FINANCIAL ECONOMICS (5TH SEM): IRR & NPV – A COMPARATIVE STUDY

The internal rate of return (IRR) is a rate of return used to measure and compare the profitability of investments. It is also called the discounted cash flow rate of return or simply the rate of return (ROR). In the context of savings and loans, the IRR is also called the effective interest rate. The term internal refers to the fact that its calculation does not incorporate other objective factors (e.g., the interest rate or inflation).

The internal rate of return on an investment or project is thus **the "rate of return" that makes the net present value of all cash flows (both positive and negative) from a particular investment equal to zero.** In more specific terms, the IRR of an investment is:

That discount rate at which the net present value of costs (negative cash flows) of the investment equals the net present value of the benefits (positive cash flows) of the investment.

Internal rates of return are frequently used to evaluate the desirability of investments or projects. The higher a project's internal rate of return, the more desirable it is to undertake the project. Assuming all projects require the same amount of up-front investment, the project with the highest IRR would be considered the best and undertaken first. A firm (or individual) should, in theory, undertake all projects or investments available with IRRs that exceed the cost of capital.

Calculation: Given a set of pairs (time, cash flow) involved in a project, the internal rate of return follows from the net present value as a function of the rate of return. As mentioned earlier, **a rate of return for which this function is zero is an internal rate of return**. Given the (period, cash flow) pairs (n, C_n), where n is a positive integer, the total number of periods is N, and the net present value is NPV, the internal rate of return is given by R in:

$0 = \sum_0^N Cn/(1+R)\text{^}n$; as NPV is taken to be zero for the purpose of IRR calculation

That is, $IRR = -C_0 + C_1 / (1+r) + C_2 / (1+r)^2 + \ldots + C_n/(1+r)^n = NPV = 0$

The period is usually given in years. Any fixed time can be used in place of the present (e.g., the end of one interval of an annuity); the value obtained is zero if and only if the NPV is zero. In the case that the cash flows are random variables, such as in the case of a life annuity, the expected values are put into the above formula. Often, the value of cannot be found analytically. In this case, numerical methods or graphical methods must be used.

Example: If an investment generates the following sequence of cash flows:

Year(n)	Cash flow (C_n)
0	-8000
1	2400
2	2820
3	3750
4	2100

Employing the formula above, the IRR is 14.3%.

Differences between the IRR & the NPV

Parameter of Comparison	**NPV**	**IRR**
Outcome	The **NPV** results in a money value that a project is expected to yield.	**IRR** gives the percentage return that the project is expected to yield.
Represents	Surplus from the project	Point of no profit no loss (Break-even point)
Use of a Discount Rate	The NPV method requires the use of a discount rate, which may be difficult to derive.	The IRR method does not need a pre-determined discount rate, since the rate of return is simply derived from the underlying cash flows.
Problem when the discount Rate changes	If the discount rate changes, the NPV method yields different results for the same project	The IRR method yields the same result for the same project, no matter how the discount rate changes
Rules of acceptance of a project	If a project produces a **positive NPV; that is, if NPV>0,** then we can accept that project. With a **negative NPV or NPV<0**, one should not accept the project.	If a project produces a **IRR** that is greater than the required rate of return, or the weighted average cost of capital, then we can accept that project. Otherwise, one should not accept the project.
For projects of unequal life	NPV may not give an accurate comparative judgment	IRR may be a better guide

A Company is planning to invest in a plant. It generates the following cash flows.

Assume a discount rate of 10%.

Year	Cash flow (Rs.)
0	-50,000
1	15,000
2	17,000
3	18,000
4	10,000
5	10,000

Applying the formula for NPV, we get NPV = Rs. 4,248.96

Again, applying the IRR formula, the IRR = 14%.

So, both methods tell us to accept the project.

In general, for most projects, NPV and IRR lead to the same conclusion.

Business managers normally like to use IRR because this measure gives them a good idea about at what rate they are able to earn. Knowing the rate of return is intuitively appealing. However, the IRR method has to be used cautiously. For, typical IRR calculations are based on reinvestment assumption, which makes projects look better than they actually are.

One problem with the IRR method is that it may lead to non-unique solutions. For example, consider the following project with negative cash flows at the beginning and at the end of the project life (like, say, what a landlord experiences; he repairs and paints the house first before offering it for rent, takes a security deposit and collects rent monthly, and finally, at the end of the contract period, refunds the deposit):

Year	Cash flow (Rs.)	**NPV at r = 10%**	**NPV at r = 20%**
0	- 100	-100	-100
1	230	209.1	191.67*
2	-132	-109.1	-91.67*

So, in both cases, we have: **NPV = 0** **NPV = 0**

(230)/(1 + 0.2) = 191.67 and (–132)/(1 + 0.2)^2 = -91.67* ***and* *(230)/(1 + 0.1) = 209.1 and (–132)/(1 + 0.1)^2 = - 109.1*

With two mutually exclusive projects with different patterns of cash flows, the NPV and the IRR may yield entirely different decision rules, as shown in the following example.

Year	**Cash flow (Rs.) of project 1 (Rs.)**	**Cash flow (Rs.) of project 2 (Rs.)**
0	-25,000	-25,000
1	18,000	1,500
2	13,000	2,540
3	3,000	15,500
4	1,815	27,000

If we follow the formulae given for NPV and IRR as discussed before, we will find that project 2 has an NPV of approximately Rs. 6556 and project 1 has an NPV of Rs. 4724. So, according to the NPV principle, project 2

is better. On the other hand, the IRR is 25% for project 1 and 20% for project 2. Therefore, according to the IRR principle, project 1 is better.

In the case of mutually exclusive projects such that acceptance of one implies rejection of the other; NPV and IRR often give contradicting results.

Both, of course, have their **advantages and disadvantages**. NPV takes into account the amount of addition to the wealth of the firm, which is of interest to the shareholders. This is certainly an advantage **not offered by the IRR method,** which is concerned with the percentage of return.

However, one disadvantage of the NPV method is that it is not useful for **comparing two projects of different sizes.** For, the NPV method results in an answer in rupee terms and so,, the size of the net present value output is determined mostly by the size of the input.

For example, a Rs. 1 crore project is likely to have a much higher NPV than a Rs. 1,00,000 project, even if the latter project provides a much higher return in percentage terms. If capital is scarce -- and it usually is -- the NPV method is a poor method to use because projects of different size are not immediately comparable based on the output.

Interestingly, this is also a disadvantage of the IRR method. As it focuses on just the rate of return, it ignores the value that a project can add to the worth of a firm, or the total additional profit it can generate. It is clear that the Rs. 1 crore project will possibly lead to much higher value addition for the firm; so ignoring it altogether for the purpose of a higher rate of return may not be judicious.

To summarise, it is usually beneficial for a firm to utilize both methods and use the decision rules provided by them to best suit its own objectives.