterion is to accept the project with less payback period or when the accumulated discounted cash flows are equal to the initial investment. The discounted payback period is measured as follows:

To understand the method better, let us consider the following example:

	Project X			**Project Y**		
End of the year	CFAT	Discounted cash flows at the end of the year	Accumulated discounted cash flows	CFAT	Discounted cash flows at the end of the year	Accumulated discounted cash flows
1	38000	34545	34545	13500	12273	12273
2	44000	36364	70909	14700	12149	24422
3	49000	36814	107723	17300	12998	37420
4	5450	37227	144950	1880	12842	50262

	0			0		
5	60000	37267	182217	20500	12733	62995

*The cost of capital is assumed as 10%

*The present value of cash flow at the end of the 1st year = Cash flows at the end of the 1st year/$(1 + 0.10)^1$

The initial investment in Project X (Rs 155000) is paid back in 4.27 years and the initial investment in project Y (Rs 48000) is paid back in 3.82 years This method has the following merits: •It takes into account the time value of money.

•It considers the riskiness of cash flows. The demerit of this method is that it does not have any particular decision rules.

The evaluation criteria for this method are:

•The project is accepted when the actual discounted payback period is less than the required or predetermined payback period. •The project is rejected when the actual discounted payback period is greater than the required or predetermined payback period.

•Where there are mutually exclusive projects, the one with the least discounted payback period but less than the cut off payback period must be selected.

APPRAISAL TECHNIQUES IN PRACTICE FOR VARIOUS TYPES OF PROJECTS

•The most commonly used method for conducting a financial appraisal of small projects requiring less financial investments is the payback method.
•For larger projects, the average rate of return is commonly used as the principal criterion and the payback period is used as a supplementary criterion.
•Discounted cash flow (DCF) techniques are now being increasingly used to evaluate large investments.
•Many other criterias are used for evaluating investments: profit per rupee invested (calculates the actual profit earned in terms of each rupee invested); cost saving per unit of product (calculates the amount of savings on the cost of production per unit); and investment required to replace a worker (calculates the additional amount required to replace an existing worker).

CAVEATS FOR IMPROVED FINANCIAL EVALUATION

•The appraisal criteria for evaluating projects should be standardized.
The use of many methods makes comparison between projects

difficult.

- The approach followed for evaluating projects must be clearly defined. Vague qualitative phrases should be substituted by quantitative measures wherever possible. This is necessary to promote understanding and avoid confusion.
- Discounted cash flow techniques should receive greater emphasis. They are theoretically superior and practically feasible.
- To sum up, the evaluation must be carried out in explicit, well-defined, preferably standardized terms and should be based on sound economic principles. Investment decision-making must be based on a careful and sound evaluation of the available data.

CONCLUSION

The selection of a technique essentially depends on whether the projects are independent or mutually exclusive and whether or not capital rationing is applied to them. Firms generally use the discounted cash flow method as the primary evaluation technique and conventional methods as secondary techniques for evaluating a single project. Project evaluation techniques help a firm maximize wealth by determining the right project to be undertaken from the various alternatives available to the firm. The finance managers of a firm are responsible for choosing a project evaluation technique that would best suit the organization's requirements.