

A holistic view on investment appraisal

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Discounted Cash Flow

The two traditional investment appraisal techniques are

1. 'payback period'
2. return on capital employed

These two methods may still be preferred by some appraisers. However they have various disadvantages that outweigh the advantages. For example the payback period uses speed of return rather than the rate of return as its criterion of project desirability. The ROCE is equally unsuitable because it ignores the time value of money and there is no clear definition of the components such as capital employed.

An alternative to the mentioned traditional techniques mentioned is the Discounted Cash Flow (DCF) technique. This includes the

1. NPV (net present value) and
2. IRR (internal rate of return)

Put simply, the NPV works on the simple but fundamental principle that an investment is worthwhile if the money derived from the investment exceeds the money put in. The decision rule is to accept all investments with a positive or zero net value, and to reject all those that produce negative net values. In as much as the money in different currencies have to be converted to a common currency to be compared, cash flows, even if in the same currency, occur at different points in time and must first be converted to a common point in time. This is because of the 'time value of money'.

'Time value of money' refers to different value of a given sum of money depending upon when it occurs in time. The idea is not directly concerned with inflation or deflation but with the fact that money can be invested elsewhere so as to earn interest.

Time value is taken into account through what is termed as the discounting process. In simple terms, the conversion to present value, of a cash flow received say, in a year's time, if invested at rate $r\%$ p.a. would be calculated arithmetically by the formula

$$\frac{C_t}{(1+r)^n}$$

where C_t is the cash flow received in time t ,

r is the rate of return per annum and

n is the number of years from the present to the point in time t .

This formula is used to discount the cash outflows and inflows to the present to calculate the NPV. The NPV of an investment can be therefore expressed as

$$\sum_{t=0}^n \frac{C_t}{(1+r)^t}$$

The components of this notation may need further clarification. The focus is on **cash flows** C_t over the life of the investment. Cash flows should be distinguished from accounting earnings. In the case of evaluation of an investment, the cash outflows to acquire the investment are quite straightforward to determine. The cash inflows and out flows pertinent to the project represent the incremental revenues and costs adjusted for working capital changes (debtors plus stocks less creditors) so as to convert the revenue and costs into cash inflows and outflows. The project should be evaluated on after-tax cash flows. Therefore, any incremental tax less any tax shields on capital allowances incident to the project should come into the calculation.

The remaining component in the formula expressed above to calculate the NPV of the investment is the **discount rate** r .

The discount rate used in DCF analysis represents the minimum return investors will require. If they do not get this minimum return, they may be better off investing elsewhere. This so called 'opportunity cost' of finance is better known as the 'Cost of Capital'. Cost of capital has three elements namely

1. risk-free rate of return
2. premium for business risk (existence of uncertainty about the future business prospects of the firm)
3. premium for financial risk (danger of high gearing)

This opportunity cost of capital is used to value new assets that have the same risks as the old ones. However, r cannot be looked up anywhere and therefore, financial managers turn the problem around by starting with the estimates of the expected return on Equity and on Debt.

Inflation

As explained above, one dilemma that is faced when carrying out project appraisals is the issue of the inflation rate. There are two alternatives for tackling this issue in the NPV exercise. One method is to project the cash flows in 'real terms', that is taking into account the inflation in Germany. The other method is to ignore inflation from the cash flows. Whichever method adopted calls for a different discount rate. The relationship between nominal rates, real rates and inflation is given by the equation

$$1 + r_{no\ min\ al} = (1 + r_{real})(1 + inf\ rate)$$

If we project cash flows in 'real terms', that is taking into account the effect of inflation, the discount rate r should also be 'real'.

Weighted Average Cost of Capital

Because different companies are in different types of business and have different capital structures, the cost of capital applied to one company may differ radically from the cost of capital of another company.

A technique referred to as the weighted average cost of capital (WACC) has been developed to compute the discount rate for DCF investment appraisals. The assumption behind this technique is that in many cases it will be difficult to associate a particular project with a particular form of finance and therefore a company's funds may be viewed as a pool of resources. Put simply the WACC is calculated by the formula

$$WACC = K_e \left(\frac{E}{E + D} \right) + K_d \left(\frac{D}{E + D} \right)$$

where

K_e is the cost of equity

K_d is the cost debt capital

E is the equity value at market prices

D is the market value of debt in the firm

Estimating K_d , the **cost of debt capital** or fixed interest (or dividend) capital is much more straight forward than estimating the cost of ordinary share capital because the interest received by the holder of a security is fixed by contract and will not fluctuate. The cost of debt capital already issued is the rate of interest which equates the market price with the discounted future cash receipts from the security. This cost of debt normally takes into account the tax relief due on interest payments, thus resulting in an 'after-tax- cost of debt.

$$K_d = \frac{I}{P_o} (1 - t)$$

where

I is the annual interest payment

P_0 is the current market price of debt capital ex-interest

t is the rate of corporation tax

Estimating the **cost of equity capital** K_e , vaults us into a more complex discussion about portfolio theory which originated from the works of Markowitz. Portfolio theory applies to both stock market investors and to companies with capital projects to invest in.

When an investor has a portfolio of investments he will expect the portfolio to provide him with a certain **return** on his investment. The **risk** of an investment is the probability that the return will not be the same as expected. A prudent investor will want to avoid too much risk and will hope that the actual returns are much the same as what he expected them to be. The risk of a security can be measured as the **standard deviation** of the expected returns and is defined by the following notation:

$$\sigma = \sqrt{\sum p(x - \bar{x})^2}$$

where

σ is the standard deviation or risk

p is the probability that the return will not be as expected

x is the expected return

\bar{x} is the sum of xp divided by the number of observations

Capital Asset Pricing Model

Any investment involves some risk and the actual return on the investment, whether in shares or in a new project, might be better or worse than that hoped for. Unless the investor settles for risk-free securities such as gilts, risk is unavoidable.

$$\text{Total risk} = \text{Systematic risk} + \text{Unsystematic risk}$$

Unsystematic risk refers to risk that can be diversified away such as risks of specific sectors, companies or projects.

Systematic risk or market risk is the inherent risk of the whole market such as macroeconomic factors. This type of risk must be accepted by any investor unless she invests entirely in risk-free investments.

The CAPM (capital asset pricing model) seeks to explain

1. how systematic risk is measured
2. how systematic risk affects the required returns and share prices

Systematic risk is measured by **beta factors**.

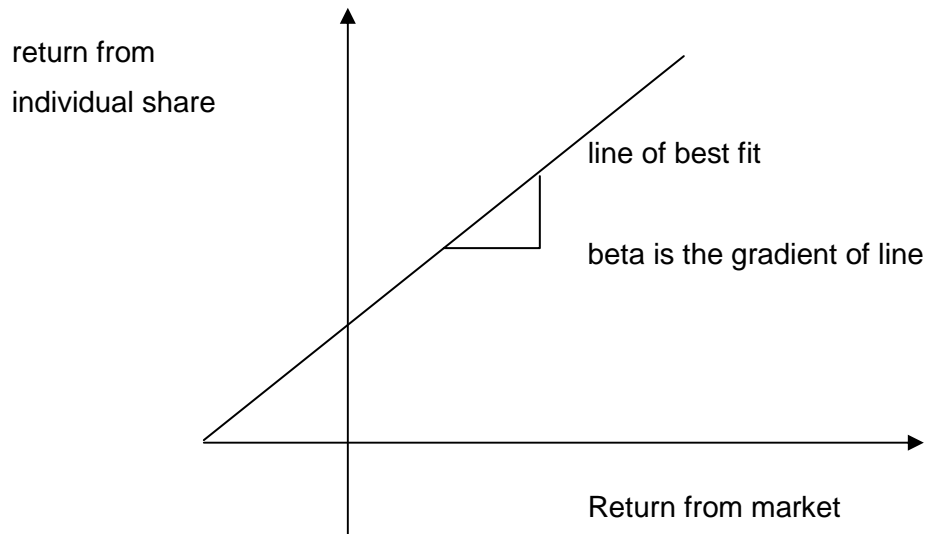
CAPM includes the following propositions:

1. investors require a return in excess of the risk-free rate to compensate for systematic risk
2. investors should not require a premium for unsystematic risk since this can be diversified away by holding a wide portfolio of investments
3. the greater the systematic risk, the greater the expected return

The CAPM was first formulated for investments in stocks and shares on the market. It is based on a comparison of the systematic risk of shares in a particular company and the risks of all shares in the whole market.

Systematic risk, or market risk is the average risk of the market as a whole. The return that investors will expect on one individual security will be higher or lower than the market return depending on whether the security's systematic risk is greater or less than the market average. A major assumption in CAPM is that there exists a linear relationship between the return from an individual security and the average return from all the securities on the market.

A series of comparative figures could be prepared (month by month) of the return from a company's shares and the average return of the market as a whole. The results could be plotted on a scattergraph and line of best fit drawn using regression analysis techniques.



Since the actual returns are effected by the unsystematic risk as well, the scattergraph may not give a good line of best fit unless a large number of data items are plotted.

A share's beta factor is the measure of its volatility in terms of market risk. The beta factor of the market as a whole is taken to be 1.0

This said, if for example the average market return rises by 2%, and the beta of the share of an individual company is 0.8, then the return from the share should increase by 1.6%. If the actual return rose by say 2.5%, the difference between the 2.5% and the 1.6% would be attributable to unsystematic risk unique to the company or its industry.

The CAPM formula is

$$Er_j = r_f + (Er_m - r_f)\beta_j$$

where

Er_j is the expected return from an individual security

r_f is the risk-free rate of return (eg British Government Stocks)

Er_m is the expected return of the market as a whole (even though in practice the historical returns are used not the expected)

β_j is the beta factor of the individual security

As shown in the scattergraph, beta is the gradient of the line of best fit and is given by the formula:

$$\beta = \frac{n \sum xy - \sum x \sum y}{n \sum x^2 - (\sum x)^2}$$

where

n is the number of pairs of data for x and y

x is the return on the market

y is the return on the security

Another method of calculating beta using statistical tools is

$$\beta = \frac{\sigma_s \rho_{sm}}{\sigma_m}$$

where

σ_s is the standard deviation of the returns on the individual security

σ_m is the standard deviation of the returns on the market as a whole

ρ_{sm} is the correlation coefficient between the returns on equity for the stock market and the return on equity of the individual company. This coefficient is a unit free measure of the strength and the direction of a linear relationship between two variables. There is no inference of the causality in the statistic in that there is no suggestion whatsoever that a change in one would lead to a change in the other. The coefficient of correlation is calculated by the formula

$$\rho_{sm} = \frac{\sigma_{sm}}{\sigma_s \sigma_m}$$

where

$$\sigma_{sm} = \frac{\sum (s - \bar{s})(m - \bar{m})}{n - 1}$$

$$\sigma_s = \sqrt{\frac{\sum (s - \bar{s})^2}{n - 1}}$$

$$\sigma_m = \sqrt{\frac{\sum (m - \bar{m})^2}{n - 1}}$$

and

\bar{s} is the mean of the returns on the share of the company

\bar{m} is the mean of the returns on the market

n is the number of pairs

Apart from the β , statisticians also calculate the 'standard error' of the estimated beta to show the extent of possible mis-measurement. The lower the standard error, the more confident one can be of the beta being the true β . If the standard error is (0.20) for example, then the confidence interval for the β is $1 \pm (1.96 \times 0.20) = 0.60 < \beta < 1.4$ and the chance of this being right is 95%. The standard error is calculated by the formula

$$SE = \sqrt{\frac{s^2}{n}}$$

where

$$s = \sqrt{\frac{\sum (x - \bar{x})^2}{n - 1}}$$
 is the sample standard deviation

Complications may arise with this procedure when evaluating investments in different countries. We have seen above that in order to establish the

cost of capital, β is measured with reference to σ_m and σ_s , but both relative to the home market index.

It is important that the risk of bad outcome be distinguished from the risk of uncertainty. Discount rates should not be 'fudged' with bad outcomes but rather the cash flows should reflect them. There is no satisfactory theory that describes how risks are generated and to what extent investors would regard a project as more or less risky. Research suggests that there is a variety of factors that affect asset beta β . Good managers examine any project from a variety of angles and look for clues as to its riskiness. For example cyclical ventures and projects with high fixed costs are characteristics of high market risk.

A problem of using CAPM to determine an NPV discount rate is that CAPM is a single-period return model while the NPV discount rate should be a multi-time period of return. Therefore although multi-time period CAPM do exist, there are considerable difficulties involved with them. Therefore it is normally assumed that the r_f and Er_m will remain constant over the life of the project.

The **gearing** (leverage) of a company will affect the risk of its equity. This implies that the beta of a geared company will be greater than the beta of a similar but ungeared company. The CAPM is consistent with the propositions of Modigliani & Miller (M&M) who argue that as gearing rises, the cost of equity rises to compensate shareholders for the extra financial risk of investing in a geared company. This connection between M&M and CAPM makes it possible to establish a mathematical relationship between the beta value of an ungeared company and that of a geared company.

$$\beta_a = \beta_e \frac{E}{E + D(1-t)} + \beta_d \frac{D(1-t)}{E + D(1-t)}$$

where

β_a is the beta of the assets of the company

β_e is the beta of the equity of the geared company

β_d is the beta of the debt capital of the geared company

E is the market value of the equity capital of the geared company

D is the market value of the debt of the geared company

T is the rate of corporation tax

One can note that the gearing does not affect the β of the assets of the company but just the β of equity. Shareholders demand a higher return because of the financial risk imposed by the additional debt. That told, note that if the firm is venturing into a new project that is reckoned to bear the same risk as its assets, the fact that the firm will be financing the project by issuing new debt will not affect the β of the asset, but just the β of the equity.

All said, beta factors that are greater than 1.0 would imply greater than average returns when market returns are greater than the risk-free rate of return. It would also imply heavy losses if the market return falls. In practice betas are obtainable from a variety of investment analysts or from the London Business School's Risk Management Service.

The above brings us back to the cost of capital required as a discount rate in DCF techniques.

1. the cost of equity is calculated by the formula

$$K_e = r_f + (E r_m - r_f) \beta_j$$

2. WACC is applied to give weightings to the cost of equity and the cost of debt (after tax relief) in order to establish the cost of capital.

$$WACC = K_e \left(\frac{E}{E + D} \right) + K_d (1 - T_c) \left(\frac{D}{E + D} \right)$$

The WACC gives the right discount rate or 'hurdle rate' only for projects that are just like the firm undertaking them. It is incorrect for projects that

are safer or riskier than the average of the firm's existing assets. It is also incorrect for projects that will lead to a change in the firm's debt ratio. WACC can also be used to value a target company just like Sonnenberg and Suhl, so as to help in the decision whether to go ahead with the merger. It is important to note however that discounting cash flows using the WACC:

1. do not deduct interest
2. calculate taxes as if the company is all equity financed
3. interest tax shields are picked up in the WACC formula
4. cash flows will probably not be forecasted to infinity and one must be careful with the terminal value in the horizon year H, calculated

as follows
$$\frac{1}{(1+r)^H} \left(\frac{\text{Investment_at_H}}{r - \text{growth_rate}} \right)$$

5. M&M Proposition II says that the expected return on the common stock of a geared firm increases in proportion to the debt-equity ratio expressed in market values.

If gearing is changing, then the steps to follow are:

1. calculate the WACC before the change in the gearing using the above formula for WACC ie

$$WACC = r = K_e \left(\frac{E}{E + D} \right) + K_d \left(\frac{D}{E + D} \right)$$

2. estimate the cost of debt K_d at the new debt ratio and use it to calculate the new cost of equity using MM proposition II namely

$$K_e = r + (r - K_d) \frac{D}{E}$$

and substituting the r (or WACC) established in step 1, into this equation

3. recalculate the new WACC using the K_d and K_e found in the previous step, and using the new gearing ratios

Taxation

Taxation has an important role to play in investment appraisal as it can have a substantial effect on the desirability or otherwise of the investment opportunity. The basic underlying assumption in the theory of financial decision making is 'maximising shareholder wealth'. It therefore follows that in the appraisal of an investment project, what is of importance is the cash flows that will be generated by the project and that are available for shareholders. Therefore as far as investment appraisal is concerned, we need to evaluate the after-tax cash flows. There are three ways in which tax impacts upon project appraisal.

1. tax relief on writing down allowances
2. tax on taxable profit
3. tax relief on interest payments in the case the project is financed by debt capital

Therefore with these in view, we need to evaluate the project using after-tax cash flows and after-tax discount rates. This is either done through using the WACC as explained above, ignoring interest payments and calculating taxes as if the project is all-equity financed, or else using the cost of equity and including in the cash flows all the above three items.

Adjusted present value

When a company is assessing whether the project should be equity financed or debt financed, it is important to bear in mind that the value of the project can be shown as

value of project = value if all equity financed + PV(tax shield) – PV (costs of financial distress)

This model is also known as the APV (adjusted present value)

The 'trade-off' theory suggests that the firm should increase debt until the value from PV (tax shield) is just offset by the PV (costs of distress). The value of the tax shield is somewhat controversial. Had we only corporate

taxes to worry about, then the net tax saving would be the Corporate Tax times the interest payments. The tax shield is normally valued by discounting at the borrowing rate. The effect of simplifying this simple algebraic equation results in $PV(\text{tax shield}) = \text{Corporate tax times the debt}$ (assuming it is fixed and permanent). Understandably, borrowing may not make sense to companies that have an exhaustion in taxable profits as the tax shields will not be able to be utilized.

A competing theory to the 'trade-off' theory is the 'pecking order theory' already mentioned above.