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# Financial Analysis Using Discounting and Non-Discounting Techniques - II

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## 1. Introduction

In the first session we discussed the meaning of discounting and non-discounting techniques with a special focus on ARR, Payback period, and NPV. Now in this session we are going to discuss IRR, BCR/PI Merits and demerits of each, NPV vs. IRR: Pitfalls, No IRR, Multiple IRR, Incremental IRR, the Choice between NPV and IRR, Specific project decisions like equivalent annual Value, Unequal Lives of Projects, Adjustment for Inflation, and Projects with Resource Constraint etc

The other important discounted technique is Internal Rate of Return.

### Internal Rate of Return (IRR)

It is a discounted technique for appraising capital budgeting proposals. This technique is also known as yield on investment, marginal efficiency of capital, marginal productivity of capital, rate of return, etc. it is the rate of return that a project usually earns.

This is defined as the rate at which the net present value of the investment is zero. The discounted cash inflow is equal to the discounted cash outflow. This method also considers time value of money. It tries to arrive to a rate of interest at which funds invested in the project could be repaid out of the cash inflows. However, computation of IRR is a tedious task.

It is called internal rate because it depends solely on the outlay and proceeds associated with the project and not any rate determined outside the investment.

It can be determined by solving the equation:

### Formula

$$\text{Internal Rate of Return} + R1 = \frac{NPV1 \times (R2 - R1)}{(NPV1 - NPV2)}$$

Where:

R1 = Lower discount rate

R2 = Higher discount rate

NPV1 = Higher Net Present Value (derived from R1)

NPV2 = Lower Net Present Value (derived from R2)

If IRR > WACC then the project is profitable.

If IRR > k = accept

If IRR < k = reject

IRR is easier to understand. Business executives and non technical people understand the concept of IRR much more readily than the concept of NPV.

It is consistent with the overall objective of wealth maximization. The IRR is compared with the required rate of return. The required rate of return is the minimum rate which the investors expect on their investment.

The IRR suffers from some serious limitations. It involves tedious calculations. Moreover it produces multiple rates which can be confusing.

As an investment decision tool, the calculated IRR should *not* be used to rate mutually exclusive projects, but only to decide whether a single project is worth investing in or not.

In the evaluation of mutually exclusive proposals the project with the highest IRR would be selected. In practice it may not turn out to be the best.

Moreover this technique is based on the assumption of reinvestment of all cash inflows at the IRR. If the IRR from different machines are different then it is ridiculous to think that the same company can have the ability to reinvest the cash flows at different rates.

In fact sometimes it is not possible for the companies to reinvest all the cash inflows because companies may pay a portion of cash inflows as dividends.

With certain cash flow streams it is mathematically possible to produce negative IRRs, or multiple IRRs for the cash stream (more than one discount rate that leads to a 0 NPV). For other cash flow streams, there is simply no mathematically correct IRR solution.

- Impossible IRR: There is no possible IRR solution when the cash flow includes only positive or only negative net cash flows. There may be real cash outflows in every period, but when the inflows always outweigh outflows, there will be no negative net cash flows. There is no IRR in such cases. Other patterns of negative and positive net cash flows can also have no IRR solution.

- Multiple IRRs: A net cash flow stream will have multiple IRRs when it includes more than one sign change. When the first cash flow is negative and the second cash flow is positive, that is one sign change and there will be one IRR for the stream. If another, later, net cash flow event is negative, that makes 2 sign changes. There will be one IRR for every sign change in the cash flow stream. In such cases, it is probably best to consider the IRR closest to the real cost of capital as the "true" IRR.

- So In the case of positive cash flows followed by negative ones and then by positive ones (for example, + + − − − +) the IRR may have multiple values
- Negative IRR: It is also possible for some net cash flow streams to produce a negative IRR value. This signals simply that the investment or action should be considered a "net loss." Further quantitative analysis of negative IRRs is not advised. Negative IRRs should certainly be disregarded when the analyst prepares IRR averages, or weighted average IRRs for multiple actions.
- Incremental IRR: The incremental internal rate of return is an analysis of the financial return to an investor or entity where there are two competing investment opportunities involving different amounts of investment. The analysis is applied to the difference between the costs of the two investments. Thus, you would subtract the cash flows associated with the less expensive alternative from the cash flows associated with the more expensive alternative to arrive at the cash flows applicable to the difference between the two alternatives, and then conduct an internal rate of return analysis on this difference.
- Based just on quantitative analysis, you would select the more expensive investment opportunity if it has an incremental internal rate of return higher than the minimum return you consider acceptable. However, there are qualitative issues to consider as well, such as whether there is an incremental increase in risk associated with the more expensive investment. Therefore, realistically, the investor must weigh a variety of factors besides just the incremental

internal rate of return before making an investment decision. This rate of return may not even be the deciding factor in making an investment decision.

- If the investor believes that there is a considerable amount of additional risk associated with the more expensive investment opportunity, he or she can adjust for this risk by increasing the minimum return considered acceptable. For example, the minimum rate of return threshold for a low-risk investment might be 5%, while the threshold might be 10% for a high-risk investment.
- Lets understand with an example
- ABC International is considering obtaining a colour copier, and it can do so either with a lease or an outright purchase. The lease involves a series of payments over the three-year useful life of the copier, while the purchase option involves more cash up-front and some continuing maintenance, but it also has a resale value at the end of its useful life. The following analysis of the incremental differences in the cash flows between the two alternatives reveals that there is a positive incremental internal rate of return for the purchasing option. Barring any other issues (such as available cash to buy the copier), the purchasing option therefore appears to be the better alternative.

| Year | Lease | Buy | Difference |
|---|---|---|---|
| 0 | 70,000 | 2,90,000 | -2,20,000 |
| 1 | 70,000 | 15,000 | 55,000 |
| 2 | 70,000 | 15,000 | 55,000 |
| 3 | 70,000 | 15,000 | 55,000 |
| Resale | | +1,50,000 | 1,50,000 |
| | | Incremental IRR | 13.3% |

An
internal rate of return is an estimate for the potential yieldonan i nvestment; calculating the incremental internal rate
of return is a tool to help an investor decide whether the addedri sk of increased expenditure is worth the potential
reward. Generally, if the incremental internal rate of return is hi gher than the minimum acceptable rate of return, the more expensive investment is considered the better one.

- MIRR: Modified Internal Rate of Return: Modified Internal rate of return is that rate of compounding which makes the initial cash outflow in zero year equal to the terminal value of the cash inflows. If the Project MIRR is greater than or equal to k, the project proposal should be accepted and if MIRR is less than k then reject the project. In case of mutually exclusive projects, the project with the highest MIRR should be selected.

- MIRR is different from IRR. MIRR is based on the assumption that intermediate cash inflows are reinvested at cost of capital where as IRR assumes that intermediate cash inflows are reinvested at IRR.

- MIRR does not yield negative rates or multiple rates under any circumstances but IRR may yield negative rates or multiple rates under certain circumstances.

**2. Profitability Index (PI)**

It is the measure which measures the present value of returns per rupee invested whereas NPV is based on the difference between the present value of future cash inflows and the present value of cash outlays.

It is the ratio of the present value of future cash benefits, at the required rate of return to the initial cash outflow of the investment. It may be gross or net, net being simply gross minus one. The formula to calculate profitability index (PI) or benefit cost (BC) ratio is

PI = PV cash inflows/Initial cash outlay

PI = NPV (benefits) / NPV (Costs)

All projects with PI > 1.0 is accepted.

This method gives a solution to the problem posed by NPV being a absolute measure it is not possible to evaluate the projects requiring different initial investments.

PI satisfies almost all the requirements of a sound investment criterion.

**3. Comparison of NPV and IRR**

Both of these techniques are primarily used in capital budgeting, Through these techniques companies determine whether a new investment or expansion opportunity is worth making an

investment or not. Given an investment opportunity, a firm needs to decide whether undertaking the investment will generate net economic profits or losses for the company.

To do this, the firm estimates the future cash flows of the project and discounts them into present value amounts using a discount rate that represents the project's cost of capital and its risk. Then a summation of present values of cash inflows is obtained and subtracting the initial cash outlay required for the investment provides the net present value (NPV) of the investment.

Let's illustrate with an example: suppose Jumbo Media Company wants to buy a small publishing company. Jumbo determines that the future cash flows generated by the publisher, when discounted at a 12% annual rate, yields a present value of Rs 23 thousands. If the publishing company's owner is willing to sell for Rs20 thousands, then the NPV of the project would be Rs 3 thousands (Rs 23 – Rs 20 = Rs 3). The Rs 3million NPV represents the intrinsic value that will be added to Jumbo Media if it undertakes this acquisition.

So, Jumbo Media's project has a positive NPV, but from a business perspective, the firm should also know what rate of return will be generated by this investment. To do this, the firm would simply recalculate the NPV equation, this time setting the NPV factor to zero, and solve for the now unknown discount rate. The rate that is produced by the solution is the project's internal rate of return (IRR).

For this example, the project's IRR could, depending on the timing and proportions of cash flow distributions, be equal to 17.15%. Thus, Jumbo Media, given its projected cash flows, has a project with a 17.15% return. If there were a project that JKL

could undertake with a higher IRR, it would probably pursue the higher-yielding project instead. Thus, you can see that the usefulness of the IRR measurement lies in its ability to represent any investment opportunity's return and to compare it with other possible investments.

**Similarities**

The techniques give consistent results in terms of acceptance or rejection of investment proposals in certain situations.

The situations in which the two methods will give a concurrent( agreeing) in conventional and independent projects.

**Difference**

In the case of mutually exclusive proposals these techniques might give a contradictory result.

**Size disparity problem**

This arises when the initial investment in projects under consideration, that is, mutually exclusive projects, is different. The cash outlay of some projects is larger than that of others.

**Time disparity problem**

This arises when the cash flow pattern of mutually exclusive projects is different.

**Unequal expected lives**

Another situation in which the IRR and NPV methods would give a conflicting ranking to mutually exclusive projects is when the projects have different expected lives.

**Net present value and Profitability Index**

In most situations the NPV and PI provide the same accept and reject decision because both the methods are closely related to each other. The investment proposal will be acceptable if PI is greater than 1 and this is possible only when NPV is positive. In

case of Mutually exclusive proposals, these methods may give different rankings.

**Now let us discuss the choice between the NPV and IRR**

The conflict between the NPV and IRR methods is mainly recognized . The IRR method implicitly assumes that the cash flows generated from the projects are subject to reinvestment rate assumptions of intermediate cash inflows accruing from the projects.

The IRR technique is based on the assumption that the cash flows would be reinvested at the IRR whereas In NPV method this reinvestment is done at the cost of capital. So the assumption under NPV is superior to IRR assumption, because NPV would provide uniformity and which can be consistently be applied to all investment proposals.

The NPV method is considered to be the best under the capital rationing situations. For these reasons, NPV emerges as the theoretically correct and better technique for evaluating and assessing the investment proposals.

**4. Capital Rationing or project with resource constraint**

It refers to the situation of choosing investment proposals under financial constraints. Every company has a financial budget and this makes the process more complex.

The limited capital budgeting funds makes it inevitable to make a right choice. The project selection under capital rationing involves two stages:

Identification of the acceptable projects

Selection of the combination of projects

There are two types of capital rationing proposals.

Soft rationing

Hard rationing

Soft capital rationing or "internal" rationing is caused due to the internal policies of the company. The company may voluntarily have certain restrictions that limit the amount of funds available for investments in projects.

On the other hand, hard capital rationing or "external" rationing occurs when the company faces problems in raising funds in the external equity markets. This can lead to the shortage of capital to finance the new projects in the company.

Capital rationing does not allow the firm to accept all profitable projects which could add to the net present value and adding to the wealth of shareholders.

Capital rationing may lead to the acceptance of several small investment projects which might have a bearing on the risk complexion of the business firm. For making a correct selection , the companies should rely on profitability index, being a relative measure compared to the NPV method, an absolute measure.

Profitability index should be used to rank the divisible projects under the capital rationing situation.

**Unequal lives of project**

As mentioned previously, NPV and IRR can sometimes lead to conflicting results in the analysis of mutually exclusive projects. One reason for this potential problem is the timing of the cash flows of the mutually exclusive projects. As a result, we need to adjust for the timing issue in order to correct this problem.

There are two methods used to make the adjustments:

1. Replacement-chain method
2. Equivalent annual annuity

The Replacement Chain Method is a decision model that takes into consideration the different life spans of alternative proposals, allowing a more accurate comparison of the proposals.
In Replacement Chain Analysis, the Net Present Value (NPV) is determined for each proposal, and one or more iterations can be completed to create comparable time frames for the proposals. By comparing the proposals over like-periods of time, accept-reject information for the various proposals becomes more reliable.

The **equivalent annual** annuity (EAA) **approach** calculates the constant **annual** cash flow generated by a project over its lifespan if it was an annuity.

The equivalent annual annuity approach (EAA) is one of two methods used in capital budgeting to compare mutually exclusive projects with unequal lives.

The present value of the constant annual cash flows is exactly equal to the project's net present value (NPV). When used to compare projects with unequal lives, the one with the higher EAA should be selected.

The EAA approach is relatively easier to use rather than the other method used to compare projects with unequal lives, the replacement-chain or common life approach.

The present **value** of the constant **annual** cash flows is exactly equal to the project's net present **value** (NPV).

**Inflation and capital budgeting**

The capital budgeting results would be unrealistic if the impact of inflation is not incorporated in the analysis. The cash flows would not reflect the real purchasing power. In order to overcome this problem, the company should rely on Real cash flows which means cash flows discounted to reflect effect of inflation on nominal cash flows. The company should also rely on Real cost of capital which means cost of capital adjusted for inflation effect.

## 5. Summary

NPV, IRR and profitability index are the discounted techniques which are superior to the non discounted techniques of capital budgeting.

In most cases firms do not have access to unlimited amounts of funds or financial managers do not have access to additional funds, which might mean that some acceptable capital budgeting projects are not chosen. If the amount of funds that is invested in capital budgeting projects is constrained, then capital rationing exists. In such situations, the firm should invest in the combination of projects that provides the highest combined NPV— that is, that increases the firm's value by the most.

When evaluating capital projects, companies can evaluate capital projects in nominal or real (i.e. inflation adjusted) terms. Real cash flows are based on purchasing power at the time the decision to invest is made.

Commonly, capital projects are analyzed in nominal terms, so the discount rate applied is inclusive of expected inflation; however actual inflation may change direction from expectations

and inflation may impact the different project variables in different ways.