FINANCE

DCF AND INTEREST RATES

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The focus of the next few finance articles in Management Quarterly *will be shareholder value and company valuations. As a grounding for those future articles, this issue recaps the basics of discounted cash flow, which should be familiar to most accountants. The article explains the principles of the time value of money, the difference between net present value and internal rate of return, and how a project/company is evaluated using the techniques. The 'further reading' section gives some pointers to more advanced techniques.*

Introduction

The use of Discounted Cash Flow (DCF) techniques to assist in investment decision making has been commonplace for many years now. This article will briefly review the basic DCF techniques, and discuss some of the issues arising from their use.

What to include

Before applying DCF techniques, it is necessary to decide which figures are actually relevant to the decision to be taken. There are four fundamental rules to follow.

1. First, we are only interested in *future* cash flows. Those which have happened already, such as the costs of a marketing study (already undertaken) that has helped us to estimate better our likely future cash flows, are sunk costs that cannot be 'undone' and are therefore not relevant to our decision, even if allocated to the project P&L.
2. Only incremental cash flows should be included – ie those that would not have happened anyway. Thus, when head office decrees that, if the project goes ahead, it will be allocated a certain level of overheads in the firm's internal accounting, these should only come into the calculations to the extent that there will be a genuine increase in overheads. A simple reallocation of existing overheads is irrelevant.
3. Look specifically at cash flows – for example, the amount and timing of the actual payment for a piece of machinery, rather than the annual depreciation charge. One needs to be careful here of being too pedantic about the definition of 'cash flows' because, for example, cost *savings* arising from the project are very relevant to our calculations, despite not involving a *literal* cash inflow.
4. Finally, the impact of the project on the whole enterprise should be taken into account. If the project will cannibalise sales from elsewhere in the organisation, the lost cash flows should be included as outflows in the project calculations. Equally, if the project is expected to have a positive knock-on effect on other parts of the business, that should be included as an inflow.

The basic technique

Imagine that you owe me £100, but you come to me today and offer me two choices: either to pay me the £100 now, or £125 in two years' time. The going interest rate, known in this context as the discount rate, is 10%. If I take the £100 now and invest it at the discount rate, it will be worth £100 x 1.10 = £110 in one year's time, and £110 x 1.10 = £121 in two years' time, with interest compounding. £121 is the *terminal* value of £100 in two years' time at 10%. I can therefore see that the offer of £125 in two years

is preferable. However, I am more interested in what £125 in two years is worth in today's terms, because in practice I will be considering cash flows at many different dates in the future, and it is much easier to bring them all back to today's value than carry them all forward to some future date.

To achieve this, I have to rearrange the equations. What I have done so far is –

$$100 \times 1.10 \times 1.10 = 121$$

ie

$$100 \times (1.10)^2 = 121$$

or

$$121 \times \frac{1}{1.10^2} = 100$$

We know that £121 in two years' time is the equivalent to £100 today. Substituting £125 into the equation instead of £121:

$$125 \times \frac{1}{1.10^2} = 103.31$$

Ie £125 in two in two years' time is the equivalent of £103.31 today – the *present value* is £103.31. Thus, I am comparing £100 today with the equivalent of £103.31 today, and the latter is clearly preferable.

The factor $1/(1.10)^2$ can be re-written in general terms

$$1/(1+r)^n$$

where r is the discount rate in decimal terms, and n is the number of years into the future that the cash flow is predicted to occur. Tables are published of the appropriate *discount factors*, as the product of $1/(1+r)^n$ is described, (for example, see Brealey and Myers (1996) in the suggested reading), and most spreadsheet programs include a discounting function. All future cash flows are thus subjected to the appropriate discount factor to bring them back to what they are 'worth' today.

A brief example follows:

Having followed the four basic rules of which figures are relevant to the calculation, you have predicted the net cash flows from a project as:

End of year	0	1	2	3	4
Net Cash flows	-400	+100	+200	+200	+80

(Year 0 represents 'now' – the start of the project.)

The appropriate discount factor is now applied to each cash flow, and the various present values summed to give the Net Present Value.

End of Year	0	1	2	3	4
Net Cash flows	-400	100	200	200	80
Discount factor @ 10%	1	0.909	0.826	0.751	0.683
Present Value	-400	90.9	165.2	150.2	54.64
Net Present Value	**60.94**				

In the example, there is a positive net present value (NPV). The implication of this is that, if the discount rate is correct and the anticipated cash flows indeed materialise, then the shareholders will be better off if the company carries out the project than if it doesn't. We will return to these 'ifs' in a moment.

Meanwhile, there is a further extension to DCF techniques. If you substitute different discount rates into the example above, you will eventually find one that yields a zero NPV – this rate is called the Internal Rate of Return (IRR) of the project, and signifies the discount rate at which the company would be indifferent as to whether or not it carries out the project – it will neither gain nor lose by so doing. Again, most spreadsheet programs will perform this calculation.

In the example, since 10% yields a positive NPV, we can deduce that the IRR must be *higher* than 10%, as higher discount rates reduce the present value of future cash inflows. The IRR in this case is 16.9%.

Many companies use the IRR because it is straightforward to understand – if the IRR exceeds the company's appropriate discount rate, then the project should add to shareholder value. However, the Net Present Value is technically a superior measurement. This is for two main reasons. First, when comparing NPVs of several different potential projects, that with the highest NPV, all other things being equal (and with no capital constraints), will unequivocally be the best, irrespective of the initial levels of outlay. With IRR, this is not the case. Which would you rather have – a project returning 20% on an investment of £1m, or a return of 25% on an investment of £100? Also, IRR does not cope very well with projects which have negative cashflows subsequent to the initial outflows on the project. Such projects often have more than one IRR, due to the implicit assumption in the calculations that surplus funds are reinvested at the same rate as the *project's* IRR.

To return to the 'ifs' above. Two major questions have always arisen with DCF techniques: how to allow for risk – the degree of likelihood that the cash flows will *not* turn out to be as predicted – and what discount rate to use.

One way to deal with risk is by running the figures with best, worst and intermediate scenarios, as described in *Management Quarterly 1*, and seeing what that does to the NPVs. But what about the discount rate? This will be dealt with in depth in later articles, but briefly, the rate generally used is based on the company's Weighted Average Cost of Capital (WACC), which is derived by taking the company's cost of equity and post-tax cost of debt, and weighting them according to the proportion the company has of each.

As an example:

Prop'n of Equity		Cost of Equity*	Prop'n of debt	Cost of debt
60%	x	14%	40%	7%
=			=	
8.4%			**2.8%**	
WACC = 8.4 + 2.8 = 11.2%				

*Cost of equity will be the covered in *Management Quarterly 4.*

Note that the WACC takes account of the financing cost of the project and the tax deductibility of debt interest. No financing costs should appear in the project cash flows. This is because the cash flow forecast is used to derive the amount of funds available to satisfy all sources of finance, both debt and equity. Therefore, any funds used to pay interest, dividends or repayments are *applications* of those funds, and do not belong in the calculation.

(It should be noted that there are alternative methods of discounting. For example, if cash flows are discounted at the cost of equity rather than the WACC, this indicates that the user is concerned with

the cash flows available to satisfy *equity providers only* – and so the debt interest and repayments would be seen as outflows in this instance.)

In arriving at a discount rate, the WACC may be adjusted up or down to take account of the project risk, which may be higher or lower than that associated with the company as a whole.

Interest rates

The cost of debt relates to the interest rate paid by the company, less tax. There are three main determinants of the interest rate that a firm will face on its debt:

- Liquidity preference.
- Inflation.
- Risk.

First, there is what Keynes described as '*liquidity preference*' – the compensation that lenders demand for foregoing the use of their own money for a period of time. Historically, this figure has been around 3% pa. Of course, receiving an annual interest level of 3% would be of zero benefit if *inflation* had simultaneously reduced the value of the capital by 3% pa, and hence the lender demands compensation for anticipated inflation during the period of the loan. Furthermore, investors will wish to be compensated for the perceived *risk* that they will not receive their interest, or their capital, or be repaid principal. This is the third constituent part of the interest rate: compensation for perceived risk.

Thus, the yield to redemption of Government stock reflects liquidity preference and inflation expectations at the present time. Most – probably all – company borrowing will be perceived by the lenders as riskier than lending to the Government, so this element of the total interest charge can be quite substantial.

A company facing an interest rate on its debt of, say, 10%, might effectively be paying 3% for liquidity preference, 3% to allow for anticipated inflation, and 4% risk premium. (Note that in adding the percentages together we are being a little lax with the maths – technically, the interest rate combining the factors above would be 1.03 x 1.03 x 1.04 = 1.1033, or 10.33%.)

Recent developments

Increased sophistication and computer power in recent years has added a further dimension to DCF techniques. Instead of simply summing the cash flows for the project and applying the WACC (perhaps risk-adjusted) to those flows, there is no reason why each *line* of the cash flows should not be subjected to a different discount rate according to our perception of its risk, or indeed to use a different discount rate for each *column* if we predict future changes in the discount rate. Moreover, some companies are now using the concept of Adjusted Present Value (APV) as described in the Harvard Business Review articles in the suggested reading below. This is arguing that financing structures these days are so complex that it is better, first, to value a project (using NPV techniques as described above) assuming only equity financing – ie discounting at the cost of equity rather than WACC – then to calculate the effects of debt and the tax-deductibility of debt interest, as a separate item. The results are then added together to give the APV of the project.

The important fact about the ideas in the above paragraph is that they rely on value additivity – the NPV or APV are the *sums* of the discounted cash flows. In essence, the techniques unbundle the cash flows so that different approaches can be taken to each category, then add up the results. Managers can then

see the effects of each individual component on the final outcome, and thus make more informed and better decisions – which is, of course, the point of the exercise.

Further reading

- ***Principles of Corporate Finance***

  Brealey, R A and Myers, S C (5th edn, 1996) International Edition, McGraw Hill

  This very readable textbook discusses many of the issues raised in this article. Includes discount tables in the Appendix.

- ***Investment Appraisal and Financing Decisions***

  Lumby, S (1991) Chapman & Hall

  Not for the faint-hearted, but if you really want to investigate this subject in depth, this is the book!

- **'What's it Worth? A General Manager's Guide to Valuation'**

  Luehrman, T A *Harvard Business Review* (May-June 1997)

  A very accessible introduction to the concepts of APV and other approaches to project evaluation.

- **'Using APV: a Better Tool for Valuing Operations'**

  Luehrman, T A *Harvard Business Review* (May-June 1997)

  This gives the nuts and bolts of APV technique, including a comprehensive worked example.

OUTLINE SYLLABUS

Management Quarterly is designed to be an three-year endeavour, setting out key management techniques in core disciplines. Over that time, it is expected that the content may develop and change. However, here we set out the current anticipated syllabus for the journal.

Strategy

What is strategy? ✔ *Part 1, October 1998*
What does corporate HQ do? ✔ *Part 2, January 1999*
Strategic alliances ✔ *Part 3, April 1999*
Competitive strategy
Strategic analysis tools – the external environment
Strategic analysis – assessing internal resources
Linking external and internal analysis
Strategic choice: stakeholders
Strategic decision making
Strategic change
International strategy
The future of strategy

Human resources

Introduction to people management ✔ *Part 1, October 1998*
Changing roles and responsibilities ✔ *Part 2, January 1999*
Strategic HRM and the management of change ✔ *Part 3, April 1999*
Resourcing the organisation
Motivating and monitoring
Developing the organisation
Personal development and people management competencies
Managing conflict and difference
The role of trade unions and collective representation
Impact of the European Union
International HRM
Ethics and corporate governance