



HIGH LEVEL ANALYSIS

Capital budgeting is a decision-making process where an organisation assesses if a project is expected to be profitable and is worth to be funded. Many techniques are frequently used in Capital Budgeting, including IRR, MIRR, PPM, NPV, AARR, PI and EAC; this paper is dedicated to briefly get through those techniques while highlighting the pros and cons of each method.

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1. Introduction

Capital Budgeting, also known as investment appraisal, is the process followed by an organisation to determine whether a specific project is worth pursuing or not. Several methods are frequently used in capital budgeting, including:

- Internal Rate of Return (IRR)
- Modified Internal Rate of Return (MIRR)
- Payback Period Method (PPM)
- Average Annual Rate of Return (AARR)
- Net Present Value (NPV)
- Profitability Index (PI)
- Equivalent Annual Cost (EAC)

This paper is dedicated to briefly introduce those techniques while highlighting the key strengths and weaknesses of each method.

On purpose, we only approach techniques that can be computed right-away from the set of cash-flows of a project, any methods like Real Options Valuations (*i.e.* ROA) requiring in-depth knowledge of the business, or advanced assumptions about the cash-flows or the incomes generated by a project are excluded.

2. Metrics at a Glance

Internal Rate of Return (IRR)	
<p><i>The IRR, or Internal Rate of Return, is the discount rate that makes the Net Present Value of all Cash-Flows (“CFs”) equal to zero.</i></p> $\sum_{t=0}^n \frac{CF_t}{(1 + IRR)^t} = 0$	
Advantages	Pitfalls
<p>⇒ Easy to understand, quick to compute. ⇒ IRR doesn’t require any WACC (Weighted Average Cost of Capital) assumptions, <i>i.e.</i> you don’t need</p>	<p>⇒ IRR doesn’t consider the size of cash-flows. Large projects with high positive CFs can have a lower IRR than projects with lower CFs. IRR must then</p>



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<p>to know the minimum rates of return investors are ready to accept.</p> <ul style="list-style-type: none"> ⇒ IRR considers the time-value of money, but it assigns an equal weight to each cash-flow and assumes future CFs are reinvested at the IRR. ⇒ IRR considers the full set of cash-flows. ⇒ IRR's core objective is maximising investors' wealth. 	<p>be used to assess mutually exclusive projects as it ignores the size of those projects.</p> <ul style="list-style-type: none"> ⇒ IRR doesn't consider reinvestment rates. ⇒ IRR can be ineffective when the project combines a set of positive and negative CFs. If a project faces negative CFs across time because of a revised strategy or a change in market conditions, this can lead to have several IRR for the same project.
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Modified Internal Rate of Return (MIRR)

The MIRR, or Modified Internal Rate of Return, is a modified version of the IRR; it assumes positive cash-flows are reinvested at the firm's cost of capital, and that the initial outlays are financed at the firm's financing cost.

$$\sqrt[n]{\frac{FV(\text{Positive CFs at WACC Rate})}{-PV(\text{Negative CFs at Financing Rate})}} - 1$$

Advantages	Pitfalls
<ul style="list-style-type: none"> ⇒ MIRR considers the time-value of money, but it assigns an equal weight to each cash-flow. ⇒ MIRR considers the full set of cash-flows. ⇒ MIRR copes with one of the major limits of the IRR technique, it considers the Risk of the project via the WACC and funding costs. 	<ul style="list-style-type: none"> ⇒ MIRR doesn't consider the size of cash-flows. Large projects with high positive CFs can have a lower IRR than projects with lower CFs. MIRR must then be used to assess mutually exclusive projects as it ignores the size of those projects. ⇒ It requires to know the WACC and financing rates of the company, metrics which are not necessarily easy to compute.

Payback Period Method (PPM)

The PPM, or Payback Period Method, measures the period of time required by an investment to reach its breakeven point.

$$\frac{\text{Initial Investment}}{\text{Net Cash Flow per Period}}$$

Advantages	Pitfalls
<ul style="list-style-type: none"> ⇒ Easy to understand and quick to compute. ⇒ For distressed companies, it enables to identify projects that will return money very quickly. ⇒ Considers the uncertainty of CFs as it emphasises 	<ul style="list-style-type: none"> ⇒ Doesn't consider the time value of money. ⇒ Doesn't measure the return of capital invested, it's then not an appropriate method to measure the profitability of a project.



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<p>early returns and neglects distant ones.</p>	<p>⇒ It doesn't consider CFs occurring after the breakeven point. A project can wait several years before reaching the breakeven point, and then having very positive CFs in the long-term; PPM ignores this.</p> <p>⇒ PPM requires to have a target period, if PPM is less than the target period, the project can be accepted.</p>
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Average Annual Rate of Return (AARR)

The AARR, or Average Annual Rate of Return, is defined as the annual return over the year of the project.

$$\sqrt[n]{\frac{\text{Terminal Value Project}}{\text{Initial Value Project}}} - 1$$

Advantages	Pitfalls
<p>⇒ Easy to understand and quick to compute.</p> <p>⇒ Considers the full set of cash-flows and takes into consideration the total earnings of the project through its entire life cycle.</p> <p>⇒ For long-term projects, with irregular cash-flows, the metric eliminates outlying statistics in sets of data. It gives a smooth and intuitive measure.</p>	<p>⇒ Assumes intermediary cash-flows are reinvested at the AARR rate.</p> <p>⇒ Since this is an annualised metric, the project doesn't allow to compare projects with different time-periods.</p> <p>⇒ This is an average metric, and it doesn't consider the specific pattern of CFs.</p>

Net Present Value (NPV)

The NPV, or Net Present Value, is defined as the value of all the future cash-flows over the entire life of an investment discounted to the present. Cash-Flows are discounted at the Weighted Average Cost of Capital (WACC).

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

Advantages	Pitfalls
<p>⇒ NPV considers the time value of money and considers the full set of cash-flows across the life of the deal.</p> <p>⇒ NPV considers the minimum rate of return or cost of capital of the company, it is then a robust way to assess the profitability of a project.</p> <p>⇒ While an IRR gives a percentage that can be</p>	<p>⇒ Intermediate CFs are reinvested at the WACC rate.</p> <p>⇒ It requires to know the WACC of the company, metric which is not necessarily easy to compute (it requires to assume a perfect capital market).</p> <p>⇒ As for IRR, NPV makes the comparison between projects of different size quite difficult. It must</p>



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<p>difficult to interpret, NPV gives a dollar value, easily understandable. ⇒ Considers the Risk of the project <i>via</i> the WACC.</p>	<p>then be used to assess mutually exclusive projects.</p>
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Profitability Index (PI)

The PI, or Profitability Index, is the ratio of payoff to investment of a proposed project; it determines the amount of value created per unit of investment.

$$\frac{PV \text{ of Future Cash Flows}}{\text{Initial Value of Project}}$$

Advantages	Pitfalls
<p>⇒ PI considers the time value of money and considers the full set of cash-flows across the life of the deal. ⇒ It is easy to interpret as it is a simple multiple. ⇒ Considers the Risk of the project <i>via</i> the WACC.</p>	<p>⇒ Intermediate CFs are reinvested at the WACC rate. ⇒ As for NPV, it requires to know the WACC to discount future CFs. ⇒ As for IRR, PI makes the comparison between projects of different size quite difficult. It must then be used to assess mutually exclusive projects.</p>

Equivalent Annual Cost (EAC)

The EAC, or Equivalent Annual Cost, is the annual cost of owning, operating, and maintaining an asset over its entire life.

$$\frac{NPV}{A_{t,WACC}} \text{ where } A_{t,WACC} = \frac{1 - \frac{1}{(1 + WACC)^t}}{WACC}$$

Advantages	Pitfalls
<p>⇒ EAC considers the time value of money and considers the full set of cash-flows across the life of the deal. ⇒ EAC considers the minimum rate of return or cost of capital of the company, it is then a robust way to assess the profitability of a project. ⇒ It considers the Risk of the project <i>via</i> the WACC.</p>	<p>⇒ Intermediate CFs are reinvested at the WACC rate. ⇒ As for NPV, it requires to know the WACC to discount future CFs. ⇒ As for IRR, EAC makes the comparison between projects of different size quite difficult. It must then be used to assess mutually exclusive projects.</p>