

Reader's Guide: The U.S. SEC enforcement of the *Mark-To-Market* definition on financial instruments had a significant negative impact on the 2008-09 international economy and contributed to the resulting major recession. A modified Beta definition for stock investing is one Open4Definition members undertaking to jump start the process of developing a suite of potentially counterbalancing financial definitions. An improved Beta will enable investors to make better investment decisions based on a truer reading of the sensitivity of a security to the movement of the general stock market. This paper explains a modified definition for Beta. (1,100 words) Other definitions: correlation, date range, stock volatility, formula, arbitrage and investment risk.

Reformulating Beta (β) -

Is the “normal” calculation of this correlation coefficient correct?

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Introduction:

At a time of historic stock market volatility and paradigm shattering circumstances, sit back and think of the risk associated in today's financial markets. Not just the real estate or credit risk one hears about on the nightly news, but the risk associated with investments and financial instruments—particularly stocks (i.e., securities)—and how it is measured. This paper will focus on a variable that is used to calculate risk known as Beta, signified by the Greek symbol β . The paper will examine the common calculation, or definition, used to derive Beta and offer an alternative theory on how to calculate this measure.

Wikipedia's definition for Beta follows:

Beta of a stock measures the sensitivity of the security to the general stock market by using the movements of a stock and compares, or correlates, them over time to the movement of the stock market¹, hence the term of correlation coefficient.

Before presenting an alternative method to calculate Beta it is important to understand what exactly Beta is and why it is used. In short, most commonly traded stocks have a Beta associated with it. Beta signifies how well the stock is correlated with the market as a whole. If a stock has a Beta of 1.5 and the overall stock market value goes up 10% in one time period, the stock's value should go up by 15% (1.5 x 10%) in the same time period. Stocks with negative Beta would mean that when the general stock market has a downward movement then the negative Beta stock value will go up. For example, Microsoft (MSFT)² has a Beta of 1.07; MSFT stock holders could accept a return in excess of 7% in addition to the average market return. The Coca-Cola Company (KO)³ Beta is

¹ Traditionally the S&P 500 is used as the Stock Market Value - [http://en.wikipedia.org/wiki/Beta_\(finance\)](http://en.wikipedia.org/wiki/Beta_(finance))

² <http://finance.yahoo.com/q/ks?s=MSFT>

³ <http://finance.yahoo.com/q/ks?s=KO>

0.62; meaning KO stock holders could expect a return equal to 62% of that of the general market. Take a KO example, if the market's yearly return was -10%, KO share holders could expect a - 6.2% return on their investment. The understanding of a stock's Beta is undeniably valuable, but a concern lies in the calculation of a stock's Beta.

Please note, the nuts-and-bolts calculations in this paper are not intended to be precise, but more as tools used to break the common definition and thought pattern around this highly used variable. The traditional calculation of Beta is below:

$$\beta_a = \frac{\text{Cov}(r_a, r_p)}{\text{Var}(r_p)}$$

- Looks fun doesn't it. Try doing the calculation by hand!

The above formula is the most widely used calculation for Beta with data being equally weighted over a defined date range, typically three years. In essence, the most widely used calculation for Beta states, that what happened three years ago with the stock has the same weight as what happened yesterday with the sock.

A more accurate measure for Beta would be to give more weight to the stock's more recent activity. For example, assuming time period one in the chart below was yesterday and time period five was five days ago:

Different Beta Calculations			
Time Period	Period Beta	Simple Mean.	Weighted Mean
1	1.6	0.20	0.40
2	1.4	0.20	0.30
3	1.2	0.20	0.20
4	1.0	0.20	0.10
5	0.8	0.20	0.00
Calculated Beta		1.20	1.40

As one can see there is a significant difference in the values of the calculated Betas as a result of the weights of the measures.

Applicable Examples:

With the understanding that there may be a different way to calculate Beta, let's turn to why that is important. Recall Beta can help understand volatility, and thus risk of a stock, or financial instrument, versus that of the general stock market. The formulas below all use Beta in deriving expected values of various investment or cost opportunities. An adjustment to the way Beta is calculated could greatly change one's decision-making process of taking on the corresponding investment. The examples presented below highlight the common name used for the formula as well as the technical textbook calculation, so one can see where Beta exists in the calculation. Lastly, applicable examples of how this formula would be used in real-world decisions are presented, under the terminology, real-world relevance.

- **CAPM** – Capital Asset Pricing Model

- **Technical Definition**⁴ – CAPM is used to determine a theoretically appropriate required rate of return of an asset.

- **Formula**⁵:

$$\frac{E(R_i) - R_f}{\beta_i} = E(R_m) - R_f$$

- **Real-World Relevance** – With Beta weighing heavily into this calculation, an adjustment to the variable would then change the expected rate of return on an asset. Corporate financial planning could greatly be affected by errors in the expected risk with a normal weighted Beta. A company may invest in a capital budget initiative, such as an acquisition target, with an expected return calculated by CAPM. An inaccurate Beta calculation could have the acquiring company greatly overpay the target company’s shareholders, therefore hurting the acquiring company’s bottom line profits in the long run.

- **Arbitrage Pricing Theory (APT)** – (i.e., Multiple Beta Model)

- **Technical Definition**⁶ – APT holds that the expected return of a financial asset can be modeled as a linear function of various macro-economic factors or theoretical market indices, where sensitivity to changes in each factor is represented by a factor-specific Beta coefficient.

- **Formula**⁷:

$$E(r_j) = r_f + b_{j1}RP_1 + b_{j2}RP_2 + \dots + b_{jn}RP_n; \text{ where } r_j = E(r_j) + b_{j1}F_1 + b_{j2}F_2 + \dots + b_{jn}F_n + \epsilon_j$$

- **Real-World Relevance** – In this formula multiple factors are used in deriving the expected return on an asset. These factors could range from prices on commodities such as oil, to exchange rate instruments for example, options on currency futures. Respective Betas are used for each coefficient in the formula. This asset’s expected value is then used to make investment decisions based on the factors in this model. The current normal definition of Beta would compound the inaccuracy across not just one but multiple financial instruments. An inaccurate calculation could be devastating to a company making financing decisions, such as to hedge its internal balance sheet exposure through a currency swap or other financial instrument.

⁴ http://en.wikipedia.org/wiki/Capital_asset_pricing_model

⁵ http://en.wikipedia.org/wiki/Capital_asset_pricing_model

⁶ http://en.wikipedia.org/wiki/Arbitrage_pricing_theory

⁷ http://en.wikipedia.org/wiki/Arbitrage_pricing_theory

Conclusion:

The goal of this paper was to present an inaccuracy used in the normally accepted calculation of Beta. Beta is imperative to financial decisions as it measures the risk of an asset of a financial instrument to that of the stock market, traditionally the S&P 500. Changing the way Beta is traditionally calculated could revolutionize the way risk is viewed and valued for the securities and instruments being measured.

Of course, the normal definition of the “stock market” being the S&P 500 is a definition that one could challenge, due to the global interactions within today’s business environment. Sounds like the topic for an accompanying paper or a suite of similarly reformulated financial-centered definitions.

Additional Reading:

INVESTMENT VOLATILITY: A CRITIQUE OF STANDARD BETA ESTIMATION AND A SIMPLE WAY FORWARD

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