PROFIT
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Internal rate of return

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1. Introduction

When you make a capital investment, whether in equipment for your existing business or by investing in another business, you do so because you expect to generate income in the future. If this were not the case, you would not make the investment. If capital investments are relatively small, it is unlikely that you will need special techniques to appraise them.

An investment appraisal compares cash outflows now with the likely cash inflows at some time in the future. Since the 'worth' of money changes over time, this presents a challenge if the capital asset – or the investee business – has an expected life of many years. Effective techniques can be used to assess investments from the small – such as deciding whether it is cheaper to lease equipment than to buy it – to the large – such as deciding whether to build a new factory or invest in a business in a new market.

The simplest, and least useful method, is to compare total revenue with total expenditure. However, this ignores the cost of the money and ignores any time factor. Other methods include looking at the pay-back and discounted cashflows. The pay-back method looks at how long it takes for the business to recover its initial investment. How long will it take before the savings repay the initial investment? The most commonly used techniques, however, use discounted cashflow – either to calculate net present value or to calculate the internal rate of return.

2. Appraisal techniques

2.1 Return on capital employed

Some businesses look at the return on capital employed over the likely life of the asset or for a specific period.

In the example below the total outlay is $44,000. This is exactly paid back in three years so the average annual profit is $14,667. This represents an average return of 33 per cent. If the cost of borrowing the money, or the opportunity cost is less than 33 per cent then this is a project worth pursuing.

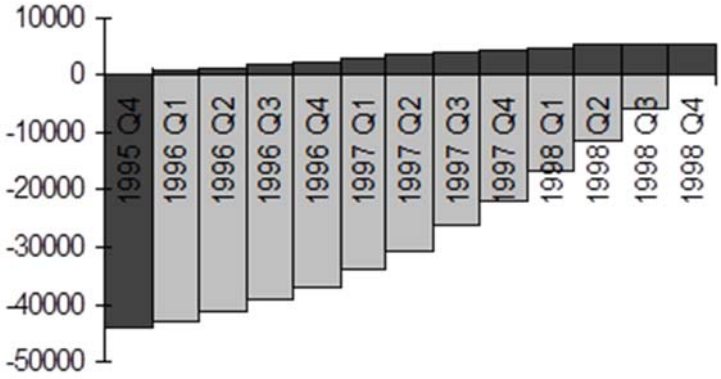
[1] This factsheet is based on material originally published by David Irwin in his book on Financial Control for Non-financial Managers.

Box 1: Katie's Kitchens: payback

EXAMPLE

Katie is considering spending $44,000 on new automated bench forming equipment. She has looked carefully at the total costs involved and estimated the additional income that she is likely to generate as a direct result. She has then calculated the net profit for each quarter for the next three years. She plots the cashflows on a bar chart, as shown in the dark shading in the figure.

Figure 1: Payback



She has also plotted the cumulative position (in light shading) which shows that the machine will have paid for itself in three years.

2.2 Discounting

Neither payback, nor appraisal looking at return on capital employed, allows for the cost of the money or the fact that a pound in your hand now is worth more than a pound in, say, one year's time. In larger business, the most common techniques use discounted cashflow – either to calculate net present value or to calculate the internal rate of return. $100 in your hand now is not the same as $100 receivable in, say, one year because money you have now could be earning interest. If the current rate of interest is 10 per cent, then the money you hold now will be worth $110 in one year. If this were reinvested, it would be worth $121 after a further year. This is known as compounding and can be formalised thus:

$100 now will be worth:
$100 x (1 + r) in one year
$100 x $(1 + r)^2$ in two years
$100 x $(1 + r)^n$ in n years (where r is the interest rate expressed as a decimal)

So what is $100 receivable in n years worth now? It is the reverse of the above example. At an interest rate of 10 per cent:

$100 receivable in one year is worth 100/(1.1) = $91 now
$100 receivable in two years is worth $100/(1.1)^2$ = $83 now

This procedure is the opposite of compounding and is called discounting. In other words, if you were given $83 now and invested it for two years at 10 per cent, it would by then be

worth $100. Generally, we can say that $100 receivable in n years is worth $100/(1+r)^n$ (where r is the current rate of interest expressed as a decimal).

2.3 Discounted cash flow

A discounted cash flow (DCF) shows future cash flows, usually over several years, adjusted by a suitable rate, to take account of the cash flow timing.

One method of comparing different options is to calculate the net present value (NPV) of each. An investment with a net present value which is positive is worth pursuing; if a choice has to be made, the investment with the highest NPV is the most profitable. The alternative is to calculate the internal rate of return (IRR). This is the estimated annual percentage profitability on the initial investment, once again allowing for the fact that future receipts are worth less than receipts today.

The IRR can be compared to the cost of the capital required or, in larger businesses, to a predefined threshold. If it is higher than the cost of capital or the threshold, the investment is worth pursuing; the investment with the highest IRR is the most profitable. Remember however that uncertainty also needs to be considered. The riskier a project, the higher IRR you will be seeking to compensate for the risk, but your assumptions may be less certain. You might, therefore, choose a lower level of risk and accept a lower IRR.

2.4 Net present value

The first step in calculating net present value is to estimate the cashflows, both positive and negative, for the expected life of the project (or, more often, the asset). The net cashflow is usually shown as the net profit, ignoring interest and tax. The capital expenditure is usually shown in period 0. These then need to be discounted to present values at a predetermined rate of interest. This is often taken as the cost of capital to your business, particularly appropriate if you will need to borrow the money from the bank. If you already have the money available, then use the opportunity cost, that is, the rate of return you could achieve with the money on deposit.

Box 2: Katie's Kitchens: net present value

EXAMPLE

Katie has reconsidered the cost and returns on capital for the automated bench forming equipment. She believes she can buy it at a cost of $40,000. She has estimated the net cashflows as shown below and used an interest rate of 10 per cent to calculate the discount factor, since she has the money in the bank and believes that 10 per cent is the best return she could get. Determining the cash flow may be difficult if overheads have to spread over more than one machine. However, that is clearly essential if you are going to achieve an accurate answer.

Year	Cashflow	Discount factor	Present value
0	(40,000)	1.000	(40,000)
1	3,000	.909	2,727
2	11,000	.826	9,091
3	14,000	.751	10,518
4	16,000	.683	10,928
5	18,000	.621	11,177
NPV			4,441

The cashflows are multiplied by the discount factor to give the present values. These are totalled to give the net present value. In this case, the NPV is $4,441; this is positive so the return is greater than 10 per cent. In other words, the project is worth pursuing.

Suppose Katie has to borrow the money and has been offered a loan at an interest rate of 15 per cent. She now does the calculation again using different discount factors.

Year	Cashflow	Discount factor	Present value
0	(40,000)	1.000	(40,000)
1	3,000	.870	2,609
2	11,000	.756	8,318
3	14,000	.658	9,205
4	16,000	.572	9,148
5	18,000	.497	8,949
NPV			(1,771)

This time the NPV is negative. The project returns less than it costs to borrow the money so it is not worth doing purely in financial terms.

This technique can be used to compare the returns on different projects or on different ways of implementing the same project. Is it, for example, cheaper to borrow the money to buy outright or to lease the equipment?

Do not confuse the investment decision with the decision of whether to buy or lease. The decision whether to proceed with a project needs to be made first. Once you are certain that you wish to proceed, then you are ready to decide whether to buy or lease.

Box 3: Buy or lease

EXAMPLE

You are wondering whether to buy or lease a new car. If you lease, you will have to make an immediate payment of $4,800 with two further payments in the following two years. Here, the discount factors assume an opportunity cost of 14 per cent. This gives an NPV of $12,720. If you can buy the car for less money than this, buy it; otherwise, lease it (assuming the car becomes yours at the end of the three-year period. Otherwise include any additional purchase payments.) Remember that if you have to borrow the money, you must make the calculations with the interest rate which you will have to pay. The discount factor will reflect the interest rate rather than opportunity cost.

Year	Cashflow	Discount factor	Present value
0	4,800	1.000	4,800
1	4,800	0.877	4,224
2	4,800	0.769	3,696
NPV			12,720

All these NPV calculations have assumed that interest rates stay constant for the period of the lease. A combination of inflation and a reducing interest rate may tip the scales in favour of leasing. Furthermore, so far we have ignored the effects of tax and inflation on the DCF calculation. Unless you are good at seeing into the future, both are difficult to account for, but you may wish to adjust the cashflow figures in order to make some allowance for them. Inflation, particularly if it is high, will affect the real rate of return.

Imagine that your business has made a return of 15 per cent on capital and that the rate of inflation is 5 per cent - what is the real rate of return?

$$\text{Real rate of return} = \frac{1+\text{nominal rate of return}}{1+\text{rate of inflation}} - 1$$

Write the rates as decimals rather than as percentages: in our example, therefore, the real rate of return=1.15/1.05 -1=0.095 or nearly 10 per cent, as you might guess intuitively. Whilst inflation is relatively low you do not need to worry about it too much. But if it starts to climb again, it will affect the rate of return which you will be seeking on your investment.

2.5 Internal rate of return

The internal rate of return is the yield or return on your investment and is equivalent to the discount rate required to give a net present value equal to zero. This can be calculated by calculating NPVs at different discount rates until an NPV of zero is achieved. Or just look for the IRR function within excel, though you need to take care that you are using the correct figures since it can give misleading results.

Box 4: Katie's Kitchens: internal rate of return

EXAMPLE

Choosing a rate of 13.46 per cent for Katie's Kitchens gives an NPV equal to zero:

Year	Cashflow	Discount factor	Present value
0	(40,000)	1.000	(40,000)
1	3,000	.881	2,644
2	11,000	.777	8,545
3	14,000	.685	9,585
4	16,000	.603	9,654
5	18,000	.532	9,573
NPV			0

If this yield is greater than the cost of borrowing the money, or greater than your predetermined yield, then undertake the project. Calculating the IRR is normally used by larger companies, who need to know the precise yield, and who have a minimum threshold below which they will not accept projects. If you ever decide to seek equity from a venture capital fund, they will use IRR calculations to help decide whether to invest. They normally have a pre-determined threshold which may be 35 per cent or higher.

In an effort to keep the examples relatively simple, the impact of tax and the possible availability of grants has been ignored. These do however need to be included if you are assessing a proposal against a target return. If you are assessing competing investments, ensure both are treated in the same way.

3. Conclusion

Calculating IRR is very easy and will quickly tell you whether an investment is worth pursuing. It can be used for small investments as easily as for large investments. If you feel that you need help with your own calculations, feel free to ask your mentor.

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