Economic Internal Rate of Return (EIRR) decoded

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The Financial Internal rate of return is one of the pivotal metrics of capital budgeting. Each financial entity today also has an obligation to the economy of a country as a whole. The Economic Internal rate of return as a metric has very high importance in the current world order where sustainable development goals (SDG) as provided by the United Nations need to be acted upon by 2030.

An entity needs to consider numerous investment decisions during its lifetime. As part of the decision making, the long term assets need careful assessment to provide most efficient basis of long term capital building. The benefits of such investment may have a far reaching impact with benefits spread over multiple years spilling over long term periods. Thus a meticulous appraisal of the investment is fundamental to the decision making process. As part of the financial evaluation of any capital budgeting problem we come across many metrics, some of them are:

ARR: Accounting rate of return

ARR is the absolute return generated on an investment. This is also known as an return on investment (ROI). It is derived by the division of income that an entity anticipates to generate from the investment and the investment cost. It is pertinent to note that the time value of the money is not a factor in this metric

$$ARR = \frac{Income\ from\ Investment * 100}{Investment\ cost}$$

PBP: Pay Back Period

Payback period is the duration or number of years that would be required to recoup the initial investment cost of an investment. In the case of a project proposal which is generating regular annual cashflow, the formula for payback period is as follows:

$$PBP = \frac{Investment\ cost}{Annual\ cash\ inflow}$$

This metric does not use the present value (PV) of the future cash flow and merely relies on the ratio of annual cash inflow to matchup with the investment cost. A high payback period indicates that the investment proposal is slow to provide the required investment return. A low payback period indicates that the investment proposal is faster to provide the required investment return and accordingly may be considered for investment purpose.

PI: Profitability Index

Profitability Index is the relationship of the present value of the future cash inflows vs the initial cash outflow required as an investment.

The formula for profitability index is as follows:

$$PI = \frac{PV\ of\ cash\ inflow}{Investment\ cost}$$

If the profitability index provides for the value of more than 1 (PI>1) then it indicates that the PV of cash inflow is exceeding the investment cost and such investment proposal can be accepted by the management. On the other hand, profitability index which provides for value of less than 1 (PI<1) indicates that the PC of cash inflow is below the investment cost and such an investment proposal may be rejected.

NPV: Net Present Value

As the name suggests, this metric uses the time value of the cash flows generated from the investment by an entity. Here

the present value (PV) of the expected future cash inflows are assessed as against the present value of cash outflows.

If the cash outflow of investment is in the initial year, the below is the formula:

$$NPV = \frac{Cash\ Inflow - Initial\ investment}{(1+i)^t}$$

Where:

i = the discount rate or the required rate of return

t = number of time period

If the cash outflow of investment is in multiple years, below is the formula:

$$NPV = \sum_{t=0}^{n} \frac{R_t}{(1+i)^t}$$

Where:

R_t = net cash inflow – cash outflow during period t

i = the discount rate or the required rate of return

t = number of time period

n = total number of time period

If the NPV as calculated based on the required rate of return is positive i.e. >1 then the investment proposal is within the defined parameters of generating the required returns and can be accepted. In case the NPV is negative i.e. <1, then the investment proposal is not within the defined parameters of generating the required returns and is generating below par returns resulting in rejection.

IRR: Internal Rate of return

Internal rate of return is on similar lines of the net present value with one basic difference that it will provide the rate of return when the net present value of cash inflows and cash outflows will be equal to zero (0). In other words, internal rate of return is the rate at which the present value of the cash inflow will be equal to the present value of cash outflow (initial investment in case of single year outflow)

The formula for internal rate of return is:

$$0 = NPV = \sum_{t=1}^{t} \frac{C_t}{(1+IRR)^t} - C_0$$

Where:

C_t = net cash inflow during period t

C_0 = Initial investment or cash outflow

IRR = Internal rate of return

t = number of time period

IRR can be worked out iteratively via trial and error method or by using computer spreadsheet.

Internal rate of return can be likened to the growth in the investment that can be expected on an annual basis. This is analogous to the compound annual growth rate (CAGR) which is the rate of return that the investment will grow from the beginning to the end. Any investment proposal which results in an internal rate of return above the expected rate of return will be acceptable to the management (IRR> expected rate of return).

The investment decision making process considering internal rate of return considers only financial implications of the investment proposal or the project, and can be said to be addressing the financial feasibility of the project. Accordingly this is also known as the financial internal rate of return (FIRR).

EIRR: Economic Internal rate of return

The Economic Internal rate of return evaluates the additional economic parameters from the investment proposal by reckoning the measurable and non-measurable benefits accruing in the investment proposal. Where all the stakeholder of the investment proposal also have social responsibility to the economy as a participant and beneficiary, evaluation of the economic benefits of the proposal is very imperative. This is also the case where the investment is sourced from an external investor concerned with the social and developmental impact of their investments.

EIRR is the discount rate at which the NPV of the economic benefit is equal to the NPV of the economic costs. As a corollary at EIRR, the difference between the economic benefit (NPV) and the economic cost (NPV) is equal to zero.

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

Where:

B_t = gross economic benefit during period t

C_t = economic cost during period t

n = project life

t = number of time period

Difference between Financial Internal rate of return and Economic Internal rate of return

A financial evaluation (FIRR) of a project dedicates the identification of the project benefits (cashflows) and related costs of an investment proposal in a project that occur in the respective years and discount the future cashflows to the present value. Here, no regard is given to the parameters of social or economic impact of the project cashflows. Accordingly, the objective of the financial evaluation is to purely evaluate the capability of the project;

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generate sufficient cash inflow to cover the cash outflow in isolation of the external economy. On the contrary, the objective of economic evaluation is to evaluate the investment project from the standpoint of the entire economy and measure the economic impact of the project from the citizen's welfare experience. Thus the intent behind economic analysis is to evaluate the economic viability of the project for the economy as a whole through Economic Internal rate of return.

The varied objectives and intent between the two approaches of analyses also indicate that there are fundamental dissimilarities in the considerations and valuation of the benefits of the project and related costs of the project. The financial evaluation (FIRR) is primarily based on the market prices that are expected to be expended or recovered by an investment project, and the concentration is on financial values of the benefits of the project and related costs of the project.

Economic analyses (EIRR) engages the economic prices which are also known as "shadow prices" in the measurement and the concentration is on the economic values of the benefits of the project and related costs of the project. Divergences between the financial values and economic values of the benefits of the project and related costs of the project results from two key factors: price distortions and non-marketed impacts

Price distortions

Price distortions get embedded into the economy due to government involvements like subsidies, taxes and price controls or due to limited competition:

- Subsidies and taxes are by nature transfer payments affecting the distribution of financial benefits and related costs of the project entity and associated stakeholders like the government and households, however they do not enlarge or diminish the total resources available for the economy taken together
- Price controls are levied by the government or regulators and may comprise pricing below the market equilibrium scales resulting in partial impact on value of goods or services to the consumer
- Limited competition results from monopolistic or oligopolistic market scenarios and can set in motion opaque pricing of products which is much higher that the long term cost of supplying those products

Non-marketed impacts

A lot of government section projects result in outputs that are not commonly processed through the open markets. Some of the instances involve government health deliveries, government educational institutions, transportation etc. In some other cases, government projects are moderately processed in open markets like water and sanitation projects. Many other projects create outputs that are processed in open markets but also lead to side effects (or positive impacts) that are affecting the public, however the pricing of products or services do not include the price of such side effects or positive impacts. Negative side effects may be in the form of pollution from a coal based power generation or positive impacts in the form of better health attributed to lower instances of disease due to good water and sanitation projects.

For these type of projects, deficiency in availability of normal marketed prices for the inputs or outputs means other means of valuation of the economic benefits and costs are essential. For instance, the economic benefit of a government school can be valued by the education's influence in higher economic productivity; economic benefits of better roads can be valued by the saving in time and lower vehicle operating costs.

The economic pricing indicate the economic value of the goods and services and give vital direction on the selection of the government projects. As a concept, economic pricing can be a gain (or loss) to the societal welfare as a result of consumption of a single measurable commodity. Societal welfare can be valued based on the consumption of the commodity which are made available to the society at large, irrespective of the fact that they are not transacted in open market. Economic costs of inputs of a project indicate the consumption foregone somewhere else due to deviation of the resources to a project from alternative utilizations. The total value of the net effect in the combined consumption made available to the society indicates the net economic impact of a project.

Economic valuation of the benefits and costs

The economic valuation of the benefits and costs of the project comprises a process of converting the financial values to economic values which is also known as "shadow pricing". This process of conversion necessitates pricing (economic) of the inputs as well as outputs of the project to be assessed.

The basis of estimating economic prices for frequently traded goods and services is the national average prices available of those goods or services. In case the domestic prices are unavailable, global market prices can be assessed as the international markets reflect the best alternate to the domestic produce. On the other hand the basis of estimating economic non traded output goods and services can be "willingness to pay" assessment i.e. the price that the consumer is willing to pay for consuming such produced output. Where non traded goods or services are used as input for the project, the value of such input can be the marginal economic costs excluding any indirect taxes or estimate of willingness to pay by trader for retaining such input supplies.

Sample Sector-wise economic valuation of EIRR

1. Transportation

The transport section encompasses various projects like road, rail, ports, and airports which give direct benefits to the public users with faster access to markets, reduced travel time & cost and safety. New Transport projects may usher in benefits to the current traffic which includes decongestion effect i.e. using current route as an alternative was not available as compared to diversion to new transport project from current traffic. The economic pricing can be assessed in terms of the cost savings. Incremental economic benefits on account of access to new transport project can be assessed in terms of willingness to pay.

Some of the benefits of transportation sector include:

Vehicle operating costs (VOC) savings: It is the difference in the operating costs of various types of vehicles like motorbikes, cars, trucks, and buses which is affected by the characteristics of the road (E.g.- width, roughness etc.) and characteristics of the vehicle (E.g. – weight, speed, age) and costs involved (E.g - capital cost of vehicle, maintenance costs and fuel). For traffic that is diverted from alternate current routes to new project, the VOC savings can be the difference of the VOC of the new project and VOC of the current route. In case of rail project, this can be assessed in terms of shift in users of the existing road vehicles to rail based transport. In case of port project, the savings in per unit cost of cargo and passengers handled can be valued.

Time cost savings: It is the reduction in the time consumed for travel. This could be expressed in terms of reduction in the total distance led time savings or reduced congestion led time savings or faster speed led time savings. The savings in time can be of benefit to both the passengers of the vehicles as well as the transport cargo. The pricing of the time savings benefits needs careful consideration of the leisure time, work time and can be expressed as the rate of hourly wage. For the transport cargo, reduced time can lead to faster delivery of the goods. This benefit can be assessed as a working capital savings due to earlier delivery of goods and the opportunity cost of the capital. In case of perishables, the time savings can be additional benefit in terms of spoilage cost being prevented. In case of airport project, this can be substantial with reduced loan on the alternate mode of road or rail transport.

Accident cost savings: It is the cost of prevented medical expenditure, and prevented damage to the vehicles and properties. It also includes the averted loss of income on account of injuries and prevented deaths. The accident cost savings can be assessed based on accident data that indicates the medical expenditure, cost of replacing the asset, and loss of income per accident. Also needed would be the estimated statistical value of life. In case of rail project, this can be assessed on the basis of the transfer of passengers from the existing road transport to rail project.

Environmental savings: It is the impact that the road project would have on the environment. An internal combustion engine (ICE) vehicle can emit various greenhouse gases (GHG) including carbon dioxide (CO_2), carbon monoxide (CO), nitrogen oxides (NOx), oxides of sulphur (SO_2) etc. The assessment of environmental savings can be valued for reduced pollution of air in terms of the benefits of prevented health expenditure and avoided productive time

loss. In case of a rail project, the benefit of environmental savings can be the elimination of the air pollution especially in case of electricity run rail.

2. Power

The power sector projects are components of a larger grid or network. A new power generation project adds capacity to the existing capability to supply, improves efficiency leading to reduced generation costs, and also increase the dependability of the electric network. The power transmission project provides link for a generation capacity to the distribution system and the larger grid or network.

Some of the benefits of power sector include:

Efficiency cost: It is the impact that the power project would have on the efficiency levels compared to a plant that is being displaced. It can also be the effect of better efficiency as compared to rehabilitating an old power plant. This can be assessed in terms of the reduced costs on fuel, machinery, and labour from the rehabilitation.

Environmental savings: It is the impact that the power project would have on the environment due to renewable power plant. An fossil fuel power plant can emit various greenhouse gases (GHG) including carbon dioxide (CO_2), carbon monoxide (CO), Particulate matter (PM) etc. The assessment of environmental savings due to renewable power can be valued by the eliminated pollution of air in terms of the benefits of health expenditure.

Reliability savings: It is the impact that the power project would have on the service reliability by reducing the outage costs associated with the interruptions of supply (blackouts), voltage reductions (brownouts) or frequency / voltage fluctuations. The willingness to pay for such improved supply can be assessed directly. The avoided outage costs could be assessed as resource cost savings like backup generators cost or preventing loss of income.

3. Water

The water sector projects may offer improved provision of service to existing households or industries or provide new service to households or industries not currently served and are relying on unsatisfactory service provision from water vendors, wells etc.

Some of the benefits of water sector include:

Resource savings: It is the impact that the water project would have on the service related cost of resource relating to existing supplies. These could be assessed as resource cost savings in terms of the charges of the existing water vendors, time consumed on collecting water and fuel consumed for boiling of water. The savings in time can be assessed as the cost of daily unskilled labour wage rate. The benefits of the output can be assessed based on the willingness to pay for clean water service.

Leakage savings: It is the impact that the water project would have on the service related technical losses due to leakages. Such savings in leakages can be assessed as the price of the units of water that can be saved based on the willingness to pay for such an improved supply.

Health savings: It is the impact that the water project would have on the health of the consumers due to safe and clean supplies. These could be assessed as health savings in terms of the avoided health expenditure and gains in the income level due to avoided leave due to illness. The savings in leave time can be assessed as the cost of daily unskilled labour wage rate.

Thus, for a social investor and stake holder, the need of the hour is the economic internal rate of return which measures the economic advantage expected from the investment proposal and address Environmental, Social, and Governance (ESG) goals.

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