# Capital Asset Pricing Model (CAPM)

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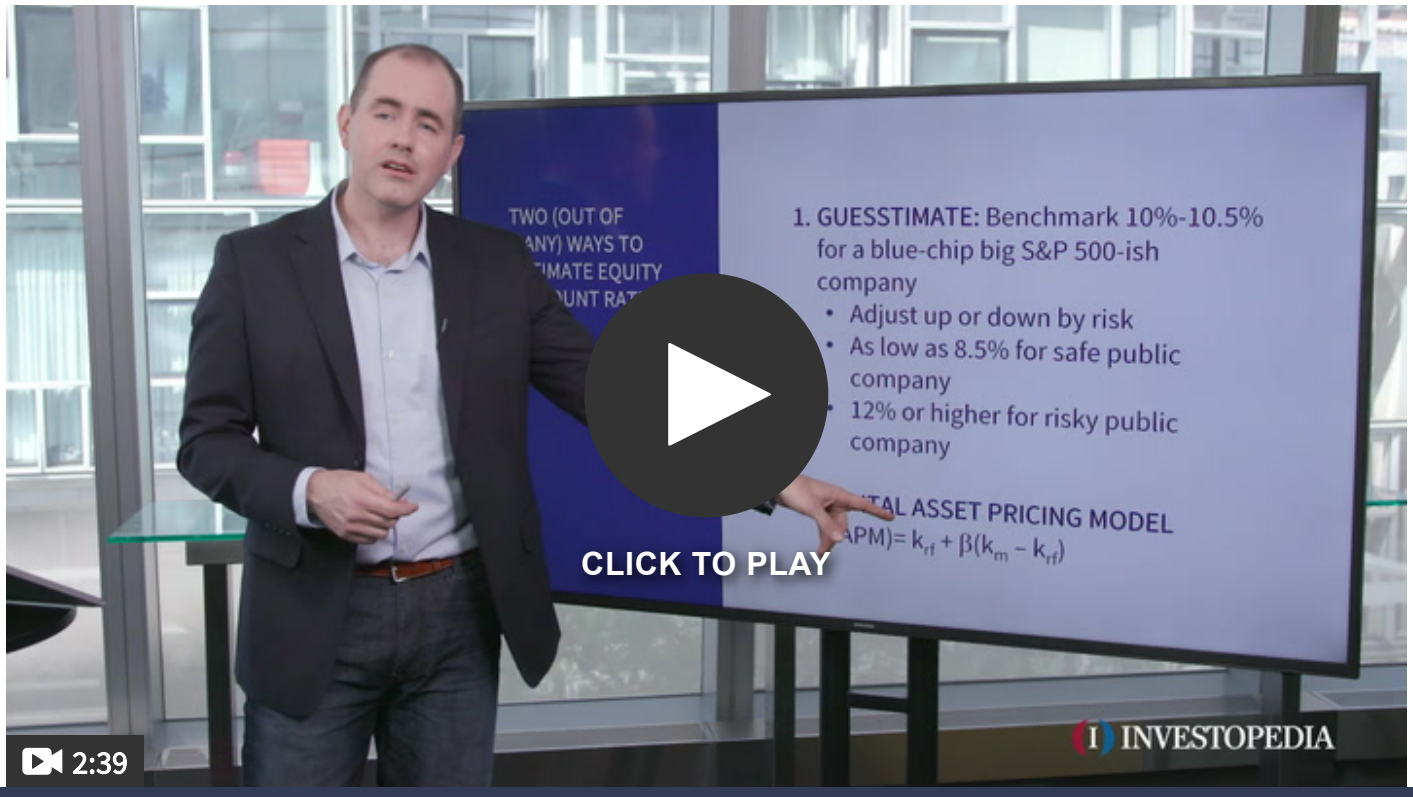
## What Is the Capital Asset Pricing Model?

The Capital Asset Pricing Model (CAPM) describes the relationship between systematic risk and expected return for assets, particularly stocks. CAPM is widely used throughout finance for pricing risky securities and generating expected returns for assets given the risk of those assets and cost of capital.



## Understanding the Capital Asset Pricing Model (CAPM)

The formula for calculating the expected return of an asset given its risk is as follows:

$$ER_i = R_f + \beta_i(ER_m - R_f)$$

**where:**

$ER_i = \text{expected return of investment}$

$R_f = \text{risk-free rate}$

$\beta_i = \text{beta of the investment}$

$(ER_m - R_f) = \text{market risk premium}$

Investors expect to be compensated for risk and the time value of money. The risk-free rate in

greater than one. If a stock has a beta of less than one, the formula assumes it will reduce the risk of a portfolio.

A stock's beta is then multiplied by the market risk premium, which is the return expected from the market above the risk-free rate. The risk-free rate is then added to the product of the stock's beta and the market risk premium. The result should give an investor the required return or discount rate they can use to find the value of an asset.

The goal of the CAPM formula is to evaluate whether a stock is fairly valued when its risk and the time value of money are compared to its expected return.

The expected return of the stock based on the CAPM formula is 9.5%:

$$9.5\% = 3\% + 1.3 \times (8\% - 3\%)$$

The expected return of the CAPM formula is used to discount the expected dividends and capital appreciation of the stock over the expected holding period. If the discounted value of those future cash flows is equal to $100 then the CAPM formula indicates the stock is fairly valued relative to risk.

## Problems With the CAPM

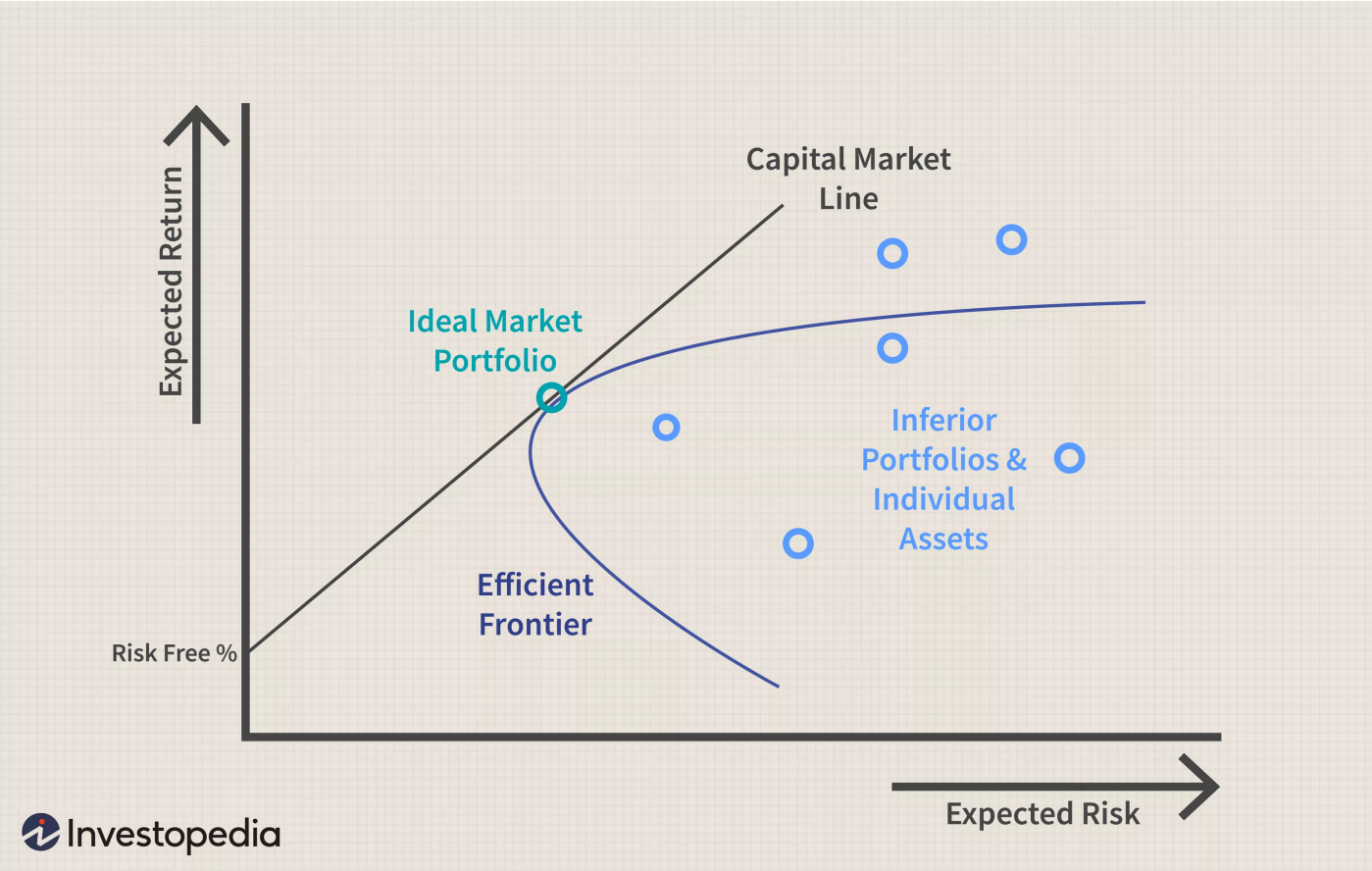
There are several assumptions behind the CAPM formula that have been shown not to hold in reality. Despite these issues, the CAPM formula is still widely used because it is simple and allows for easy comparisons of investment alternatives.

Including beta in the formula assumes that risk can be measured by a stock's price volatility. However, price movements in both directions are not equally risky. The look-back period to determine a stock's volatility is not standard because stock returns (and risk) are not normally distributed.

The CAPM also assumes that the risk-free rate will remain constant over the discounting period. Assume in the previous example that the interest rate on U.S. Treasury bonds rose to 5% or 6% during the 10-year holding period. An increase in the risk-free rate also increases the cost of the capital used in the investment and could make the stock look overvalued.

The market portfolio that is used to find the market risk premium is only a theoretical value and is not an asset that can be purchased or invested in as an alternative to the stock. Most of the time, investors will use a major stock index, like the S&P 500, to substitute for the market, which is an imperfect comparison.

investor were able to use the CAPM to perfectly optimize a portfolio's return relative to risk, it would exist on a curve called the efficient frontier, as shown on the following graph.

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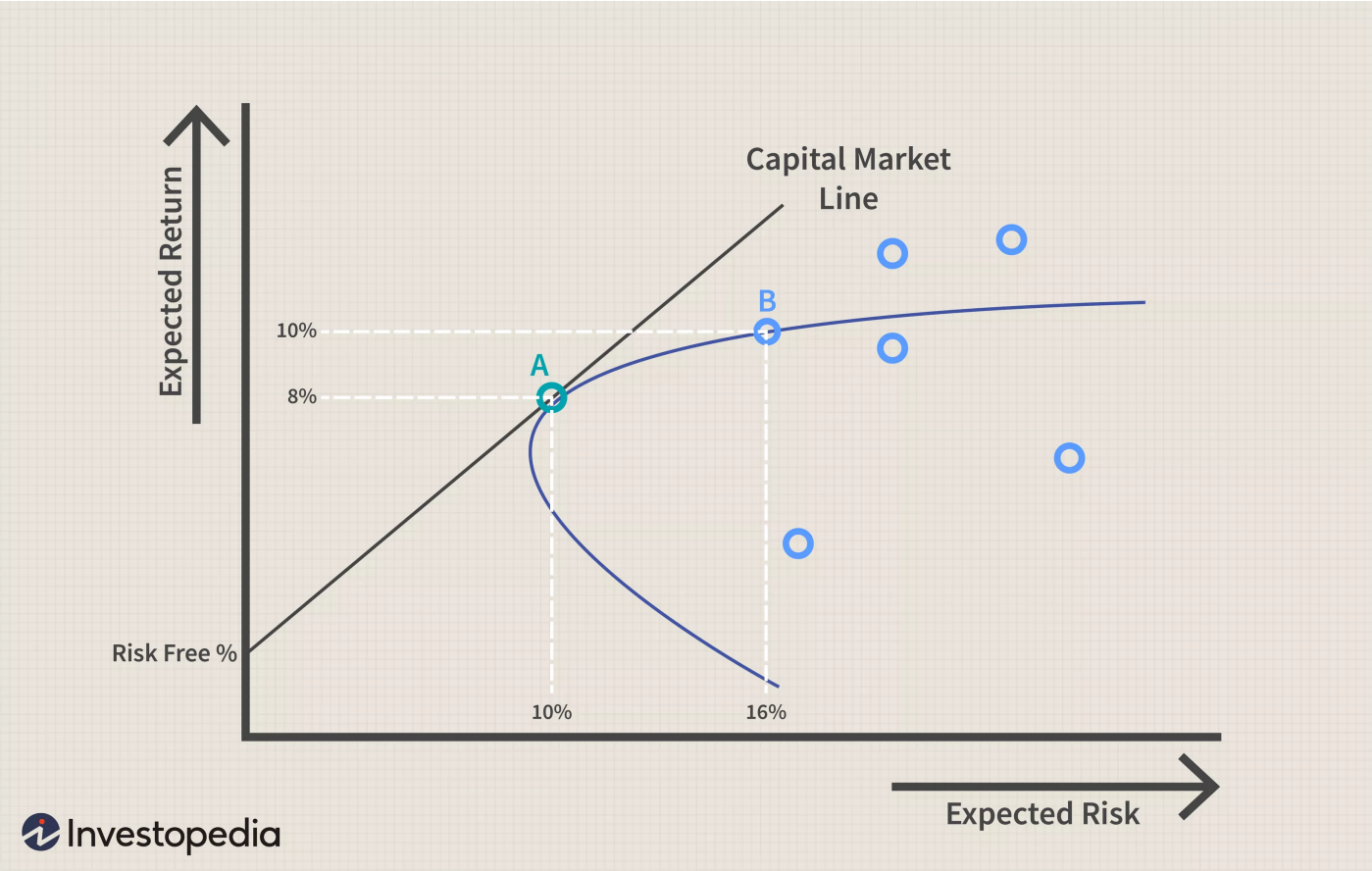
The graph shows how greater expected returns (y-axis) require greater expected risk (x-axis). Modern Portfolio Theory suggests that starting with the risk-free rate, the expected return of a portfolio increases as the risk increases. Any portfolio that fits on the Capital Market Line (CML) is better than any possible portfolio to the right of that line, but at some point, a theoretical portfolio can be constructed on the CML with the best return for the amount of risk being taken.

The CML and efficient frontier may be difficult to define, but it illustrates an important concept for investors: there is a trade-off between increased return and increased risk. Because it isn't possible to perfectly build a portfolio that fits on the CML, it is more common for investors to take on too much risk as they seek additional return.

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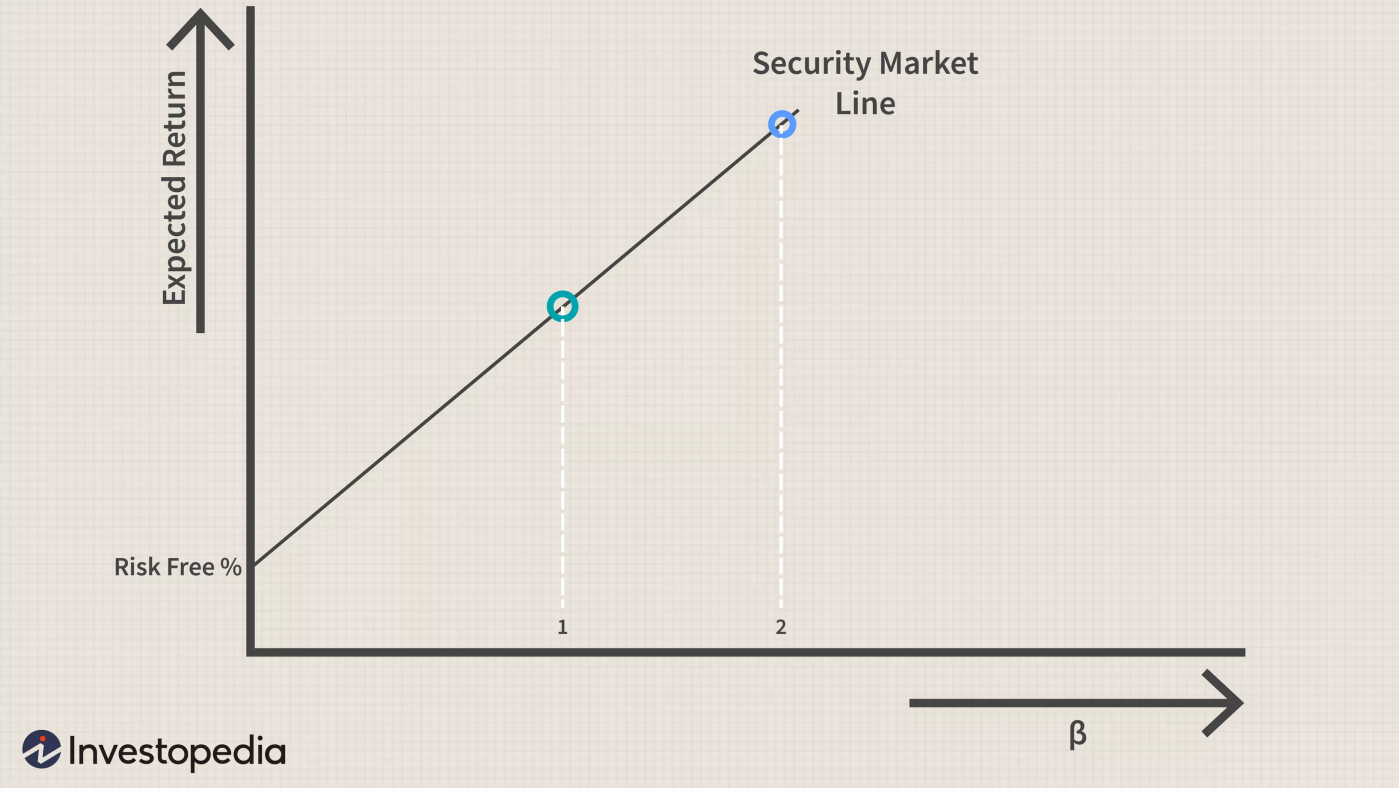
The efficient frontier assumes the same things as the CAPM and can only be calculated in theory. If a portfolio existed on the efficient frontier it would be providing the maximal return for its level of risk. However, it is impossible to know whether a portfolio exists on the efficient frontier or not because future returns cannot be predicted.

This trade-off between risk and return applies to the CAPM and the efficient frontier graph can be rearranged to illustrate the trade-off for individual assets. In the following chart, you can see that the CML is now called the Security Market Line (SML). Instead of expected risk on the x-axis, the stock's beta is used. As you can see in the illustration, as beta increases from one to two, the expected return is also rising.

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The CAPM and SML make a connection between a stock's beta and its expected risk. A higher beta means more risk but a portfolio of high beta stocks could exist somewhere on the CML where the trade-off is acceptable, if not the theoretical ideal.

The value of these two models is diminished by assumptions about beta and market participants that aren't true in the real markets. For example, beta does not account for the relative riskiness of a stock that is more volatile than the market with a high frequency of downside shocks compared to another stock with an equally high beta that does not experience the same kind of price movements to the downside.

## Practical Value of the CAPM

Considering the critiques of the CAPM and the assumptions behind its use in portfolio construction, it might be difficult to see how it could be useful. However, using the CAPM as a tool to evaluate the reasonableness of future expectations or to conduct comparisons can still have some value.

Assume in this example that the peer group's performance over the last few years was a little better than 10% while this stock had consistently underperformed with 9% returns. The investment manager shouldn't take the advisor's recommendation without some justification for the increased expected return.

An investor can also use the concepts from the CAPM and efficient frontier to evaluate their portfolio or individual stock performance compared to the rest of the market. For example, assume that an investor's portfolio has returned 10% per year for the last three years with a standard deviation of returns (risk) of 10%. However, the market averages have returned 10% for the last three years with a risk of 8%.

The investor could use this observation to reevaluate how their portfolio is constructed and which holdings may not be on the SML. This could explain why the investor's portfolio is to the right of the CML. If the holdings that are either dragging on returns or have increased the portfolio's risk disproportionately can be identified, the investor can make changes to improve returns.

## Capital Asset Pricing Model (CAPM) Summary

The CAPM uses the principles of Modern Portfolio Theory to determine if a security is fairly valued. It relies on assumptions about investor behaviors, risk and return distributions, and market fundamentals that don't match reality. However, the underlying concepts of CAPM and the associated efficient frontier can help investors understand the relationship between expected risk and reward as they make better decisions about adding securities to a portfolio.

## Related Terms

### International Capital Asset Pricing Model (CAPM)

The international capital asset pricing model (CAPM) is a financial model that extends the concept of the CAPM to international investments. more

that did not have to do with the market. more

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## Market Portfolio

A market portfolio is a theoretical, diversified group of investments, with each asset weighted in proportion to its total presence in the market. more

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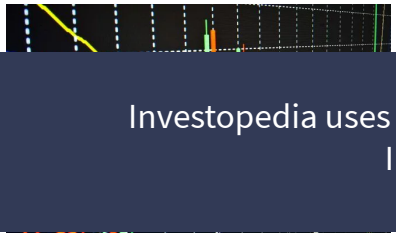

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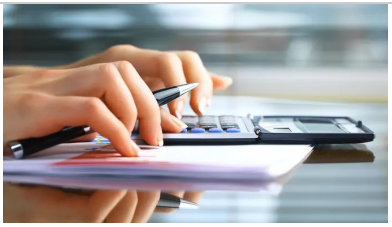

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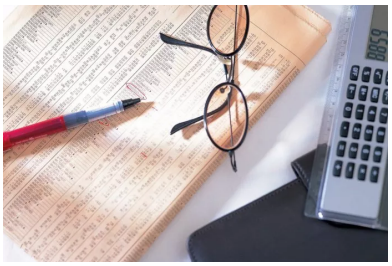

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