SIXTH EDITION

CORPORATE FINANCIAL MANAGEMENT

GLEN ARNOLD
DEBORAH LEWIS

Pearson

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so, if inflation is 1%, the expected return on Rose will be 10%; if it is 2%, Rose is expected to return 15%.

(Strictly speaking, many factor models focus on only the unexpected part of the change in F_1, F_2 etc. because returns on share j over a period are not going to respond to expected changes in F_1 or F_2 because in an efficient market the share would already have moved to the new level at the start of the period in anticipation.)

Of course, the CAPM is a type of one-factor model where F_1 is defined as the equity risk premium and b equates to CAPM-beta (representing sensitivity to the determining factor):

$$r_j = a + b\,F_1 + e$$

In the CAPM: $a = r_f$, $b = \beta$, $F_1 = (r_m - r_f)$. Thus:

$$r_j = r_f + \beta(r_m - r_f) + e$$

However, the useful characteristic of this factor model is that it permits F_1 to be any one of a number of explanatory influences, and does not restrict the researcher or practitioner to the market index premium.

An investment in Rose is an investment in a single company's shares; therefore both systematic and unsystematic risk will be present – or in the language of factor models, *factor risk* and *non-factor risk*. By diversifying, an investor can eliminate non-factor risk. Most factor model analysis takes place under the assumption that all non-factor (unsystematic) risk can be ignored because the investors are fully diversified and therefore this type of risk will not be rewarded with a higher return.

A two-factor model

The returns on Rose may be influenced by more than simply the general inflation rate. Perhaps the price of oil products has an effect. A two-factor model can be represented by the following equation:

$$r_j = a + b_1\,F_1 + b_2\,F_2 + e$$

where: F_1 = inflation rate
b_1 = sensitivity of j to inflation rate growth
F_2 = price of oil
b_2 = sensitivity of j to price of oil

To establish the slope values of b_1 and b_2 as well as a, a multiple regression analysis could be carried out. The relationship of the returns on Rose and the influencing factors can no longer be represented by a two-dimensional graph. The level of return in any one period is determined by the following formula, which has been constructed on the assumption that for every (unexpected) \$1 on the price of oil return increases by 0.3 of a percentage point and every (unexpected) 1% increase in inflation generates an extra 5% of return . . .

$$r_j = a + b_1\,F_1 + b_2\,F_2$$
$$r_j = 3 + 5\,F_1 + 0.3\,F_2$$

Of course, for a particular share in addition to this systematic risk-related return there is likely to be an unsystematic (specific to the firm) element of return in any period. This is the element e in the equation, which can often be much greater than the systematic elements in explaining a return for, say, a period of a year.

Multi-factor models

No doubt the reader can think of many other systematic risk factors that might influence the returns on a share, ranging from GDP growth to the exchange rate. These relationships have to be presented in a purely mathematical fashion. So, for a five-factor model the equation could look like this:

$$r_j = a + b_1\,F_1 + b_2\,F_2 + b_3\,F_3 + b_4\,F_4 + b_5\,F_5 + e$$

where F_3 might be, say, the industrial group that firm j belongs to, F_4 is the growth in national GDP and F_5 is the size of the firm. This particular share will have a set of sensitivities (b_1, b_2, b_3, b_4 and b_5) to its influencing factors which is likely to be different from the sensitivity of other shares, even those within the same line of business.

The arbitrage pricing theory

As the CAPM has come under attack the arbitrage pricing theory (APT) has attracted more attention (at least in the academic world) since it was developed by Stephen Ross in 1976. In similar fashion to the CAPM it assumes that investors are fully diversified and therefore factor risks (systematic risks) are the only influence on long-term returns. However, the systematic factors permissible under the APT are many and various, compared with the CAPM's single determining variable. The returns on a share under the APT are found through the following formula:

$$\text{Expected returns} = \text{risk-free return} + \beta_1(r_1 - r_f) + \beta_2(r_2 - r_f) + \beta_3(r_3 - r_f) + \beta_4(r_4 - r_f) \ldots + \beta_n(r_n - r_f) + e$$

where β_1 stands for the security's beta with respect to the first factor, β_2 stands for the security's beta with respect to the second factor, and so on. The terms in brackets are the risk premiums for each of the factors in the model – $(r_1 - r_f)$ is the risk premium for the first factor for a security whose beta with respect to the first factor is 1 and whose beta with respect to all other factors is zero. Notice that the $(r_1 - r_f)$ etc. are the extra percentage annual returns on a share for bearing this type of risk. This is different from F_1, F_2, etc. above, which relate to, say, the unexpected change in the price of oil which may be expressed in dollars per barrel, or GDP growth, as they change year on year.

Arbitrage pricing theory does not specify what will be systematic risk factors, nor does it state the size or the sign (positive or negative) of the 'βs'. Each share or portfolio will have a different degree of sensitivity to each of the risk factors that happen to be included in the model tested.

Researchers have tried to identify the most frequently encountered systematic risk factors. Some studies have shown these to be changes in the macroeconomic environment such as inflation, interest rates, industrial production levels, personal consumption and money supply. This seems to make sense given that future profits are likely to be influenced by the state of the economy. All firms are likely to react to a greater or lesser extent to changes in those macroeconomic variables. Also, most firms will respond in the same way. For instance, if the economy is growing strongly then most firms' profits will rise; therefore these factors cannot be diversified away. However, some firms will be more sensitive to changes in the factors than others – this is measured by the 'βs'. Each of these risk factors has a risk premium because investors will only accept the risk if they are adequately rewarded with a higher return. It is the sum of these risk premiums when added to the risk-free rate that creates the return on a particular share or portfolio.

A major problem with the APT is that it does not tell us in advance what the risk factors are. In practice there have been two approaches to find these. The first is to specify those factors thought most likely to be important and then to test to see if they are relevant. The drawback here is that it is rather *ad hoc* and there will always be the nagging doubt that you failed to test some of the crucial factors. The second approach employs a complex statistical technique that simultaneously determines from a mass of factors which are relevant in a data set, as well as their coefficients.

Empirical research has demonstrated the value of the APT in highlighting where there is more than one factor influencing returns. Unfortunately there is disagreement about the key variables as the identified factors vary from study to study. This lack of specificity regarding the crucial factors has meant that the APT has not been widely adopted in the investment community despite its intuitive appeal. Investors are generally left to themselves to discover the risk factors if they can. Even if they are able to identify relevant factors and the degree of sensitivity is carefully worked out, the analyst is forced to recognise that the outcomes only explain past returns. The focus of most investors and business people is on the future and so judgement is needed to make these models valuable in a predictive role. Using historical information in a mechanical fashion to predict future returns may produce disappointing results.

The three-factor model

Fama and French (1996) have developed a three-factor model based on their previous work which showed that smaller companies produce higher returns than larger companies, and those with lots of net assets compared to the market value of the company outperform those with few net assets as a proportion of share market value of the firm. They interpreted size and the book-to-market value ratio as risk factors that require compensation in the form of higher returns (rather than share traders temporarily irrationally underpricing small companies and those with high book-to-market values – *see* Chapter 13 for this alternative view). In their model returns are determined by the risk-free rate plus:

- the excess return on a broad market portfolio $(r_m - r_f)$;
- the difference between the return on a portfolio of small shares (companies with a small market capitalisation) and the return on a portfolio of large shares (SMB, small minus big);
- the difference between the return on a portfolio of high book-to-market shares and the return on a portfolio of low book-to-market shares (HML, high minus low).

$$\text{Expected returns} = \text{risk-free rate} + \beta_1(r_m - r_f) + \beta_2(\text{SMB}) + \beta_3(\text{HML})$$

The model is attempting to pick up systematic risk factors not captured by the simple CAPM. In the Fama and French model, as well as being influenced by the general risk premium for shares $(r_m - r_f)$, the average small share is taken to be more risky than the average large share and so offers an additional risk premium, SMB. Also the share with a high balance sheet (book) value per share relative to the market value of each share is assumed to be more risky than a share with a low book value compared with the share price, and so offers a risk premium, HML. Fama and French tested this model on US shares and concluded that 'the model is a good description of returns' (Fama and French 1996).

To make the model useful you need to establish the risk premium associated with each factor $(r_m - r_f)$, (SMB) and (HML). For the purposes of illustration let us assume that the risk premium on the market portfolio $(r_m - r_f)$, is 5% and the annual risk premium for a small company share compared with a large company share is 2% and the extra return received on a share with a high book-to-market ratio compared with a low book-to-market ratio is 3%.

These are the risk premiums for averagely sensitive shares. Individual shares are more or less sensitive to the fluctuations in the returns on the three factors.

So, if we take the shares of an imaginary company, A, with a high sensitivity to market movements $(r_m - r_f)$, they will be observed to have a high β_1, say, 1.5. If the sensitivity to size (SMB) is small (in fact, negative) then β_2 will be, say, −0.02. If the sensitivity to HML is 0.25 then:

$$\begin{aligned}\text{Expected risk premium} &= \beta_1(r_m - r_f) + \beta_2(\text{SMB}) + \beta_3(\text{HML}) \\ &= 1.5(5) - 0.02(2) + 0.25(3) \\ &= 8.21\%\end{aligned}$$

If the risk-free rate of return is 4% the expected return is 12.21%.

The five-factor model

Fama and French go further in a 2015 paper. Having noticed that share returns seem to be greater for companies with higher profits-to-net-asset ratios, an observation seemingly unexplained by the three-factor model, they put this new factor in. Their new model includes the variable 'RMW', which means the returns on 'Robust' profitability firms Minus the returns on 'Weak' profitability firms.

While they were at it, they added another 'anomaly' not explained by the older risk factor models, i.e. that firms with a small change in total assets over the last year perform better than those with large increases in investment levels. They labelled this 'CMA': returns on

'Conservatively' investing firms Minus returns on 'Aggressively' investing firms. Thus we have two more hypothesised 'risk factors' and the model becomes:

$$\text{Expected} = \text{risk free rate} + \beta_1(r_m - r_f) + \beta_2(SMB) + \beta_3(HML) + \beta_4(RMW) + \beta_5(CMA)$$

The arbitrage pricing theory, and the three- and five-factor models are complex answers to the flaws in the CAPM. However, they have serious flaws of their own. For example, the three- and five-factor models' assumptions of the efficient pricing of shares is very suspect. Perhaps it will be useful to step back from high academic theory and observe the techniques that some market practitioners use to see if they have greater predictive power.

Fundamental beta

Our forefathers, long before the development of the APT and the CAPM, had to grapple with the problem of quantifying risk. Perhaps some of these more traditional approaches based on commonsense risk influences provide greater insight and predictive power than the fancy theoretical constructs. For example, you do not need knowledge of high finance to realise that a firm that has a large amount of borrowing relative to its equity base will be subject to more risk than one with a lower level of borrowing (assuming all other factors are the same). Furthermore, if the geared-up firm is in a particularly volatile industry it will be subject to even more risk.

Instead of using CAPM-beta based on historical data, many analysts and company managers have switched to calculating a **fundamental beta**. This is based on the intuitive underpinning of the risk–return relationship: if the firm's (or project within the firm) cash flows are subject to more systematic variability then the required return should be higher. What causes systematic variability? Three factors have been advanced:

1 ***The type of business undertaken.*** Some businesses are more sensitive to market conditions than others. The turnover and profits of cyclical businesses change a great deal with the ups and downs of the economy. So, for example, the sales of yachts, cars or designer clothes rise in booms and crash in recessions. Non-cyclical industries, such as food retailing or tobacco, experience less variability with the economic cycle. Thus in a fundamental beta framework cyclical businesses would be allocated a higher beta than non-cyclical businesses – if the variability is systematic rather than specific to the firm. If the purchase of the product can be delayed for months, years or even indefinitely (i.e. it is discretionary) then the industry is likely to be more vulnerable to an economic downturn.

2 ***Degree of operating gearing.*** If the firm has high fixed costs compared with the variable costs of production, its profits are highly sensitive to output (turnover) levels. A small percentage fall in sales can result in a large percentage change in profits. The higher variability in profit means a higher beta should be allocated. (Chapter 18 discusses operating gearing.)

3 ***Degree of financial gearing.*** If the company has high borrowings, with a commitment to pay interest regularly, then profit attributable to shareholders is likely to be more vulnerable to shocks. The obligation to meet interest payments increases the variability of after-interest profits. In recession, profits can more easily turn into losses. So the beta will rise if the company has higher financial gearing (leverage). Financial gearing exacerbates the underlying business risk.

The obvious problem with using the fundamental beta approach is the difficulty of deriving the exact extent to which beta should be adjusted up or down depending on the strength of the three factors. I have to admit that this is subjective and imprecise, but as Warren Buffett points out, I'd rather be roughly right than precisely wrong.

Fernández (2009) has taken the fundamental beta idea a stage further with the MASCOFLAPEC method (from the initials of the parameters used to evaluate risk). This is shown in **Exhibit 8.39**, where each parameter is scored from 1 to 5 according to the contribution to the overall risk. Each factor has to be weighted. The example shows the sum of the scores of each parameter after adjusting for weights is 3.5. This is multiplied by 0.5 to obtain a beta of 1.75. With

Exhibit 8.39 A fundamental beta calculation using the MASCOFLAPEC method

Weight		Parameter (risk factor)	Risk level Low 1	Average 2	3	High 4	V. High 5	Weighted risk
10%	M	Management	1					0.1
25%	A	Assets: Business: industry/product					5	1.2
3%	S	Strategy						0.1
15%	C	Country risk				4		0.6
10%	O	Operating leverage				4		0.4
15%	F	Financial leverage				4		0.3
5%	L	Liquidity of investment						0.2
5%	A	Access to sources of funds					5	0.1
2%	P	Partners			3			0.0
5%	E	Exposure to other risks (currencies...)		2		4		0.1
5%	C	Cash flow stability		2	3			0.1
100%								Total = 3.5

Beta of equity = 3.5 × 0.5 = 1.75

Source: Fernández (2009).

this system, using 0.5 as the final multiplier, the betas can vary from 0.5 to 2.5. You could substitute other multipliers if you think a wider range is justified.

As Fernández says, these methods are simply an aid to common sense. They allow the user to value a company or a project depending on the risk that the valuer sees in the expected future cash flows.

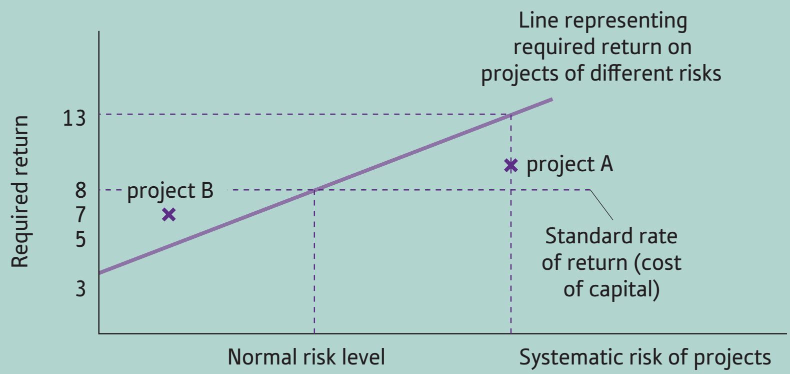
Project appraisal and systematic risk

Senior managers are generally aware that the returns on their company's shares are set at a particular level by the collective buying and selling actions of shareholders adjusting the share price. They are further aware that adjustment continues until the investors are content that the prospective returns reflect the riskiness of the share. What determines the systematic risk of a share is the underlying activities of the firm. Some firms engage in high-risk ventures and so shareholders, in exchange for accepting the possibility of a large loss, will expect a high return. Other firms undertake relatively safe activities and so shareholders will be prepared to receive a lower return.

The overall risk and return on the equity finance of a firm is determined by the portfolio of projects and their associated systematic risk. If a firm undertook an additional capital investment which had a much higher degree of risk than the average in the existing set then it is intuitively obvious that a higher return than the normal rate for this company will be required. On the other hand, if an extraordinarily low-risk activity is contemplated this should require a lower rate of return than usual.

Situations of this type are illustrated in **Exhibit 8.40** for a representative all-equity financed firm. Given the firm's normal risk level the market demands a return of 8%. If another project were started with a similar level of risk then it would be reasonable to calculate NPV on the basis of a discount rate of 8%. This is the opportunity cost of capital for the shareholders – they could obtain 8% by investing their money in shares of other firms in a similar risk class. If, however, the firm were to invest in project A with a risk twice the normal level, management would be doing their shareholders a disservice if they sought a mere 8% rate of return. At this risk level shareholders can get 13% on their money elsewhere. This sort of economic decision making will result in projects being accepted when they should have been rejected. Conversely project B, if discounted at the standard rate of 8%, will be rejected when it should have been accepted. It produces a return of 7% when all that is required is a return of 5% for this risk class. It is clear that this firm should accept any project lying above the sloping line and reject any project lying below this line.

Exhibit 8.40 Rates of return for projects of different systematic risk levels



The rule taught in Chapter 2 that a firm should accept any project that gives a return greater than the firm's opportunity cost of capital now has to be refined. This rule can only be applied if the marginal project has the same risk level as the existing set of projects. Projects with different risk levels require different levels of return.

While the logic of adjusting for risk is impeccable a problem does arise when it comes to defining risk. The traditional approach, before the use of the CAPM, was to exercise judgement. It was, and still is, popular to allocate projects to three or more categories (low, medium and high) rather than to precisely state the risk level. Then in the 1960s the CAPM presented a very precise linear relationship between CAPM-beta risk as measured by the covariance of returns against the market index. Calculating the historical beta for a share quoted on a stock market is relatively straightforward because the analyst has access to share return data to construct the characteristic line. However, the estimation of the risk on a *proposed* project that is merely one part of a firm's suite of activities is more problematic. A suggested solution is to use the CAPM-beta values of quoted firms in a similar line of business. Thus if the new project were in food retailing, the betas from all the firms in the food retailing industry could be averaged to establish an estimate of this project's beta. Adjustments might have to be made to this to allow for differences in the riskiness of the average peer group firms and this particular project but the fundamental techniques will not change.

The doubts surrounding the CAPM have led to a questioning of this approach. An alternative is to factor in a range of macroeconomic influences. Here we would try to estimate the sensitivity of the project's cash flows to changes in the economy such as GDP, inflation and industrial output. Some projects will be highly sensitive to macroeconomic forces and so will be regarded as more risky; others will be relatively stable.

Sceptics' views – alternative perspectives on risk

David Dreman, an experienced investor, does not have a great deal of respect for the financial economists' models. In his book *Contrarian Investment Strategies: The Next Generation* he asks, "What is risk?". In answering he says that the academic response, derived from the efficient market hypothesis and modern portfolio theory, is that measuring risk is simple, "an A-B-C commodity"; it is all to do with the volatility of a share or portfolio whether that is measured by beta or standard deviation. But, how did the professors find out that investors in the real world measure risk by volatility? His answer is that they didn't; they didn't do any research investigating whether investors calculate and use beta. "The academics simply declared it as fact" he wrote "Importantly, this definition was easy to use to build complex models, and that's what the professors wanted to do." He says that some academics became obsessional about the neatness of the model, because a "rational" person would use it. Whether it is realistic is another matter. Then these academic enthusiasts trained the next generation to believe that risk is volatility.

But, he points out, it has been known for decades that there is no correlation between returns on shares and risk as the academics define it. These measures of volatility even fail to remain