

INSIGHTS

The Risk Contribution of Stocks

Most investors tend to believe that stocks are a good—perhaps even the best—investment in the long run. **However, the reason for expecting good performance from stocks is perhaps not always clearly articulated: Quite simply, it is because they are risky.**

For an investor in the US, US Government debt is generally viewed as being risk-free, if we ignore inflation risk. This investor would rank investment-grade senior corporate debt as slightly more risky than Treasury bonds (with AAA-rated debt viewed as less risky than AA, followed by A, and so on). Next in the hierarchy would come subordinated debt, preferred stock, and common stock would bring up the rear. The reason stocks are the riskiest investment is that they are at the bottom of the pecking order in terms of their claim on the company's profit or cash flow. But the reason they can also be the most rewarding is that they are entitled to all residual profits, after paying off the other more senior claims in the corporate capital structure.

Generally, investments with higher risk are expected to yield higher returns as an incentive to investors. Here, we do not address the issue of return. We simply focus on the risk of various stock-bond portfolios, and examine how much of this risk comes from their components, and, in particular, from stocks.¹

We do not know how volatile stocks and bonds will be in the future. We could use historical volatility as a projection, but the realized volatility of any asset depends on both the time period and the horizon over which it is measured. We therefore make some assumptions that are based on the realized values for the period 1975-2016 (the point we are trying to make here does not depend on the exact assumptions).



Dr. Ajay Dravid

Chief Investment Officer,
Equinox Institutional
Asset Management, LP

Dr. Dravid has over 30 years of experience in industry, academia, and financial services.

He has published numerous papers in leading academic and practitioner journals including Journal of Finance, Journal of Financial Economics, and Journal of Derivatives. Dr. Dravid received a BSc in Physics from the University of Poona (India), an MA in Physics from SUNY at Stony Brook, an MBA in Finance and Marketing from the University of Rochester, and a PhD in Finance from the Graduate School of Business at Stanford University.

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¹Here, we use the standard deviation of returns, also called volatility, as the measure of risk. For most traditional assets, and when dealing with returns measured over reasonably long horizons, volatility serves as an adequate proxy for risk.

Definitions of Terms and Indices can be found on page 5.

In **Table 1**, we illustrate the assumed volatilities for stocks and bonds, and also the assumed correlation between them. We denote volatility with the Greek letter σ (sigma) and use subscripts 's' and 'b' for stocks and

bonds, respectively. The correlation is denoted by the Greek letter ρ (rho), with both 's' and 'b' as subscripts, denoting that this is the correlation coefficient between stocks and bonds.

TABLE 1

Risk Assumptions

Based on 1975-2016

	VOLATILITY	CORRELATION
Stocks	$\sigma_s = 15\%$	
Bonds	$\sigma_b = 5\%$	
Stocks/Bonds		$\rho_{sb} = 20\%$

In order to analyze how much of the risk of a stock-bond portfolio comes from each of its components, we need to understand how the volatility of a portfolio is calculated. **Table 2** illustrates the formulas behind the calculations.

TABLE 2

Contributions to the Risk of a 60/40 Stock/Bond Portfolio

	Weights	Stocks	Bonds	Squared Risk	Risk	Contribution to Risk
Stocks	$w_s = 60\%$	0.00810	0.00036	0.00846		91.8%
Bonds	$w_b = 40\%$	0.00036	0.00040	0.00076		8.2%
Portfolio					9.60%	100.0%

$$= w_s^2 \cdot \sigma_s^2$$

$$= \rho_{sb} \cdot w_s \cdot w_b \cdot \sigma_s \cdot \sigma_b$$

$$= w_b^2 \cdot \sigma_b^2$$

The risk of a stock-bond portfolio consists of four different pieces. For the sake of simplicity, we call them:

- the risk of stocks alone,
- the risk of bonds alone,
- the "co-risk" of stocks and bonds, and
- the "co-risk" of bonds and stocks.

Source: Equinox Institutional Asset Management, LP. Definitions of Terms and Indices can be found on page 5.

No amount of diversification or correlation can ensure profits or prevent losses. An investment in managed futures is speculative and involves a high degree of risk. Investors can lose money in a managed futures program. There is no guarantee that an investment in managed futures will achieve its objectives, goals, generate positive returns, or avoid losses.

The **risk of stocks alone** is given by the squared value of the allocation to stocks (60% in our example) multiplied by the squared value of the risk of stocks (assumed to be 15%). This value turns out to be 0.00810.

The **risk of bonds alone** is given by the squared value of the allocation to bonds (40% in our example) multiplied by the squared value of the risk of bonds (assumed to be 5%). This value is 0.00040.

The **“co-risk” of stocks and bonds** is given by the product of five quantities: the allocation to stocks, the allocation to bonds, the risk of stocks, the risk of bonds, and the correlation between stocks and bonds. This is equal to 0.00036. The **“co-risk” of bonds and stocks**, by symmetry, is also 0.00036.

Adding up these four numbers, we get 0.00922. The square root of this gives us 9.6%, the volatility of the 60/40 stock/bond portfolio.³

which is 0.00922. Thus, stocks contribute almost 92% of the portfolio’s risk, while bonds contribute the remaining 8.2%!

Upon reflection, **perhaps this should not be a surprising result**. The risk of stocks is three times as high as bonds (15% vs. 5%), and the allocation to stocks is 1.50 times the bond allocation (60% vs. 40%). These two factors combined result in the high contribution of stocks to portfolio risk. Many investors mistakenly believe that a 60/40 stock/bond portfolio is “well diversified” relative to an all-stock portfolio. In fact, even though this may appear true given that the portfolio’s risk is only about 64% of the risk of stocks (9.6% vs. 15%), the fact remains that 92% of this lower total risk still comes from stocks.

In going from an all-stock portfolio, where 100% of the risk comes from stocks, to a 60/40 portfolio, the risk contribution of stocks falls to about 92%. In Table 3, we show the corresponding result for other portfolios, ranging from all-stock to all-bond. The results are also depicted graphically.

What is the contribution of each component?

The risk of stocks alone plus the shared risk of stocks and bonds is 0.00846, which is 91.8% of the total squared risk,

TABLE 3

Risk Contribution of Stocks in Various Stock/Bond Portfolios

Stock Allocation	Portfolio Risk	Contribution of Stocks
100%	15.0%	100.0%
90%	13.6%	99.1%
80%	12.2%	97.7%
70%	10.9%	95.5%
60%	9.6%	91.8%
50%	8.4%	85.7%
40%	7.2%	75.9%
30%	6.2%	60.3%
20%	5.5%	38.3%
10%	5.0%	14.3%
0%	5.0%	0.0%

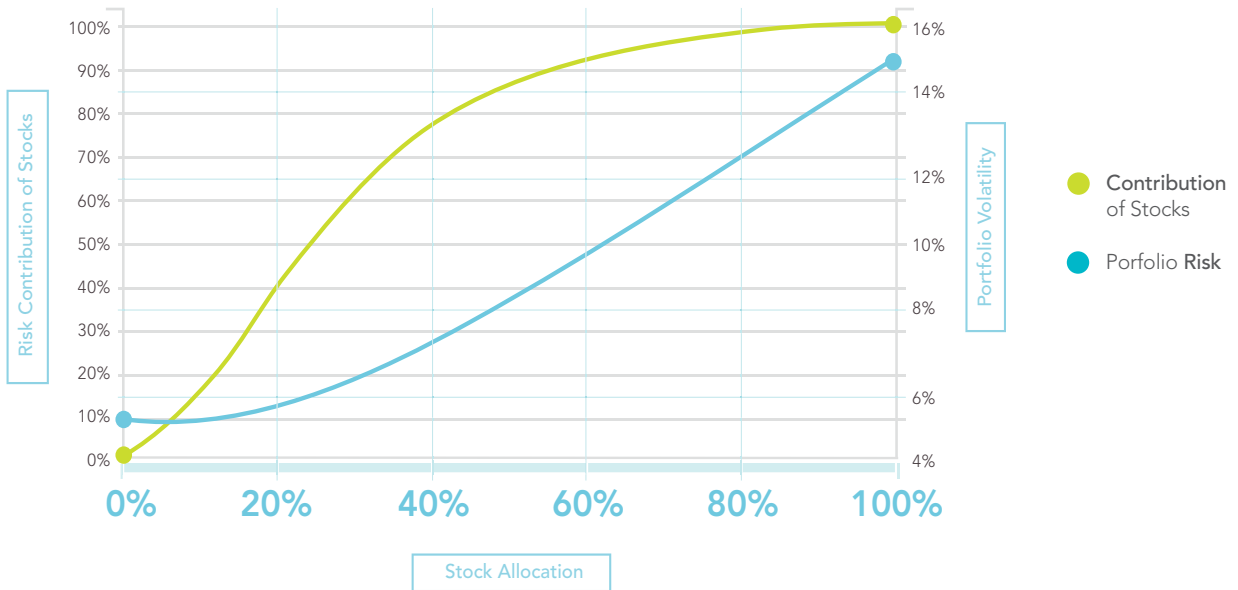
³Note that this is lower than the weighted average of the volatilities, which is 60% of 15% plus 40% of 5%, i.e., 11%. The fact that the portfolio volatility is only 9.6% rather than 11% represents the benefit of diversification: the correlation coefficient is only 20%, and this results in lower risk. If stocks and bonds were perfectly (100%) correlated, the portfolio’s volatility would have been 11%.

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Risk Contribution of Stocks in Various Stock/Bond Portfolios



For an all-stock portfolio, all of its total risk of 15% (depicted on the right-hand vertical axis) comes from stocks. If we diversify into an 80/20 stock-bond portfolio, total risk falls to 12.2%, but almost 98% of this risk is still attributable to stocks. We have already seen the results for a 60/40 portfolio: almost 92% of portfolio risk comes from stocks. Even if we diversify further and consider a 40/60 portfolio, nearly 76% of its total risk, which is 7.2%, still comes from stocks. Even a portfolio with only 20% allocated to stocks derives almost 40% of its risk from them.

It bears repeating that risk is only one dimension, the other being return. While portfolio risk drops with the allocation to stocks, so does the expected return of the portfolio. In the long run, stocks must be expected to earn higher returns than

bonds, in order to compensate investors for their higher risk. Investors, in conjunction with their advisors, need to decide the level of total portfolio risk with which they are comfortable.

This will likely be a function of several variables, including age and position in the life-cycle, wealth, liquidity, and attitude towards risk.

In our next piece, we will address the topic of extended diversification: How does investing in other non-correlated asset classes affect total portfolio risk and its components. This may be a particularly important issue at a time when global stock markets are near all-time highs while volatility appears to be almost unusually low.

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DEFINITIONS OF TERMS AND INDICES

Terms

A **bond** is a debt investment in which an investor loans money to an entity (typically corporate or governmental) which borrows the funds for a defined period of time at a variable or fixed interest rate.

Common Stock is a security that represents ownership in a corporation.

Preferred Stock is a class of ownership in a corporation that has a higher claim on its assets and earnings than common stock.

Investment **risk** is the probability or likelihood of occurrence of losses relative to the expected return on any particular investment.

A **stock** is a type of security that signifies ownership in a corporation and represents a claim on part of the corporation's assets and earnings.

Subordinated debt is a loan or security that ranks below other loans and securities with regard to claims on a company's assets or earnings.

Treasury stock is the portion of shares that a company keeps in its own treasury.

Volatility is the degree of variation of a trading price series over time as measured by the standard deviation of logarithmic returns.

Index Descriptions

Investors cannot directly invest in an index and unmanaged index returns do not reflect any fees, expenses or sales charges.

The **Barclays Capital US Aggregate Bond Index**[®] covers the USD-denominated, investment-grade, fixed-rate, taxable bond market of SEC-registered securities. The index includes bonds from the Treasury, Government-Related, Corporate, MBS (agency fixed rate and hybrid ARM pass-throughs), ABS, and CMBS sectors.

The **S&P 500**[®] **Total Return Index** is widely regarded as the best single gauge of the US equities market. This world-renowned Index includes 500 leading companies in leading industries of the US economy.

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equinoxampersand.com
1.877.837.0600
info@equinoxampersand.com

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Equinox Institutional Asset Management, LP
47 Hulfish Street, Suite 510, Princeton, NJ 0854
T 1.877.837.0600 equinoxampersand.com