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Ruminations on Risk

Beta Versus Margin of Safety

- **Volatility remains a reasonable measure of risk for the short term. Long-term investors are better off considering the "margin of safety" concept. There is evidence that suggests that volatility understates risk for up to four years, but overstates risk for holding periods beyond four years.**
- **Margin of safety can be restated as a discount to expected value. Expected value is a function of the weighted probability of potential outcomes. Judgments on both outcomes and probabilities are tricky, but essential to the investment process.**
- **Investors should base the magnitude of their investments on the size of the margin of safety. For companies with variable outcomes, the consensus can be the most likely outcome and the stock may still be attractive or unattractive. Companies with narrow outcomes require a non-consensus point of view for a buy or sell.**

US Investment Strategy

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Executive Summary

The concept of risk plays a central role in the investment process. Yet risk is an elusive concept—difficult to define, quantify and integrate.

In this report, we consider two senses of the term risk. The first is what is mainstream in finance circles: you can measure risk by seeing how much a stock bounces around versus "the market." You can quantify this measure of risk through variance. The higher the variance—the larger the swings in relative price—the riskier the stock.

The second sense is the "margin of safety", or a discount to expected value. The idea here is that for every stock there is an intrinsic value, and that the deeper the discount the stock price is to intrinsic value, the lower the risk.

We start this report by noting Warren Buffett's attack on the first risk definition. (We suggest that he believes in, and acts according to, the second definition.) Unfortunately, Buffett attacks an idea that does not follow from finance theory. Without defending the traditional theory, we note that Buffett's comments better reflect the second risk definition.

The conclusions from the report are as follows:

- Volatility remains a reasonable measure of risk for the short-term. Long-term investors are better off considering the concept of margin of safety. There is evidence that suggests that volatility understates risk for up to four years, but overstates risk for holding periods beyond four years.
- Margin of safety can be restated as a discount to expected value. Expected value is a function of the weighted probability of potential outcomes. Judgments on both outcomes and probabilities are tricky, but essential to the investment process.
- Investors should base the magnitude of their investments on the size of the margin of safety. For companies with variable outcomes, the consensus can be the most likely outcome and the stock may still be attractive or unattractive. Companies with narrow outcomes require a non-consensus point of view for a buy or sell.

Introduction

"Finance departments teach that volatility equals risk. Now they want to measure risk. And they don't know any other way—they don't know how to do it, basically. So they say that volatility measures risk.

I've often used the example of the Washington Post stock when we first bought it: In 1973, it had gone down almost 50%—from a valuation of the whole company of close to say $180 or $175 million down to maybe $80 million or $90 million. And because it happened very *fast*, the *beta* of the stock had actually increased. A professor would have told you that the stock of the company was more risky if you bought it for $80 million than if you bought it for $170 million—which is something that I've thought about ever since they told me that 25 years ago. And I *still* haven't figured it out."

Warren Buffett

Outstanding Investor Digest (August 8, 1997)[1]

We love Warren Buffett. Anyone who's ever read our research or heard us talk knows it to be true. But there is something that's been bugging us for a long time, and we have to get it off our chests.

Buffett got this one wrong.

Often, when Buffett needs a lead-in to slam finance theory, he tells the above-quoted story as prima facie evidence of his case. In early 1970s, Washington Post stock got walloped, the beta went up (suggesting the stock was more risky) while any right-minded investor should see that the stock was actually less risky (because the price dropped more than the value).

Buffett's argument has two problems. The first is that the beta didn't go up: we have the empirical data to back that one. The second is that in saying the stock is less risky, Buffett assumed that the price to value gap had widened—the stock's "margin of safety" grew. But value could be logically distinct from price only if Buffett believed something different than what the market believed. Buffett's judgment proved to be correct, but that is not necessarily a statement about the shortcomings of finance theory.

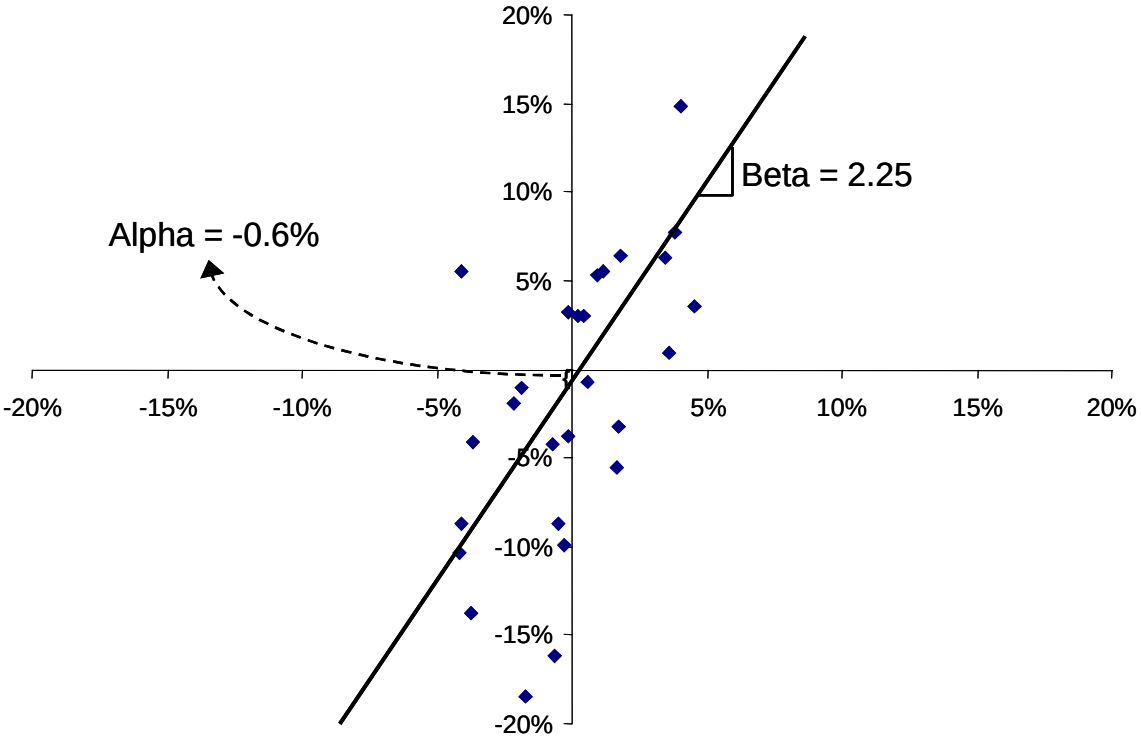
Rest assured, Buffett faithful, this report will have a happy ending. Indeed, we believe all investors can learn a great deal about an appropriate investment philosophy by studying and practicing Buffett's stock selection approach. But before we get to the good stuff, we have to address the issue of beta.

We are not enthusiastic defenders of the finance theory faith. In fact, we have argued that a new framework, based on complex adaptive systems, will supercede modern finance theory.[2] But it's one thing to attack finance theory based on what it predicts, it's another game altogether to challenge the theory based on claims it doesn't make. And nowhere does finance theory say that the beta on Washington Post's stock must rise just because the stock declines. Such a statement confuses beta, a measure of a stock's covariance vis-a-vis the market (often using the S&P 500 as a proxy), with alpha, a measure of risk-adjusted excess returns.

Exhibit 1 presents Washington Post's beta and alpha graphically. Beta is the slope of the fitted line through the plotted monthly rates of return for Washington Post versus the

S&P 500. Beta doesn't measure an asset's *returns* versus another asset, it just measures whether or not the asset's price bounces more or less than another asset's. Alpha, the intercept, *does* represent a rate of price change. So just because Washington Post's alpha was negative (i.e., its returns were below those of the market) during 1973 didn't mean that its beta had to rise.

Exhibit 1: Washington Post Beta and Alpha (1973)



Source: Barra Beta book, CSFB analysis.

Exhibit 2 shows the actual historical beta for WPO's stock. Notwithstanding the stock's correction, the beta actually dropped from roughly 2.4 in early 1973 to 2.3 by the end of the year, by our calculation. Barra's beta figures show a similar decline. The negative alpha, of course, reflects the stock's poor relative performance.

Exhibit 2: Washington Post Historical Beta (1973)

	S&P	Stock	Beta	Alpha	Barra Beta
Jan-73	116.03	$31.00	2.28	-0.2%	3.16
Feb-73	111.68	$26.75	2.40	-0.5%	3.19
Mar-73	111.52	$25.75	2.41	-0.7%	3.20
Apr-73	106.97	$23.50	2.37	-0.6%	2.98
May-73	104.95	$23.25	2.33	-0.4%	2.91
Jun-73	104.26	$19.50	2.39	-1.0%	3.06
Jul-73	108.22	$21.00	2.38	-1.0%	3.09
Aug-73	104.25	$20.13	2.29	-0.8%	2.92
Sep-73	108.43	$23.13	2.38	-0.6%	2.99
Oct-73	108.29	$23.88	2.38	-0.4%	2.95
Nov-73	95.96	$18.00	2.29	-0.3%	2.64
Dec-73	97.55	$17.00	2.25	-0.6%	2.61

Source: Barra Beta Book, CSFB analysis.

The classic definition of risk is the possibility of suffering harm or loss. So an asset that has a wide distribution of potential returns presents a greater probability of "suffering harm" (or sizable gains) than an asset with a narrow distribution of probabilities. We agree with Peter Bernstein, who notes that "volatility, or variance, has an intuitive appeal as a proxy for risk." He adds, "If you were asked to rank the riskiness of shares of the Brazil Fund, shares of General Electric, a U.S. Treasury bond due in thirty years, and a U.S. treasury bill due in ninety days, the ranking would be obvious. So would the relative volatility of the securities."[3]

The critical catch is volatility's temporal dimension. More directly, there is some evidence that variance understates risk over the first four years of a holding period, but overstates risk over four years or more.[4] This evidence implies that long-term holders assume less risk than short-term holders. We might even make the statement that the long term investor *welcomes* volatility if it helps present investment opportunities.

We like to think about risk on at least two levels. Over the short term, volatility is a pretty reasonable measure of risk.[5] Indeed, volatility plays an overwhelming important role in the design and valuation of derivatives—most notably options.

But for investors with a long-term horizon, we think the best way to maximize the risk/reward tradeoff is to buy stocks that offer a margin of safety. We think this is what Buffett refers to when he thinks about risk. A margin of safety—a concept attributable to Ben Graham—exists when an investor can purchase a stock well below its intrinsic value.[6] Buffett defines intrinsic value in no uncertain terms: "it is the discounted value of the cash that can be taken out of a business during its remaining life."[7]

Margin of Safety

We believe the best and most practical way to restate the margin of safety concept is to think about discounts to expected value. The combination of probabilities and potential outcomes determine expected value. Says Buffett, "Take the probability of loss times the amount of possible loss from the probability of gain times the amount of possible gain. That is what we're trying to do. It's imperfect, but that's what it's all about."[8]

Take the simple example of a coin toss that pays $3 for heads and $1 for tails. What's the expected value? You calculate it as (50% x $3) + (50% x $1) = $2. Now for investing, both the probabilities and the potential outcomes are much more difficult to estimate, but the idea is the same. Let's take a closer look at both probability and potential outcomes.

We can specify two types of probabilities: objective (or frequency) and subjective.[9] Objective, or frequency, probabilities arise when there are specified outcomes. Coin tosses are a good example. In these cases, the probability is based on the law of averages as it assumes that the event is repeated countless times. While we still can't make definitive statements about any specific outcome, the frequency of outcomes will reflect the probability of each outcome over time.

The circumstances are totally different for events that only happen once—a valid assumption for stock investing. Here, we must rely on *subjective* probabilities. Subjective probabilities describe an investor's "degree of belief" about an outcome.[10] These probabilities are rarely static, and generally change as evidence comes along. Bayes's Theorem is a means to continually update conditional probabilities based on new information. Bayesian analysis is a valuable means to weigh multiple possible outcomes when only one outcome will occur.[11]

As Robert Hagstrom notes, the textbooks on Bayesian analysis suggest that if you believe that your assumptions are reasonable, it is perfectly acceptable to make your subjective probability of a particular event equal to a frequency probability.[12] Thinking about the investing world probabilistically is critical to the margin of safety concept.

We now turn to potential outcomes. Analysts often use target prices to represent their best guess of the most likely outcome. However, intelligent investors explicitly acknowledge that they must consider a range of potential outcomes. How does an investor go about constructing this range?

The expectations investing approach offers a specific process to calculate potential outcomes based on various revisions in expectations.[13] In short, the process involves considering whether changes in sales, operating costs, or investments have the greatest impact on shareholder value. (This step explicitly considers interactivity—for example, how higher sales sometimes lifts operating profit margins as well.) Once you develop reasonable ranges for the most important trigger, you can specify ranges of the shareholder values that result.

For example, let's say that you determine that sales growth is the most important trigger for a particular company. You can then consider all of the micro-economic factors that sales set off (e.g., operating leverage, economies of scale) and estimate the resulting

computationally oriented value drivers. This allows for an estimate of stock price outcomes.

We generally recommend considering at least three outcomes: a high value, a low value, and a consensus value. The consensus value represents the expectations that the stock price implies. These outcomes, when combined with associated probabilities, provide a solid basis for estimating expected value.

Consider a simple illustration. Assume that analysis of a stock's potential outcomes yields a high value of $82 and a low value of $12. The stock currently trades at $50. Next, allow for subjective probabilities of the outcomes as follows: 20 percent for the low scenario, 30 percent for the high scenario and 50 percent for the consensus. The expected value for this stock is $52, as exhibit 3 shows.

Exhibit 3: Expected Value Calculation

Stock Price	Probability	Weighted Value
$12	20%	$2.40
50	50%	25.00
82	30%	24.60
		$52.00

Source: CSFB analysis.

Two important observations follow from the use of expected value analysis as a measure of margin of safety. The first is that the greater the discount to expected value—the larger the margin of safety—the more you should invest. The Kelly Optimization Model provides some guidance on the appropriate relative size of investments. The following formula expresses the model:

$$2p - 1 = x$$

Where 2 times the probability of winning (p) minus 1 equals the percentage of your total assets that you should invest (x).[14] The Kelly Optimization Model has limitations and, needless to say, the stock market is more complex than many risk-reward scenarios. But the idea is critical: Bet large when you believe the probability of success is high, and don't play if the probability of success is negligible. Buffett has reinforced this idea of the years by suggesting that investors only be allowed to make 20 investments decisions in their lives.

The second important observation deals with value variability. Specifically, if a company has a wide range of stock price outcomes (high variability), the stock may be attractive or unattractive even if the consensus is the most probable outcome. This is because a lower-than-consensus yet sufficiently high probability placed on, say, a high outcome well in excess of the current price creates a large price-to-expected value gap.

Alternatively, if a company has low value variability, you must bet against the consensus to achieve a sufficient margin of safety. This is so because when the consensus is most likely, the price-to-expected value gaps is too narrow to generate a sufficient margin of safety.

Warren Buffett's perspectives on risk and stock selection are clearly edifying. But we think that investors should differentiate between short-term risk, where a concept like volatility is very useful, and long-term risk, where margin of safety is more operative.

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Closing prices as of August 2, 2001:

Washington Post (WPO, $588.15)

[1] Buffett makes similar comments elsewhere. See *Outstanding Investor Digest*, April 18, 1990 and the *Berkshire Hathaway Annual Report*, 1993.

[2] See Michael J. Mauboussin, *Shift Happens*, Credit Suisse First Boston Equity Research, October 27, 1997.

[3] Peter L. Bernstein, *Against the Gods: The Remarkable Story of Risk* (New York: John Wiley & Sons, 1996), p. 260.

[4] Jeremy J. Siegel, *Stocks for the Long Run*, 2nd ed., (New York: McGraw Hill, 1998), p. 32. Also, Edgar E. Peters, *Fractal Market Analysis: Applying Chaos Theory to Investment & Economics* (New York: John Wiley & Sons, 1994), pp. 28-30.

[5] In reality, the security returns are not normally distributed, but exhibit high kurtosis and fat tails. So volatility is only an approximation of risk.

[6] Benjamin Graham, *The Intelligent Investor, 4th Ed.* (New York: Harper & Row, 1973), pp. 277-287.

[7] *Berkshire Hathaway Owner's Manual*, 1996, p. 11.

[8] Andrew Kilpatrick, *Of Permanent Value: The Story of Warren Buffett* (Birmingham, Al.: AKPE, 1998), p. 800.

[9] Much of this discussion draws heavily from Robert G. Hagstrom, *The Essential Buffett: Timeless Principles for the New Economy* (New York: John Wiley & Sons, 2001), pp. 133-140.

[10] Ibid., p. 137.

[11] Hagstrom provides a wonderful example: "Let's imagine you and a friend have spent the afternoon playing your favorite board game, and now, at the end of the game, you are chatting about this and that. Something your friend says leads you to make a friendly wager: that with one roll of the die from the game, you will get a 6. Straight odds are in six, a 16 percent probability. But then suppose your friend rolls the die, quickly covers it with her hand, and takes a peek. 'I can tell you this much,' she says; 'it's an even number.' Now you have new information and your odds change dramatically to one in three, a 33 percent probability. While you are considering whether to change your bet, your friend teasingly adds: 'And it's not a 4.' With this additional bit of information, your odds have changed again, to one in two, a 50 percent probability."

[12] Ibid., p. 137.

[13] Alfred Rappaport and Michael J. Mauboussin, *Expectations Investing: Reading Stock Prices for Better Returns* (Boston: Harvard Business School Press, 2001).

[14] Hagstrom, p. 142-143.

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