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Capital Asset Pricing Model (CAPM)

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ABSTRACT

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Introduction

An economic theory that describes the relationship between risk and expected return, and serves as a model for the pricing of risky securities. The CAPM asserts that the only risk that is priced by rational investors is systematic risk, because that risk cannot be eliminated by diversification. The CAPM says that the expected return of a security or a portfolio is equal to the rate on a risk-free security plus a risk premium multiplied by the asset's systematic risk.

Birth of a Model

The capital asset pricing model was the work of financial economist (and, later, Nobel laureate in economics) William Sharpe, set out in his 1970 book "Portfolio Theory And Capital Markets." His model starts with the idea that individual investment contains two types of risk:

1. *Systematic Risk* - These are market risks that cannot be diversified away. Interest rates, recessions and wars are examples of systematic risks.

2. Unsystematic Risk - Also known as "specific risk," this risk is specific to individual stocks and can be diversified away as the investor increases the number of stocks in his or her portfolio. In more technical terms, it represents the component of a stock's return that is not correlated with general market moves.

The CAPM Assumption

• NORMATIVE ASSUMPTION

- Expected returns & standard deviation cover a one-period investor horizon

- Nonsatiation

Tele:

- Risk averse investors
- Assets are infinitely divisible
- Risk free assets exists
- No taxes nor transaction costs
- ADDITIONAL ASSUMPTION
- One period investors horizon for all
- Risk free rate is the same for all
- Information is free and instantaneously available
- Homogeneous expectations

Example & Use of Capital Asset Pricing Model (CAPM)

No matter how much we diversify our investments, it's impossible to get rid of all the risk.

As investors, we deserve a rate of return that compensates us for taking on risk. The capital asset pricing model (CAPM) helps us to calculate investment risk and what return on

investment we should expect. Here we look at the formula behind the model, the evidence

for and against the accuracy of CAPM, and what CAPM means to the average investor.

The CAPM states that the expected return of a security or a portfolio should equal the rate on a risk-free security (a U.S. Treasury bond) plus a risk premium. If this expected return does not meet or exceed the required return, the investment should not be undertaken. The security market line plots the results of the CAPM for all different risks (betas).

Using the CAPM model with the following assumptions, one can compute the expected return of a stock: If the risk-free rate = 3%, the beta (risk measure) of the stock = 2, and the expected market return over the time period = 10%, the stock is expected to return 17% (3% + 2(10% - 3%)).

Related Terms: • Beta

- Security Market Line—SML
- Capital Market Line—CML
- Systematic Risk

Beta

Beta represents an asset's systematic (market or nondiversifiable) risk

• The CAPM at the point 'M' on the efficient frontier gives the risk adjusted equilibrium return on asset 'i'

• $E(R_i) - R_f = \beta_i [E(R_m) - R_f]$

$$\beta_i = Cov(R_i, R_m)/\sigma_m^2$$

• The risk premium is $\beta_i[E(R_m) - R_f]$ and represents the reward for taking risk **above that of the risk-free rate**

SML

• The SML is similar to the CML.

• The individual expected return of a share consists of 2 elements. The risk-free return and a risk premium.

• The risk premium for an individual share is not the product of the market price of risk λ and the risk of the share σ_i but the covariance relationship between the share and the market portfolio which is defined by - Beta

CML

• The CML provided a linear relation between expected return and risk that describes the proportion of a risk-free asset and an

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efficient portfolio of assets (market portfolio) that an investor can hold.

• The same basic function can be used to derive an expression for the expected return on an inefficient investment other than the market portfolio.

• Or indeed for a single stock

CAPM FORMULA

The linear relationship between the return required on an investment (whether in stock market securities or in business operations) and its systematic risk is represented by the CAPM formula

Formulae Sheet:

$E(ri) = Rf + \beta i(E(rm) - Rf)$

E(ri) = return required on financial asset i

Rf = risk-free rate of return

 $\beta i = beta value for financial asset i$

E(rm) = average return on the capital market

<u>The SML is a graphical representation of the CAPM</u> <u>formula.</u>

Perfect capital market

This assumption means that all securities are valued correctly and that their returns will plot on to the SML. A perfect capital market requires the following: that there are no taxes or transaction costs; that perfect information is freely available to all investors who, as a result, have the same expectations; that all investors are risk averse, rational and desire to maximize their own utility; and that there are a large number of buyers and sellers in the market.



While the assumptions made by the CAPM allow it to focus on the relationship between return and systematic risk, the idealised world created by the assumptions is not the same as the real world in which investment decisions are made by companies and individuals. risk has been essentially eliminated. This investment decision is also incorrect, however, since project B would be rejected if using a CAPM-derived projectspecific discount rate, because the project IRR offers insufficient compensation for its level of systematic risk

WACC AND CAPM

The weighted average cost of capital (WACC) can be used as the discount rate in investment appraisal provided that a number of restrictive assumptions are met. These assumptions are that: the investment project is small compared to the investing organisationthe business activities of the investment project are similar to the business activities currently undertaken by the investing organization the financing mix used to undertake the investment project is similar to the current financing mix (or capital structure) of the investing company existing finance providers of the investing company do not change their required rates of return as a result of the investment project being undertaken.

These assumptions essentially state that WACC can be used as the discount rate provided that the investment project does not change either the business risk or the financial risk of the investing organisation. If the business risk of the investment project is different to that of the investingorganisation, the CAPM can be used to calculate a project-specific discount rate. The procedure for this calculation was covered in the second article in this series

3 The benefit of using a CAPM-derived project-specific discount rate is illustrated in Figure 2. Using the CAPM will lead to better investment decisions than using the WACC in the two shaded areas, which can be represented by projects A and B.

Project A would be rejected if WACC was used as the discount rate, because the internal rate of return (IRR) of the project is less than that of the WACC. This investment decision is incorrect, however, since project A would be accepted if a CAPM-derived project-specific discount rate were used because the project IRR lies above the SML. The project offers a return greater than that needed to compensate for its level of systematic risk, and accepting it will increase the wealth of shareholders.

Project B would be accepted if WACC was used as the discount rate because its IRR is greater than the WACC



Advantages of the CAPM

- The CAPM has several advantages over other methods of calculating required return, explaining why it has remained popular for more than 40 years: It considers only systematic risk, reflecting a reality in which most investors have diversified portfolios from which unsystematic risk has been essentially eliminated. For example, real-world capital markets are clearly not perfect. Even though it can be argued that well-developed stock markets do, in practice, exhibit a high degree of efficiency, there is scope for stock market securities to be priced incorrectly and, as a result, for their returns not to plot on to the SML.

- The assumption of a single-period transaction horizon appears reasonable from a real-world perspective, because even though many investors hold securities for much longer than one year, returns on securities are usually quoted on an annual basis. The assumption that investors hold diversified portfolios means that all investors want to hold a portfolio that reflects the stock market as a whole. Although it is not possible to own the market portfolio itself, it is quite easy and inexpensive for investors to diversify away specific or unsystematic risk and to construct portfolios that 'track' the stock market. Assuming that investors are concerned only with receiving financial compensation for systematic risk seems therefore to be quite reasonable. A more serious problem is that, in reality, it is not possible for investors to borrow at the risk-free rate (for which the yield on short-dated Government debt is taken as a proxy). The reason for this is that the risk associated with individual investors is much higher than that associated with the Government. This inability to borrow at the risk-free rate means that the slope of the SML is shallower in practice than in theory.

- Overall, it seems reasonable to conclude that while the assumptions of the CAPM represent an idealised rather than real-world view, there is a strong possibility, in reality, of a linear relationship existing between required return and systematic risk.

- It generates a theoretically-derived relationship between required return and systematic risk which has been subject to frequent empirical research and testing.

- It is generally seen as a much better method of calculating the cost of equity than the dividend growth model (DGM) in that it explicitly takes into account a company's level of systematic risk relative to the stock market as a whole.

- It is clearly superior to the WACC in providing discount rates for use in investment appraisal.

Disadvantages of The Capm

The CAPM suffers from a number of disadvantages and limitations that should be noted in a balanced discussion of this important theoretical model.

- Assigning values to CAPM variablesIn order to use the CAPM, values need to be assigned to the risk-free rate of return, the return on the market, or the equity risk premium (ERP), and the equity beta.

- The yield on short-term Government debt, which is used as a substitute for the risk-free rate of return, is not fixed but changes on a daily basis according to economic circumstances. A shortterm average value can be used in order to smooth out this volatility.

- Finding a value for the ERP is more difficult.

The return on a stock market is the sum of the average capital gain and the average dividend yield.

- In the short term, a stock market can provide a negative rather than a positive return if the effect of falling share prices outweighs the dividend yield. It is therefore usual to use a longterm average value for the ERP, taken from empirical research, but it has been found that the ERP is not stable over time.

- In the UK, an ERP value of between 2% and 5% is currently seen as reasonable. However, uncertainty about the exact ERP value introduces uncertainty into the calculated value for the required return.

- Beta values are now calculated and published regularly for all stock exchange-listed companies.

- The problem here is that uncertainty arises in the value of the expected return because the value of beta is not constant, but changes over time. Using the CAPM in investment appraisal

- Problems can arise when using the CAPM to calculate a project-specific discount rate. For example, one common difficulty is finding suitable proxy betas, since proxy companies very rarely undertake only one business activity. The proxy beta for a proposed investment project must be disentangled from the company's equity beta. One way to do this is to treat the equity beta as an average of the betas of several different areas of proxy company activity, weighted by the relative share of the proxy company market value arising from each activity. However, information about relative shares of proxy company market value may be quite difficult to obtain.

- A similar difficulty is that the ungearing of proxy company betas uses capital structure information that may not be readily available.

- Some companies have complex capital structures with many different sources of finance. Other companies may have debt that is not traded, or use complex sources of finance such as convertible bonds. The simplifying assumption that the beta of debt is zero will also lead to inaccuracy in the calculated value of the project-specific discount rate.

- One disadvantage in using the CAPM in investment appraisal is that the assumption of a single-period time horizon is at odds with the multi-period nature of investment appraisal. While CAPM variables can be assumed constant in successive future periods, experience indicates that this is not true in reality.

Conclusion

Research has shown the CAPM to stand up well to criticism, although attacks against it have been increasing in recent years. Until something better presents itself, however, the CAPM remains a very useful item in the financial management toolkit. References

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