THE RELATION BETWEEN RISK AND RETURN

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1. Introduction and Preliminaries

A fundamental issue in finance pertains to the relation between risk and return. In terms of corporate finance this relation requires to be understood since it underpins the calculation of the opportunity cost of equity capital (the required rate of return on an equity investment).

The cost of capital is determined by investors in the capital market. Portfolio theory offers practical advice to investors regarding how they should invest their wealth so as to obtain an optimal risk-return trade-off.

We define the holding period return on an equity share or stock, R_t as:

(1)

$$R_t = \frac{P_t - P_{t-1} + D_t}{P_{t-1}}$$

P_t is the price at time t, the end of the period.
P_{t-1} is the price at time t-1, the beginning of the period
D_t is the dividend at time t.

However, at the time of making investment decisions we are concerned with *expected* return. We know that the value of any business asset depends on the future economic benefits that the asset will bestow on its owner. Thus valuation is always a function of future cash flows and expected (required) return.

Expected return on a share, $E(R_{t+1})$ is $\frac{E(P_{t+1}) - P_t + E(D_t)}{P_t}$

(2)

A risk free investment has only one possible outcome. For example one deposits €1,000 in a bank at 2% for one year. The return will be two percent or €20.

On the other hand a risky investment has a range or spread of possible outcomes whose probabilities are known. A probability represents the chance or "odds" of a particular outcome to the investment. If something is certain it to occur is has a probability of one. If something is certain **not** to occur is has a probability of 0. It may be helpful to think of probability in terms of the frequency of an outcome over many trials. For example, the probability of getting a head or a tails when tossing a coin is 0.5. If you tossed a coin 100 times you would expect to get a head 50 times and a tails 50 times. Similarly, the probability of throwing a six (or a two or a three etc.), when one throws a die is $\frac{1}{6}$ or 0.1667. If you threw a die 600 times you would expect to throw

100 sixes.
One metric we use to evaluate risky investments is their expected rate of return.

$$E(r_{t+1}) = \sum_{1}^{s} p_s r_s \qquad (3)$$

r(s) = return if a state occurs
p(s) =probability that state s occurs
There are 1 to s states of the world.

The simple example in Table 1 below illustrates

Table 1

	Project	t_0 Outlay	t_1 Pay-off	Prob.	Expected Return
Certain	A	100	120	1	20%
Risky	B	100	80 160	0.5 0.5	20%

The expected payoff on the risky investment B is (0.5*160) + (0.5*80) = 120. Thus, its expected return is 120/100 – 1 or 20% the exact same expected return as the risk free investment A. This could also be computed by taking the individual returns of A and B and multiplying them by their respective probabilities (see equation 3) and summing them, that is (-20%*0.5) + (60%*0.5) = -10%+30% = 20%.

<u>2. Investors' Attitude to Risk</u>

"One of the great myths about entrepreneurs is that they are risk seekers. All sane people want to avoid risk"
William A. Sahlman Harvard Business School.
"True entrepreneurs want to capture all the reward and give all the risk to others"
Howard Stevenson, Harvard Business School and Venture Capitalist.
We assume that investors are risk averse. This means that investors prefer an investment with a certain return to a risky one with the same expected return. A risk averse investor would prefer project A in Table 1 above to project B.
How can we entice such an investor to take project B?
We must lower the cost of B relative to A, thus increasing its expected return. If we increase the expected return of B sufficiently, a point will be reached where the investor is indifferent between A and B. This is the certainty equivalent rate of return. If we increase the return of the risky project (B) above the certainty equivalent rate the investor will prefer B to A. Unless risky investments are likely to offer greater returns than relatively safe ones nobody will hold them. If markets are competitive investors are unlikely to be able to increase expected returns without investing in assets which bear additional risk. Thus investments that have more risk have greater expected return and in the long run, greater actual returns, than less risky investments. We note that returns on the stock market are much greater over long periods than returns on corporate debt which in turn provide greater returns than government debt. This is empirical evidence that expected return is positively related to risk.

3. Calculation of Expected Return on Equity (Cost of Equity Capital)

We noted above that investors require to be compensated for taking on additional risk by the expectation of additional returns. Accordingly in a competitive market we would expect that assets with higher risk should promise greater returns. Specifically we might expect that the required rate of return on an asset could be described by the following equation.

$$E(R_i)= R_F + \text{risk premium}$$

This equation simply states that the required return on any asset consists of two parts. First, a rate of return, required to compensate for the time value of money and secondly, a risk premium. We need to compute the amount of extra expected return that should be demanded for each level of risk. We could then determine the required rate of return for any asset once we knew its risk. This is precisely what the Capital Asset Pricing Model (CAPM) does.

We turn to the capital market to determine the appropriate risk premium. The risk premium must inform us how much extra return we can expect to get per unit of risk we take on. Thus, in order to compute this this risk premium we first have to measure risk.

Risk is difficult to measure and there is no universally agreed method of measuring it. However, in finance it is usually measured by the amount of dispersion or variability in the return of an asset. Thus, risky assets must have very positive outcomes as well as very negative ones so that they have a high expected return. One has upside risk (potential) and downside risk.

The spread or dispersion of possible outcomes is usually measured by the variance (σ^2) or the standard deviation (σ). A graphical representation of the standard deviation is outlined in Figure 1 below. This graph shows the spread of returns for two different investments. The flatter curve B has a larger standard deviation and is therefore riskier. You will notice that investment B also has the greater probability of returning a loss, as depicted by the shaded area. Thus provided that the distribution of returns is symmetric the greater the standard deviation the greater the probability of loss for a given expected rate of return.

There are at least three aspects to risk that we must capture. First, the probability of having a poor outcome; second the potential size of this poor outcome; third risky investments must provide the chance of higher returns to compensate for the poor ones and thus give an above average expected return. This is what we mean by the spread of possible outcomes. Provided we have symmetric distributions standard deviation will capture all of these three aspects of risk.

Investors in the capital markets essentially own the companies that they have invested in. They dislike risk but like high returns. How do they balance their desire for high returns with their need to avoid risk. First, they hold their wealth in diversified portfolios in order to eliminate any risk that they do not need to bear from their portfolios.

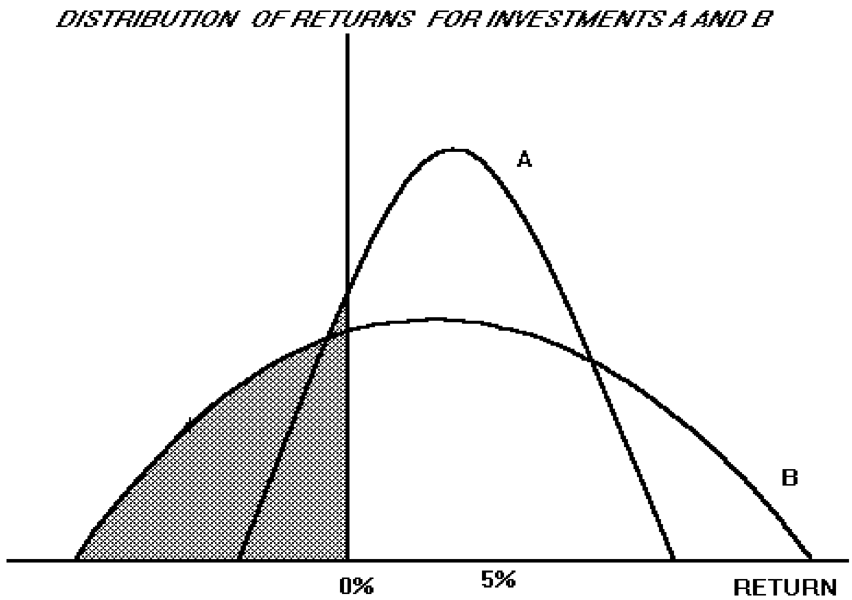

Figure 1

Diversification reduces risk because some companies in a portfolio will be doing extremely well, others will be performing satisfactorily and others will be disappointing. Different types of firm in different industries will be doing well (badly) at different times. Indeed a simple way of diversifying very quickly is to hold stocks from a range of different industries. Thus the extreme price movements and risk will be dampened down and well diversified portfolios are much less risky (have lower variances) than the individual stocks that comprise them. Investors are aware that they can reduce risk at low cost without sacrificing return simply by diversifying and the professional investors in the stock market certainly do this. Of course the ultimate diversified portfolio comprises all of the shares in the market weighted according to their value relative to the value of the market. This portfolio is called the market portfolio. Empirically this portfolio is usually proxied by a broadly based stock market index. In this portfolio the unique risk pertaining to stocks has been diversified away and all that remains is so-called market or systematic risk. The unique or diversifiable risk can be considered as risk that is specific to the company, for example, the loss in return due to a strike, due to an accident to the CEO, or technological change in the industry etc. The market risk on the other hand is due to factors that affect the return of all companies such as the general state of the economy including consumer spending, inflation etc. This is the only risk that remains when one holds the market portfolio. Therefore it is the only risk that is rewarded with additional expected return. The logic is that since you do not need to bear diversifiable risk it is not rewarded in a competitive market.

The CAPM assumes that all investors hold the market portfolio together with different amounts of the risk free asset. Of course when an investor holds a large portfolio such as the market portfolio she will be concerned with the performance of the individual stocks that comprise the portfolio only in so far as they influence the risk and return of the overall market portfolio. This subtly changes investors' perceptions of how to measure the risk of an individual stock. The investor is no longer concerned with the expected return and standard deviation of an individual stock. She is primarily concerned with the performance of the market portfolio and is only concerned with individual stocks insofar as they influence the performance of the market portfolio. In essence investors assess the marginal contribution of a stock to the expected return and risk of the market portfolio. The term for the marginal contribution a stock brings to the risk (variance) of the market portfolio is the beta (β) of the stock. Put another way the beta of an asset is its marginal contribution the risk of the market portfolio. If one already holds the market portfolio (less this asset) how much additional risk will the purchase of this asset add to its risk.

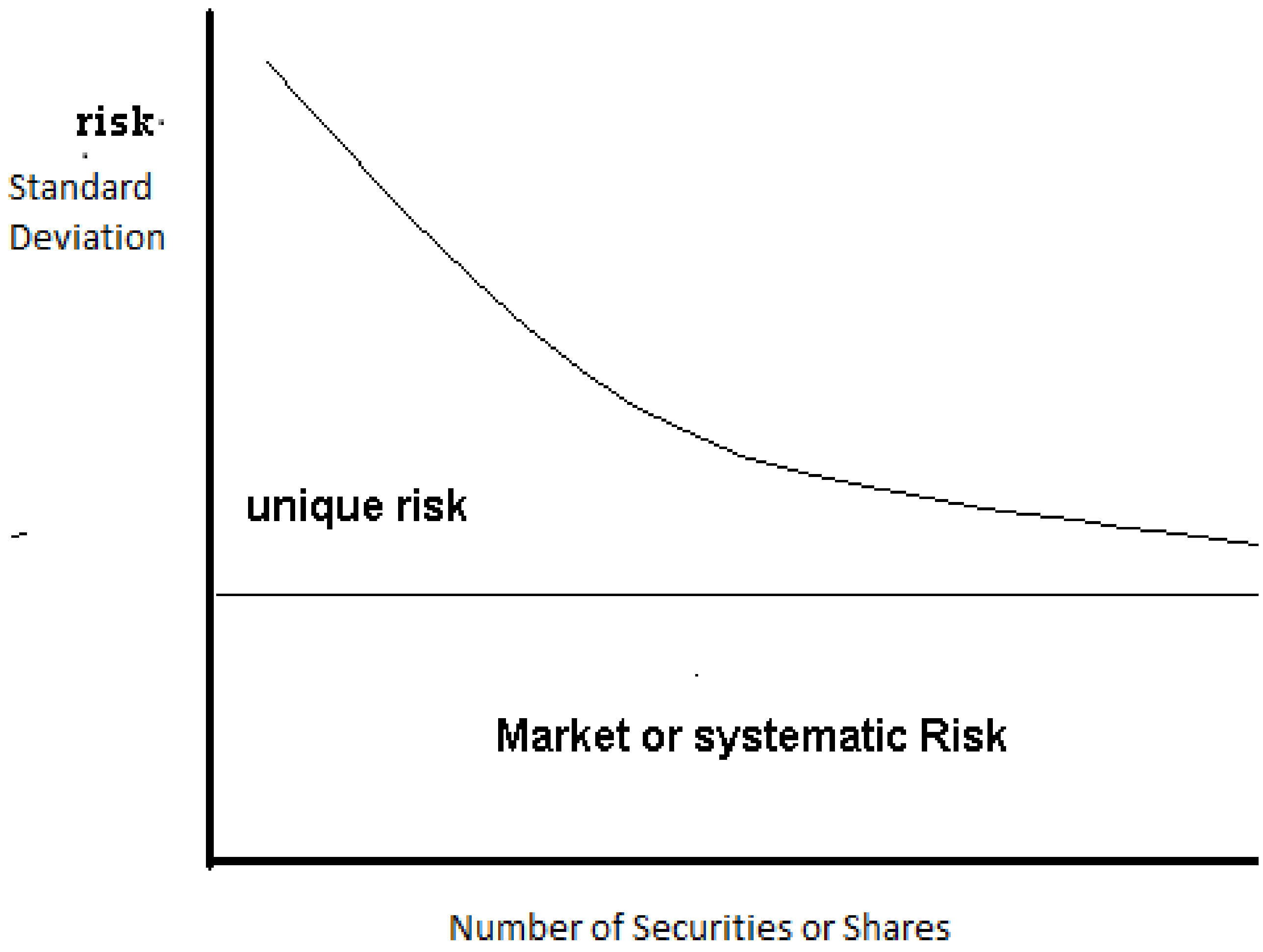

Figure 2

Remember we are looking for an expression in the form:

$E(R_j)$ = risk-free rate + risk premium.

This expression must contain a measure of risk, β, which is the marginal contribution of the stock to the risk of the market portfolio.

If j is the risk-free asset then:

$E(R_j) = r_F$ that is the risk premium is 0.

Here beta, the marginal contribution of the risk free asset to the risk of the market portfolio is also 0. The risk free asset is not part of the market portfolio anyway.

If j is the market portfolio then:

$E(R_j) = E(R_m) = r_F + [\ E(R_m - r_F]$

Here the beta of the market portfolio equals to 1. The marginal contribution of the risk of the market portfolio to itself divided by the total risk of market portfolio must be one. $[E(R_m) - r_F]$ is called the market risk premium it is the extra return or premium that you can earn by investing in the market portfolio rather than the risk free rate.

For *both* of the above expressions to hold we can envisage an expression of the following form:

$E(R_j) = r_F + ß_j[\ E(R_m - r_F]$

where:

$ß_j = 0$ when j is the risk-free asset.

$ß_j = 1$ when j is the market portfolio.

The above linear equation is called the security market line (SML).

It is clear from our assumptions that the only type of risk any investor takes on in the world of the CAPM is market risk (see Figure 2). Thus beta must be a measure of market risk. The market risk of an asset is the risk that it brings to the market portfolio (which is the investor's portfolio of risky assets). It must be remembered that the CAPM assumes that all investors are fully diversified and hold the market portfolio and so are totally unconcerned about the unique risk of a stock.

The CAPM can be used to estimate the cost of equity for any asset. For example if one wished to compute the cost of equity or required rate of return on a share one could use the SML. The risk free rate can be estimated as the yield on short-dated government stock. The beta of the stock can be obtained from Yahoo finance. The market risk premium $[\ E(R_m - r_F]$ can be estimated as its long run average which is about 5%-5.5%. On this basis if the yield on treasury bills is 0.5% and if we find that the beta is 0.8. We can compute the cost of equity for the company at $0.5 + 0.8\{5.5\} = 4.9\%$. A typical analyst would say 5% since it is recognised that the cost of capital is an estimate and we would be ascribing too much precision to our estimate by saying it was 4.9%.

4. The Cost of Equity for a Private Company with an Undiversified Shareholder.

A problem arises when one wishes to estimate the cost of equity capital for a private company. There will be no readily available beta estimate for such a company. This can be solved readily enough provided that there are some companies in the same business which are traded on the stock market. The approach here is to get the average beta of the equivalent quoted companies. Then adjust for the capital structures of those companies to get the unlevered or asset beta of the business or sector which can be obtained from Aswath Damodaran's web pages at Stern Business School, New York. Having done this one can adjust for the leverage of the private company to get its equity beta.

A further complication arises if one realises that the private company is owned by an entrepreneur who happens to be completely undiversified. Remember the CAPM assumes that investors hold the market portfolio, i.e. they are fully diversified. Accordingly, the entrepreneur's perception of risk is the total risk of his asset, the private company, not just its systematic risk. A straightforward way to deal with this complication is to divide the beta by the correlation between the returns on the sector and the market. In this scenario the adjusted beta is equivalent to the marginal contribution of the asset to the market portfolio but in the case of a one asset portfolio this marginal contribution is equal to the standard deviation of the asset.

The following example should illustrate. Suppose you have to estimate the cost of equity capital for a supermarket company. You find that the average beta of supermarket companies on the stock market is 1.2. The average Debt/Value Ratio of the Retail grocery sector (supermarkets) is 0.2 then the asset or unlevered beta can be computed using the following formula.

$$\beta_A = \beta_E \frac{E}{V} + \beta_D \frac{D}{V}$$

β_A is the asset beta
β_E is the equity beta
β_D is the beta of debt.
D is the value of Debt
E is the value of Equity
V is the value of the firm

If the beta of debt is 0.1 the beta of the assets is then

$\beta_A = 1.2(.8) + .1(.2) = 0.96 + .02 = 0.98$ say 1.0

If the private company has a debt to equity ratio of 0.2 and its debt has a beta of 0.1 then its equity beta is

$\beta_E = \beta_A + (\beta_A - \beta_D)(D/E) = 1 + .9\ (.2) = 1.18$

If the correlation between the retail grocery sector and the market is 0.6 then the unlevered or asset beta for a private company from an undiversified individual's perspective is $\frac{1.18}{.6} = 1.97$ (say 2). This is rather a high beta but this is to be expected since it reflects both systematic and unsystematic risk unlike the traditional beta which just reflects systematic or market risk. The cost of capital can then be computed for the private firm using the same market data as above. Therefore E(R) = 0.5% + 2(5.5) = 11.5% say 12%.

Note – this article essentially skips portfolio theory. However there is some coverage of portfolio theory in the solution to the August 2015 examination paper CPA Ireland Professional 2 Strategic Corporate Finance.