Discounted cash flow and net present value

The most valuable tool that analysts, companies and investors have in determining the fundamental value of a project or a company is to discount future cash flows and determine the NPV. This is the time value of money. Consider the example of a special interest-bearing account where, if you deposit $1000 in that account, you will be paid $315.47 at the end of each of the next four years. At the end of that period there will be no further payments owed to you. The cash-flow stream to you is shown in table 11.2.

Table 11.2: cash-flow stream example

Now	Year 1	Year 2	Year 3	Year 4
–$1000	$315.47	$315.47	$315.47	$315.47

For your $1000 investment (negative flow) you will receive a total of $1261.88 (positive flow), which is the sum of the four $315.47 payments. Clearly, interest has been paid on your deposit (investment). From trial and error, and a pocket calculator, you could determine that the interest paid to you is 10 per cent. In more detail the ledger for the account could be as shown in table 11.3 (overleaf).

Table 11.3: cash flow stream example

	Now	Year 1	Year 2	Year 3	Year 4
Deposit	$1000				
Interest		$100.00	$78.45	$54.75	$28.68
Payment		$315.47	$315.47	$315.47	$315.47
Balance	$1000	$784.53	$547.51	$286.79	$0.00

Table 11.3 shows that $1000 is deposited; a payment of $315.47 is paid each year; and at the end of the period there are no funds left. The amount paid in excess of the $1000 is the interest that accumulates each year on the remaining balance. The account has provided a 10 per cent internal rate of return (IRR) on your investment. This is quite different from providing a compounding 10 per cent rate of return, where the $1000 and accumulated interest is left in the account for the four years, and the whole amount is withdrawn at the end. The withdrawal at the end in this case would be $1464.10.

The higher figure is due to the accumulation of interest on the interest, which does not occur in the example in tables 11.2 (on p. 269) and 11.3. The example shown in tables 11.2 and 11.3 is not all that different from the case of a mining project. For a mining project there is an initial capital expenditure to develop the project and net cash flows each year from the sale of a commodity. It is therefore possible to determine the IRR provided by the project by solving the following equation:

$$\text{IRR} = i \text{ when } \Sigma^{0 \text{ to } n}\, CF_n \div (1 + i)^n = 0$$

In our example, using the above equation and 10 per cent (or 0.1) for i we get the following:

$$-\$1000 \div (1 + 1.1)^0 + \$315.47 \div (1.1)^1 + \$315.47 \div (1.1)^2$$

$$+ \$315.47 \div (1.1)^3 + \$315.47 \div (1.1)^4$$

which equals:

$$-\$1000 + \$286.79 + \$260.72 + \$237.02 + \$215.47$$

which equals zero.

Therefore, as we already know, the IRR is 10 per cent. There is no direct method of solving for i, only trial and error in selecting different interest rates for it, and calculating the resulting value (which is the NPV we discuss in the following section), until the NPV equals zero.

What if a company or an investor considered an 8 per cent return to be adequate? We know the previous example generates a return of 10 per cent, therefore it would meet the required hurdle. But if we don't know what return the example generated, then the previous equation could be used to calculate the NPV at an 8 per cent discount rate.

$$-\$1000 \div (1 + 0.08)^0 + \$315.47 \div (1.08)^1 + \$315.47 \div (1.08)^2$$

$$+ \$315.47 \div (1.08)^3 + \$315.47 \div (1.08)^4$$

which equals:

$$-\$1000 + \$292.10 + \$270.46 + \$250.43 + \$231.88$$

which in turn equals an NPV of \$44.87.

The above procedure for determining the NPV at 8 per cent of \$44.87 can be expressed mathematically as:

$$NPV = \Sigma^{0 \text{ to } n}\ CF_n \div (1 + i)^n$$

Trial and error is obviously not required, as long as we know the appropriate discount rate to apply (see chapter 17). The NPV is a positive dollar value, as we know the cash flow is capable of providing 10 per cent and therefore the positive value is indicating that the internal rate of return is greater than 8 per cent. If the same exercise is carried out at 12 per cent, the NPV is:

$$-\$1000 \div (1 + 0.12)^0 + \$315.47 \div (1.12)^1 + \$315.47 \div (1.12)^2$$

$$+ \$315.47 \div (1.12)^3 + \$315.47 \div (1.12)^4$$

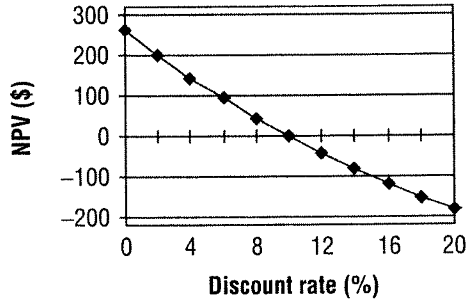
which equals:

$$-\$1000 + \$281.67 + \$251.49 + \$224.55 + \$200.49$$

which in turn equals –\$41.80.

The negative NPV of \$41.80 tells us that the cash-flow stream is providing a return of less than 12 per cent. In figure 11.1 (overleaf) the NPV is plotted at different discount rates. Note how the curve cuts the x axis at 10 per cent where the NPV is zero, and hence 10 per cent is by definition the IRR.

Figure 11.1: NPV at different discount rates



If, for a project, the future cash flow can be estimated and an appropriate discount rate is applied, then the NPV of the project can be determined. It is important that the future cash flow is discretionary, whereby all the cash flow can be distributed to the owner or shareholders. An investor or company should be willing to pay up to the NPV to gain access to that cash flow over time. For example, if a project's NPV is zero dollars then investors should be indifferent to another similar class (risk) investment as they both provide the same return; however, if our investment has a positive NPV and is therefore providing a higher return, then investors should be willing to pay a premium to participate in that opportunity. *Therefore the NPV, shown in figure 11.1, is the value we can use for resource projects and prospects.* (For further information on continuous discounting and annuities, see appendix G.)

Real option analysis might also be applied that incorporates NPV analysis. The topic is more fully explained in chapter 15.

Salvage and terminal value

The cash flows for a majority of resource projects can be modelled over the life of the project. At the end of the project life, the economic ore reserves will have been exploited; however, working plant and equipment will probably still belong to the project. The salvage value of the remaining equipment at the end of the mine life may be significant, but generally, given the secondhand value of mining and processing equipment and the large future cash flow discount factor, more often than not it is likely to be insignificant. It should also be remembered that there may be an additional cost of environmental remedial work at the end of the project's life that may mitigate the salvage value.