Capital Asset Pricing Model (CAPM)

Systematic risk (aka **market risk**, **undiversifiable risk**, **systemic risk**) is risk that affects all investments or classes of investments. Most systematic risk is either economic or political—inflation is the most significant systematic risk because it lowers the real return of all investments. Such risk cannot be diversified by investing in different classes of assets.
Diversifiable risk (aka **unsystematic risk**) affects specific companies, because of such factors as bad management, lawsuits, and labor trouble. Diversifiable risk can be lowered by investing in different companies in different sectors or by investing in different asset classes, such as stocks and bonds, but can only be minimized by investing in assets that have a negative correlation coefficient, where the lows of some assets are offset by the highs of other assets. The **total risk** of any investment is the sum of systematic risk + asset-specific risks.

Total Risk = Systematic Risk + Diversifiable Risks

The price of a stock or other security will depend not only on the risk of the security, but also on its intrinsic value, which can be calculated using the dividend discount model, where the price of the security is determined by its future cash flows.

Beta: A Measure of Specific Systematic Risk

Although systematic risk affects all investment returns, some assets are more sensitive to systematic risk than others, even those in the same asset class, such as the stocks of different companies. If a particular stock, for instance, has greater volatility due to systematic risk than the general market, then it would be prudent for an investor to demand a greater return from that stock than the **market return**, which is the return of the market as a whole, such as the stock market, or a subclass of a market, such as the NASDAQ or the S&P 500 stock index.

The **beta** of an asset, such as a stock, measures the market risk of that particular asset as compared to the rest of the market — hence, it also measures volatility of the asset compared to the general market. The beta is calculated by comparing the historical return of an asset compared to the market return using statistical techniques to calculate their covariance:

Formula for the Beta Coefficient of a Stock

$$\text{Beta Coefficient of Stock} = \frac{\text{Cov}(r_s, r_m)}{\sigma^2_m}$$

r_s = Stock Return
r_m = Market Return
σ^2_m = Market Variance

Betas are mostly used to compare return/risk ratios for stocks and mutual funds, because the stock market, or funds composed of stocks, have a greater diversity of volatility than other asset classes.

However, stock betas don't have to be calculated, since most are published in detailed stock quotations offered by major online financial services. Mutual funds also have published betas.

The beta of the S&P 500 stock index market is considered 1. Most stocks have a **positive beta**, which means that most stocks move in the same direction as the general market. If the beta is greater than 1, then the stock moves more than the market does in the same direction. For instance, if the stock market increases in value by 1%, then a stock with a beta of 2 will ***often*** increase by 2%. Likewise, if the market return decreases by 1%, then a stock with a beta of 2 will decrease by 2%. Remember, however, that since beta is a statistical calculation, the relationship is not fixed. If a stock has a beta of 0.5, then it will increase by ½% for each 1% increase in the market return. Hence, a stock with a beta of greater than 1 is riskier than the general market, but potentially more profitable; a beta of less than 1 is generally less risky than the general market, and gains will also probably be less than market gains. Most stocks have betas than range from 0.5 – 1.75.

Some stocks have a **negative beta** because they have a negative correlation to the general market—they move in the opposite direction to the general market. For instance, a stock with a beta of -1 will ***decrease*** in value by 1% for each ***increase*** of 1% in the general stock market, and vice versa.

Estimating Required Returns Using Beta and the CAPM

The **capital asset pricing model** (**CAPM**), developed by William F. Sharpe and John Lintner, uses the beta of a particular security, the risk-free rate of return, and the market return to calculate the **required return** of an investment to its **expected risk**.

Required Return	=	**Risk-Free Rate**	+	**Risk Premium**				
	=	**Risk-Free Rate**	+	**[Beta**	×	**(Market Return**	–	**Risk-Free Rate)]**

The term, **Market Return – Risk-Free Rate**, is simply the required return on stocks in general because stocks have a certain amount of risk. Hence, this term is the **risk premium** of stocks—what stocks have to return to compensate investors for the additional risk of holding stocks over holding risk-free Treasuries. Since different stocks have differing amounts of volatility, or risk, the required risk premium should also differ. The particular risk premium of a stock compared to the risk premium of the market is calculated by modifying the risk premium of the market with the stock's beta. If the beta is greater than 1, then the risk premium must be greater to compensate the investor for the additional risk; if it is less, then the risk premium will be less. Note that when beta = 1, then the risk premium of the stock is equal to the risk premium of the market.

Examples

Example—Calculating the Required Return Using the CAPM

If the **risk-free rate of a Treasury bill is 4%**, and the **return of the stock market has averaged about 12%**, what is the required return of a stock that has a beta of **1.4**?

By using the CAPM formula, shown above, we find that:

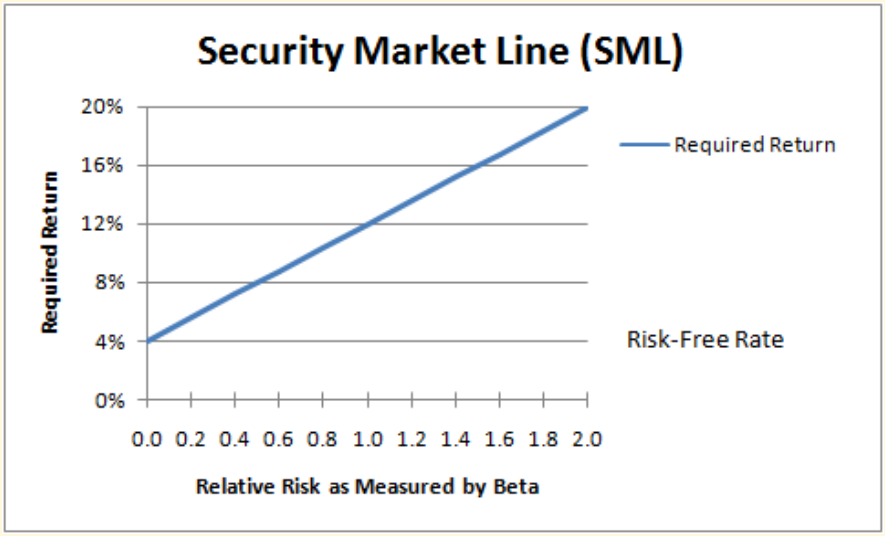
Required Return = **4%** + [**1.4** × (**12%** - **4%**)] = **4%** + **1.4** × 8% = **4%** + 11.2% = **15.2%**

So if this stock only returned 13% in the past few years, then it has a greater risk than is justified by its return compared to the general market.

Security Market Line (SML)

When the relative risk premium, represented by beta, is plotted in a graph against the required return, it yields a straight line known as the **security market line** (**SML**). This line begins at the risk-free rate and rises with beta.

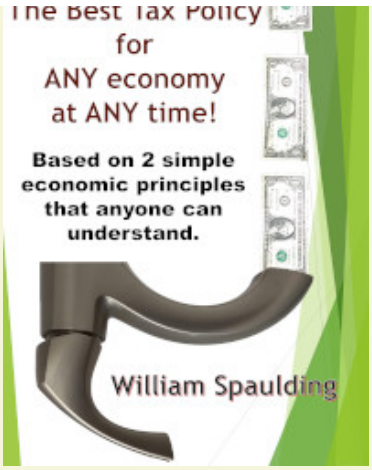
A graph of a security market line, assuming a market return of 12% and a risk-free rate of 4%. Note that a beta of 0 is equal to the risk-free rate while a beta of 1 has a relative risk equal to the market.



Conclusion

Investors differ in their willingness to accept risk for a greater return. But if investors are willing to invest in the stock market, then they are willing to assume some risk. What the capital asset pricing model provides is a consistent means to price risk premiums. If you are willing to accept higher risks to get higher returns, then it makes sense to demand a higher return for a higher risk; otherwise, why take the higher risk. By comparing the beta of a stock and its historical return with that of the general market, you can determine whether the return of a stock is worth its risk.

people, but it will also increase economic output. By understanding these basic economic principles, it will be easier to understand why the present tax structure not only hurts many people and increases inequality, but actually reduces economic wealth. Trickle-Up Economics < https://www.amazon.com/dp/B07ZXKVM5Y/ref=sr_1_1?keywords=trickle-up+economics&qid=1572792109&sr=8-1 > also suggests a much better way to vote, so that better policies can be implemented, thus reducing the influence of money and corruption in politics.



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