Discount cash flow

Introduction

When you make a capital investment, you do so because you expect to generate income in the future. If this were not the case, you would not make the investment. 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 has an expected life of many years.

The most commonly used appraisal techniques, therefore, use *discounted cash flow* – either to calculate *net present value* or to calculate the *internal rate of return*.

Discounting

If you expect to receive cash, or to spend cash, in the future, you may want to allow for the fact that money in your hand is worth more now than in, say, one year's time. For small sums, this doesn't make a significant difference, but for large sums it can be important.

£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 current rate of interest 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)

A discounted cash flow (DCF) shows future cash flows, usually over several years, adjusted by a suitable rate, to take account of the timing of the cash flow. These adjusted net cash flows are added together to give the net present value.

Calculating net present value

The first step in calculating net present value is to estimate the cash flows, both positive and negative, for the expected life of the project (or, more often in business, the asset or, for regulation, the costs and benefits to the private sector and society over say 10 years). The first step is to calculate the likely inflows and outflows. 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, i.e. the rate of return you could achieve with the money on deposit. Sometimes, the cost of capital is taken to be zero, but the inflation rate is used as the discount factor.

If you have a computer or calculator, the discount factors can easily be calculated using the formula shown above, otherwise tables of discount factors are available to save you having to do the calculations.

Example: Catherine's Consulting

Catherine runs a consulting business and is considering investing in sophisticated computing equipment and software. She has researched the cost and prepared cash flow forecasts. The hardware and software will cost $40,000. She has estimated the net cash flows (that is, receipts less payments) 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 achieve if the money was invested elsewhere.

Year	Cash flow	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 Catherine 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	Cash flow	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 in financial terms, at least, it is not worth doing.

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?

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. In this example, 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.

Year	Cash flow	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

Tax & inflation

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 cash flow 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.

Internal rate of return

An alternative to net present value, and one that is widely used by investors, is internal rate of return (IRR). This is the estimated annual percentage profitability on the initial investment, again allowing for the fact that future receipts are worth less than receipts today. The IRR is the rate that would need to be applied to give a net present value of zero. The IRR can be compared to the cost of the capital required or, in larger businesses, often to a predefined threshold. If it is higher than the cost of capital or the threshold, the investment is worth pursuing.

To calculate the internal rate of return, you will need to calculate a number of NPVs at different discount rates until an NPV of zero is achieved. This can be done quite easily on computerised spreadsheet by choosing low and high interest rates. Indeed, most spreadsheets will do the IRR calculation for you. The discount rate when the NPV is equal to zero is the yield or return on investment for the project.

ⓘ **Example: Catherine's Consulting**

Choosing a rate of 13.46% for Catherine's Consulting gives an NPV equal to zero:

Year	Cash flow	Discount factor	Present value
0	(40,000)	1.000	(40,000)
1	3,000	.88	2,644
2	11,000	.78	8,545
3	14,000	.68	9,585
4	16,000	.60	9,654
5	18,000	.53	9,573
NPV			0

If this yield is greater than the cost of borrowing the money, or greater than the 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. It is also used by equity investors before deciding whether to invest in a particular opportunity.