

Investment Basics XLVIII. Common challenges in capital budgeting

We explore four areas of common difficulty in applying the discounted cash flow rules to the valuation of a project: the relevant cash flows, problems with the IRR decision rule, dealing with inflation and choosing a discount rate.

1. RELEVANT CASH FLOWS

Accepting a new project has the effect of changing the future cash flows of the firm. To evaluate the project, we must consider whether these changes in cash flows add value to the firm. The first step is to identify the cash flows that are relevant to the decision.¹

Relevant cash flows are those that result in changes in or increments to the firm's existing cash flow and are called the **incremental cash flows** associated with the project. Since taxes are a cash outflow, we are interested in after-tax incremental cash flows.

This definition of incremental cash flows has an obvious and important corollary: any cash flow that exists regardless of whether or *not* a project is undertaken is *not* relevant. We now describe some of the common pitfalls when resolving whether a cash flow is incremental or not.

1.1 Sunk costs

A sunk cost, by definition, is a cost already incurred. It cannot therefore be changed by the decision to accept or reject a project, so it is clearly not relevant to the decision at hand and is excluded from the analysis. An example would be the cost of market research to determine whether a new style widget would be favoured by consumers. The researcher must be paid, whether or not the project goes ahead.

1.2 Allocated costs

Similarly, allocated costs (for example head office overheads) should be excluded from the analysis, unless new overheads are necessary as a result of taking the project. Simply reassigning part of the existing overhead to the new project does not add cash costs to the firm.

1.3 Opportunity costs

We normally think of costs as requiring us to actually spend some cash, but an opportunity cost is slightly different; it requires us to give up a benefit.

If the project requires the use of an empty factory owned by the firm, undertaking the project will not result in any direct cash outflow associated with buying a factory. But it cannot be treated as 'free', since it is a valuable resource which could be sold. Using it for widget manufacture thus has an opportunity cost. However it is not the original cost of the factory (that is a sunk cost!), but rather its market value today that should appear as an opportunity cost in the analysis.

1.4 Side effects

Since the incremental cash flows for a project include all the changes in the *firm's* future cash flows, we need to consider the possible erosion of sales of original style widgets that would occur as a result of the introduction of the new model. In this case, the cash flows from the new widget sales should be adjusted downward to reflect lost cash flows on other lines.

1.5 Net working capital

Normally, a project will require that the firm invest in net working capital in addition to long-term assets. For example, a project will generally need an initial investment in inventories and accounts receivable. Some of this financing will be in the form of amounts owed to suppliers, but the firm will have to supply the balance – a cash outflow.

As a project winds down, inventories are sold, receivables are collected and bills are paid. These activities free up the net working capital originally invested. The firm's investment in project net working capital closely resembles a loan. The firm supplies working capital at the beginning and recovers it towards the end. It is important to include the recovery of the working capital as a cash inflow at the end of the project.

1.6 Financing costs

The cash flows generated by the proposed project are used to pay all suppliers of capital. These cash flows are discounted at a weighted average of the cost of debt and of equity.² This is the minimum rate of return required to satisfy all investors in the firm, lenders as well as

*Graduate School of Business, University of Cape Town, Private Bag, Rondebosch 7701, Republic of South Africa.
Email: cfirer@gsb.uct.ac.za and gilberte@gsb.uct.ac.za

¹Since financial value comes from cash flows, it is important to measure the impact of a decision on the firm's cash flows, rather than on the accounting numbers. The latter are dependent on financial accounting rules, and have a degree of subjectivity embodied in them.

²Provided the project is as risky as the firm as a whole. We discuss this later.

shareholders.³

Since discounting reduces the value of future cash flows to take into account the firm's costs of capital, if interest charges are included as a cost in the calculation of cash flows, the cost of debt would effectively have been double counted. Similarly, dividends are ignored (they form part of the return to shareholders). We therefore ignore any financing costs when establishing a project's cash flows.

2. PROBLEMS WITH IRR

The internal rate of return, universally known as the IRR, is closely related to NPV. Both are derived using the same equation:

$$NPV = -C_0 + \sum_{t=1}^n \frac{C_t}{(1+k)^t} \quad \dots (1)$$

where n is the life of the project

Using the cost of capital as the discount rate k, an NPV of zero signifies that the cash flows from the project are just sufficient to repay the invested capital as well as provide the required rate of return on that capital. Thus positive NPVs signal value creation.

The IRR is a single rate of return that summarizes the merits of a project. It is 'internal' since it only depends on the cash flows of a particular project, not on rates offered elsewhere. To estimate it, we set the NPV equal to zero in equation (1) and solve for the discount rate. Value creation is signalled by an IRR that exceeds the appropriate cost of capital.

The NPV and IRR rules may give conflicting decisions about the viability of a project in two situations: when mutually exclusive projects are being considered, and when the project under consideration has a "non-standard" pattern of cash flows.

2.1 Mutually exclusive projects

Consider the two mutually exclusive projects, A and B, whose NPV profiles are shown in Figure 1:

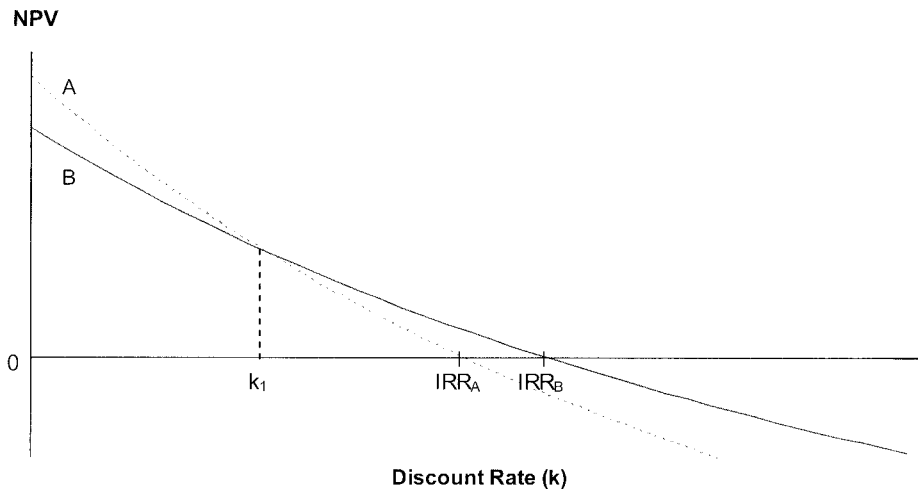


Figure 1: NPV profiles of mutually exclusive projects

³It is often argued that if a project requires an increase in the company's debt, the cash flows associated with this debt should be included in the project's evaluation. This is incorrect as the assets of the firm are regarded as being financed by a pool of funds. Sources of funds are not normally linked to specific assets, although often only one source of funds is tapped when a new project is undertaken. The firm achieves its target capital structure over time by selecting differing sources of funds depending on market conditions and the existing capital structure.

The firm can only take one of the projects, so the order of ranking is crucial. The IRR method will always give consistent ranking to such projects (with B being preferred to A in the above example), since each graph cuts the horizontal axis at one point.

With the NPV method, the ranking depends on the discount rate chosen. As can be seen, for discount rates less than k_1 , project A will be selected, but for $k > k_1$ project B has the higher NPV. A conflict between the NPV and IRR rules thus arises if the firm's cost of capital is less than the discount rate at which the intersection of the NPV profiles occurs. Differences in the ranking of mutually exclusive projects may arise for two reasons:

(i) Differences in the scale of the investments

Consider the following mutually exclusive projects A & B, for which the NPV and IRR rules give different rankings.

Project	Year 0	Year 1	NPV	IRR
A	-1 000	+2 000	818	100,0%
B	-10 000	+15 000	3 636	50,0%
B-A	-9 000	+13 000	2 818	44,4 %

NPV discount rate: 10%

The IRR rule suggests selecting project A. However, the NPV method gives priority to B for all discount rates below 15,6%, the point of intersection of the NPV profiles.

Consider the incremental cash flows (B-A) which result from choosing project B in place of project A. The IRR on this additional investment is 44,4% which exceeds the hurdle rate of 10%, so the NPV is positive. Therefore (B-A) represents a profitable investment therefore both A and (B-A), i.e. B, should be undertaken.

The IRR rule is unreliable in ranking projects of different scale; for example a 500% return on a R1 investment is compared to a 20% return on a R1 000 investment. The

NPV rule measures the contribution to value, and this can be relied upon.

(ii) The differences in the timing of the cash flows

Contradictory rankings may also occur if two projects being compared have significant differences in the timing of their cash flows. The IRR rule favours projects which have high cash inflows early on in their lives. Such cash flows increase the IRR because the method implicitly assumes that the intermediate cash inflows will be re-invested for the remainder of the project at the (relatively high) IRR rate. The NPV method, on the other hand, imposes a smaller penalty for later cash inflows because of its assumption of reinvestment at the (lower) discount rate.

2.2 Multiple rates of return

Conventional cash flows are those in which the sign of the cash flows only changes once during the project. Typically cash is invested at the start of the project, and this is followed by a stream of positive cash flows. Non-conventional patterns occur in, for example, a strip mining operation where ecological considerations require a capital outlay at the end of the life of the project. For non-conventional cash flow patterns, problems can arise in the solution of the IRR equation. Consider the following pattern of cash flows:

Year 0	Year 1	Year 2
- 1600	+10 000	-10 000

Solving the IRR equation for this series of cash flows gives two IRR's, 25% and 400%. The NPV curve is only positive between these two values. If the cost of capital lies between 25% and 400%, then one could argue for acceptance of the project since it would add value to the firm. If not, then it is far from clear what decision should be taken. This is illustrated in Figure 2.

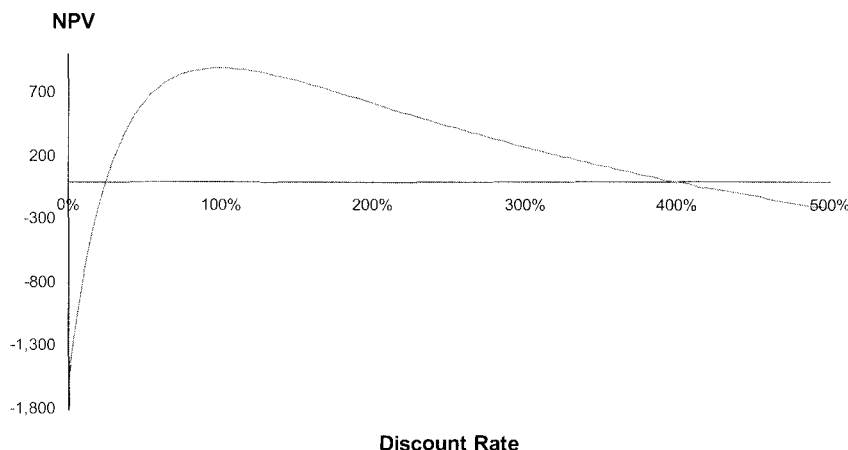


Figure 2: Multiple rates of return

3. CHOICE OF DISCOUNT RATE

The general principle guiding the choice of the discount rate is that it represents the expected rate of return required by the providers of the capital used to fund the project. Thus it should be a weighted average of all the firm's sources of capital, and it should reflect the specific risks of the project's expected cash flows. The firm's weighted average cost of capital (WACC) can be used as a starting point for identifying a project discount rate.

The cost of debt of a firm can be easily established by observing the current yield to maturity (YTM) of its debt instruments if they are publically traded. Alternatively this rate can be established from the firm's bank.

The rate of return required by equity holders is made up of a risk-free rate and a project related risk premium. The risk-free rate captures the time value of money. In practice, this rate is normally taken from the bond market where the YTM rate of a government bond with a similar life to that of the project is recommended as a proxy. The risk premium represents the additional return over and above the risk-free rate of return that (risk-averse) equity holders would expect to earn to compensate them for the risk associated with the project's cash flows. If the Beta of the project's cash flows is known, the CAPM model can be used to estimate the project's risk premium.

It is important that the risk premium used should reflect the risk associated with the project, not the firm itself. If a firm's WACC is used as a project discount rate it implies that the project has the same risk profile of the firm itself – something that is often not the case in practice. Most firms use their WACC as a centre point when deciding on their project discount rate. If the project is seen to be riskier than the firm's operation on average then a premium is added to the WACC and *vice versa*.⁴

The use of risk specific discount rates also applies to individual (or series) of cash flows within the project that have different risk profiles. For example, if the costs of a project are known with certainty (both the quantum and timing) then a risk premium should not be added when discounting these cash flows. The same project will usually, however, also have more risky cash flow streams (e.g. sales revenue). These should have a risk premium attached to their discount rate. This can lead to situations where multiple discount rates are used.

Adjusting the discount rate to reflect the project specific risks is the most common approach to dealing with risk in a capital budgeting framework.⁵

⁴The size of this premium is usually subjective as the unique nature of projects usually do not allow for the use of market based estimations such as the CAPM. In practice firms tend to adjust their WACC by discrete amounts based on experience and the project's perceived risk class.

⁵Alternative ways of dealing with risk in this context include the use of Certainty Equivalents and Monte Carlo analysis.

4. DEALING WITH INFLATION

Inflation affects the value of a capital investment project by changing the nominal values of the cash flows over the life of the project. There are two key principles when dealing with inflation in capital budgeting. Firstly, inflation must be treated consistently when calculating both the cash flows and the discount rate. Secondly, the choice of doing the calculation on either a real or nominal basis depends on the sources of inflation facing the cash flows of the project.

It is very important that inflation is treated consistently across the entire valuation exercise. For example, if nominal cash flows are used (i.e. adjusted to include inflation), then the discount rate must also include inflation, i.e. it must be a nominal rate. However, if all the project's cash flows are expressed in terms of today's prices, a real discount rate should be used.⁶

Generally, it is better to inflate the project's cash flows and use a nominal discount rate, but this requires an assumption to be made regarding future inflation rates. Note that the tax shield associated with the firm's wear and tear allowance is calculated on the historic cost of the asset and is thus not inflated.

Both the risk-free rate observed in the bond market and the cost of debt represent nominal rates, i.e. rates that include the effects of expected inflation over the life of the bond. The gauge of expected inflation included in these measures is the Consumer Price Index (CPI). If, however, some of the sources of inflation facing the project's cash flows are not CPI related (for example, a key input is imported and its price (in rand) depends on international inflation and the rand depreciation), then a real approach may be preferable. When using a real approach, it is necessary to deflate the wear and tear related tax shield.

Depending on whether the project cash flows are nominal or real, the discount rate must either remain as observed (nominal) or be reduced by the rate of expected inflation⁷ using the following approach suggested by the economist Irving Fisher:

$$(1 + \text{Real Discount Rate}) = \frac{(1 + \text{Nominal Discount Rate})}{(1 + \text{Expected Inflation Rate})}$$

⁶The most common mistake in dealing with inflation is to discount real cash flows at a nominal discount rate. This leads to an undervaluation of the project.

⁷The Expected Inflation Rate used in this calculation should be the average rate of CPI inflation expected to occur over the life of the project.

5. CONCLUSION

In conclusion we suggest that although the theory of discounted cash flows as applied to project analysis appears rather straightforward, its application raises a number of difficult issues. We identify some ways to deal with these challenges in this article.