An Application of the Capital Asset Pricing Model

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Abstract

This case deals with the Capital Asset Pricing Model (i.e. CAPM). Students will learn how to draw the Security Market Line using the risk-free rate and the expected market return. They will learn how to estimate the expected return on a stock or a portfolio given its systematic risk (i.e. beta). The students will also evaluate whether the two stocks given in the case are fairly priced, overpriced, or underpriced according to the CAPM. Finally, they will learn about the reward-to-risk ratio and use it to link two stocks' expected returns given that they have the same reward-to-risk ratio. This is a hands-on experience for students who want to learn more about asset pricing and the CAPM.

Keywords: asset pricing, capital asset pricing model, CAPM, security market line, reward-to-risk ratio

JEL classifications: G11, G12, G32

Introduction

Michael Anderson wants to make an investment in the stock market. He is considering buying shares of a young, environmentally focused company named "Green World". "Green World" deals with economic, environmental, and social sustainability projects around the world. Michael believes that "sustainability" will be a very important issue for companies as well as governments around the world in the near future. Therefore, he is confident this investment would give him good returns over the coming years.

In order to evaluate the expected returns from this investment, he wants to use an asset pricing model that he had learned when he was doing his MBA a few years ago. This is a simple model that incorporates the beta (i.e. systematic risk) of the stock, the risk-free rate of return, and the expected return on the stock market for the following year. The model is called CAPM (i.e. the Capital Asset Pricing Model).

In order to remember the details of the model, Michael has decided to do some research online. He has looked at several financial websites and gathered lots of information. He has found information on systematic risk versus unsystematic risk, the CAPM, and the Security Market Line. "I forgot all about these topics. I am glad that I have found these sources. Now, I can read them and go from there" he thought. Below is the information that he has found on these topics online.

Systematic Risk versus Unsystematic Risk

There are some risk factors that affect a large number of assets. These include macro issues like changes in GDP, inflation, interest rates, war, etc. These factors affect all investments therefore the risk associated with these macro issues is called "systematic risk" or "market risk". Since diversification (i.e. forming a portfolio) cannot eliminate this type of risk, it is also called "non-diversifiable risk".

Beta is a measure of systematic risk. It measures the reaction of an asset's return. Investopedia explains beta like this: "Beta is a measure of the volatility, or systematic risk, of a security or a portfolio in comparison to the market as a whole. Beta is used in the capital asset pricing model (CAPM), a model that calculates the expected return of an asset based on its beta and expected market returns.

"Beta is calculated using regression analysis, and you can think of beta as the tendency of a security's returns to respond to swings in the market. A beta of 1 indicates that the security's price will move with the market. A beta of less than 1 means that the security will be less volatile than the market and a beta of greater than 1 indicates that the security's price will be more volatile than the market. For example, if a stock's beta is 1.2, it's theoretically 20% more volatile than the market. Many utilities stocks have a beta of less than 1. Conversely, most high-tech, Nasdaq-based stocks have a beta of greater than 1, offering the possibility of a higher rate of return, but also posing more risk."

The macro, or "systematic", risk factors are explained above. Besides these market-wide factors, there are some risk factors that affect only a limited number of assets. These include labor strikes, part shortages, regulation changes for some industries, management change in a company, etc. These factors are unique to a company or an industry, therefore the risk associated with these factors is called "unique risk" or "asset-specific risk." Since diversification (i.e. forming a portfolio) can eliminate this type of risk, it is also called "diversifiable risk."

The Capital Asset Pricing Model
Ross et al. (2014) explains the Capital Asset Pricing Model in detail. The CAPM defines the relationship between risk and expected return:

$$E(R_A) = R_f + \beta_A(E(R_M) - R_f)$$

where, $E(R_A)$ is the expected return on stock A, R_f is the risk-free rate of return, β_A is the systematic risk of stock A, and $E(R_M)$ is the expected return on the stock market as a whole.

If we know a stock's systematic risk, we can use the CAPM to determine its expected return.

Similarly, in order to estimate the expected return on a portfolio, we can use the CAPM:

$$E(R_P) = R_f + \beta_P(E(R_M) - R_f)$$

where, $E(R_P)$ is the expected return on the portfolio and β_P is the systematic risk of the portfolio.

The Security Market Line
The Security Market Line (i.e. SML) is the graphical representation of the CAPM. Investopedia explains the Security Market Line as below:

"The security market line (SML) is a line that graphs the systematic, or market, risk versus return of the whole market at a certain time and shows all risky marketable securities. The SML essentially graphs the results from the capital asset pricing model (CAPM) formula. The x-axis represents the risk (beta), and the y-axis represents the expected return. The market risk premium is determined from the slope of the SML."

Boundless.com states that "The security market line displays the expected rate of return of a security as a function of systematic, non-diversifiable risk. The security market line is the theoretical line on which all capital investments lie. Investors want higher expected returns for more risk. On a graph, the line has risk on its horizontal axis (independent variable) and expected return on the vertical axis (dependent variable). Assuming a linear relationship

between risk and return, the assumption is that the y-intercept is the return on a risk-free investment (the risk free rate), and the slope is the premium on risk in terms of expected returns. Valuationacademy.com first explains the SML and then shows it on a graph:

"The Security Market Line (SML) is essentially a graph representation of CAPM formula. It plots the expected return of stocks on the y-axis, against beta on the x-axis. The intercept is the risk free rate and the slope represents the market premium. Individual securities' expected return and risk are plotted on the SML graph. For one security, if it is plotted above the SML, it is undervalued as the investors are expecting a greater return for the same amount of risk (beta). If it is plotted below the SML, it is overvalued as the investors would accept a lower return for the same amount of risk (beta)."
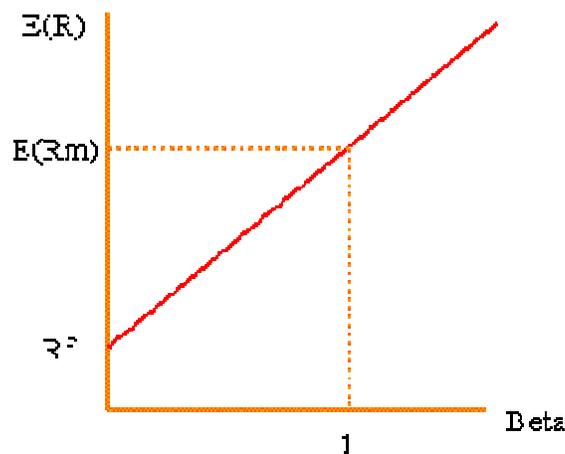
The Decision
Michael starts to collect some data from various sources. He finds the following information for current Treasury bill and Treasury bond yields:

Instrument	Yield
1-month t-bill	1%
3-month t-bill	1.30%
6-month t-bill	1.70%
12-month t-bill	1.80%
2-year Treasury Note	2%
5-year Treasury Note	2.20%
10-year Treasury bond	2.30%
15-year Treasury bond	2.50%
20-year Treasury bond	2.60%
30-year Treasury bond	3%

He has also collected some information from several websites on the expected stock market return for the next year:

Source	Expected Market Return
Yahoo Finance	12.4%
MSN Money	10.8%
Google	9.8%

He knows that he would need the "beta" (i.e. the systematic risk) coefficient for "Green World" shares, so he checks several sources and finds the following "beta" estimates for "Green World":

Source	Beta for "Green World" shares
Yahoo Finance	0.85
NASDAQ	1.02
Google	0.83

He wonders which Treasury instrument's yield would better serve as the risk-free rate. For that, he decides to consult one of his colleagues. For beta and expected market return, he thinks using the averages for both of them would be a good idea.

1. What number should he use for the "risk-free rate"?

2. Should he use any of the estimates for the expected market return (Yahoo's, MSN's, or Google's), or should he take the average of those estimates as his best estimate for expected market return?

3. Should he use any of the beta estimates (Yahoo's, Google's, or NASDAQ's), or should he take the average of those estimates as his best estimate for "Green World" shares' beta?

4. He wants to draw the Security Market Line (i.e. SML). How can he do that? How will the SML look like?

5. If a stock's expected return falls exactly on the SML, according to CAPM, is the stock fairly priced, overpriced, or underpriced?

6. If a stock's expected return is more than what the SML indicates (i.e. above the SML), is the stock fairly priced, overpriced, or underpriced?

7. Think about the SML in question #4. If the expected return on "Green World" shares is 13% and beta of "Green World" is 0.9, is "Green World" stock fairly priced, overpriced, or underpriced according to CAPM? In this case, should Michael invest in "Green World" shares?

8. There is another company that deals with sustainability projects. This company's name is "Global Unity". If "Green World" and "Global Unity" stocks both have the same reward to risk ratio (i.e. they are on the same SML) and if the beta of "Global Unity" is 1.3, what is the expected return on "Global Unity" stock? Please use the expected return and beta of "Green World" stock that are given in question #7.

9. In general, if the SML gets steeper (the reward to risk ratio gets higher), is it good for the firms who wants to get financing?

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