

INSIGHTS

The Risk Contribution of Stocks: Part 2

In our previous Insight, we focused on the risk of various stock-bond portfolios and examined how much of this risk comes from their components.¹

Based on some reasonable assumptions about the volatility of stocks and bonds, and the correlation between them, we showed that most of the risk comes from stocks.

For an 80/20 stock-bond portfolio, 98% of total risk is attributable to stocks, and for a 60/40 portfolio, the contribution is as high as 92%. If we diversify further away from stocks, and consider a 40/60 portfolio, 76% of its total risk still comes from stocks. Even a portfolio with as little as 20% allocated to stocks derives almost 40% of its risk from them.² An implication of these findings is that equity markets will have a big impact on realized portfolio returns. While this can be beneficial during bull markets, it can result in crippling losses during market

meltdowns such as 2007–08. And yet investors continue to hold significant positions in stocks, reaching for higher long-term returns while wrestling with shorter-term volatility.

In this Insight, we address the topic of diversification beyond bonds and into “alternative investments.” How does investing in other non-correlated asset classes affect total portfolio risk and its components? As an example of a non-correlated asset class, we pick managed futures.³ Not knowing how

¹The Risk Contribution of Stocks, Insight, May 2017. We use the standard deviation of returns, also called volatility, as a 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.

²These results are repeated in Panel A of Table 5.

³We have discussed elsewhere the benefits of diversification in general, and diversification through managed futures in particular: see, for example, our Insights, Harnessing the Potential Benefits of Managed Futures (2016), Speaking of Correlation (2017), and Allocating to “Liquid Alternatives” – The Importance of Correlation (2016).



Dr. Ajay Dravid

Chief Investment Officer,
Equinox Institutional
Asset Management, LP

Managing Director of
Portfolio Strategy,
Equinox Funds

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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Definitions of Terms and Indices can be found on page 10.

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volatile stocks, bonds, and managed futures may be in the future, we make some assumptions, as before, that are based roughly on the values realized during the period 1987-2016.⁴ In Table 1, we show the volatilities we assume for stocks, bonds, and managed futures, as well as the assumed correlations between each pair of asset classes.

We also make what we believe are some reasonable assumptions about the expected returns on each asset class for the long run: We assume that the risk-free rate of interest will be 1%, and that all three asset classes will have the same Sharpe Ratio going forward.⁵

TABLE 1

Risk and Return Assumptions

	Volatility	Correlation	Expected Return	Sharpe Ratio (1%)
STOCKS	15.0%		10.0%	0.60%
BONDS	5.00%		4.00%	0.60%
MANAGED FUTURES	10.0%		7.00%	0.60%
STOCKS TO BONDS		20.0%		
STOCKS TO MANAGED FUTURES		0%		
BONDS TO MANAGED FUTURES		10.0%		

In Table 2, we show the risk of hypothetical portfolios with a range of allocations to stocks and bonds, with the balance allocated to managed futures, so that the three allocations add up to 100%. Note that the portfolios at the three corners of the triangular array represent portfolios with 100% allocated to a single asset class out of the three (highlighted in yellow). Portfolios along the edges of the triangle represent two-asset portfolios: green are stock/bond portfolio, pink are stock/managed futures, and blue are bond/managed futures.⁶ Thus, a 50/50 stock/bond

portfolio has a risk of 8.4%, a 50/50 stock/managed futures portfolio a risk of 9.0%, and a 50/50 bond/managed futures portfolio a risk of 5.8%. Note that these risks are in each case lower than the simple average of the two individual risks: this is the “free lunch” of diversification. As a rule of thumb, the lower the correlation between two asset classes, all else equal, the relatively greater the diversification benefit.

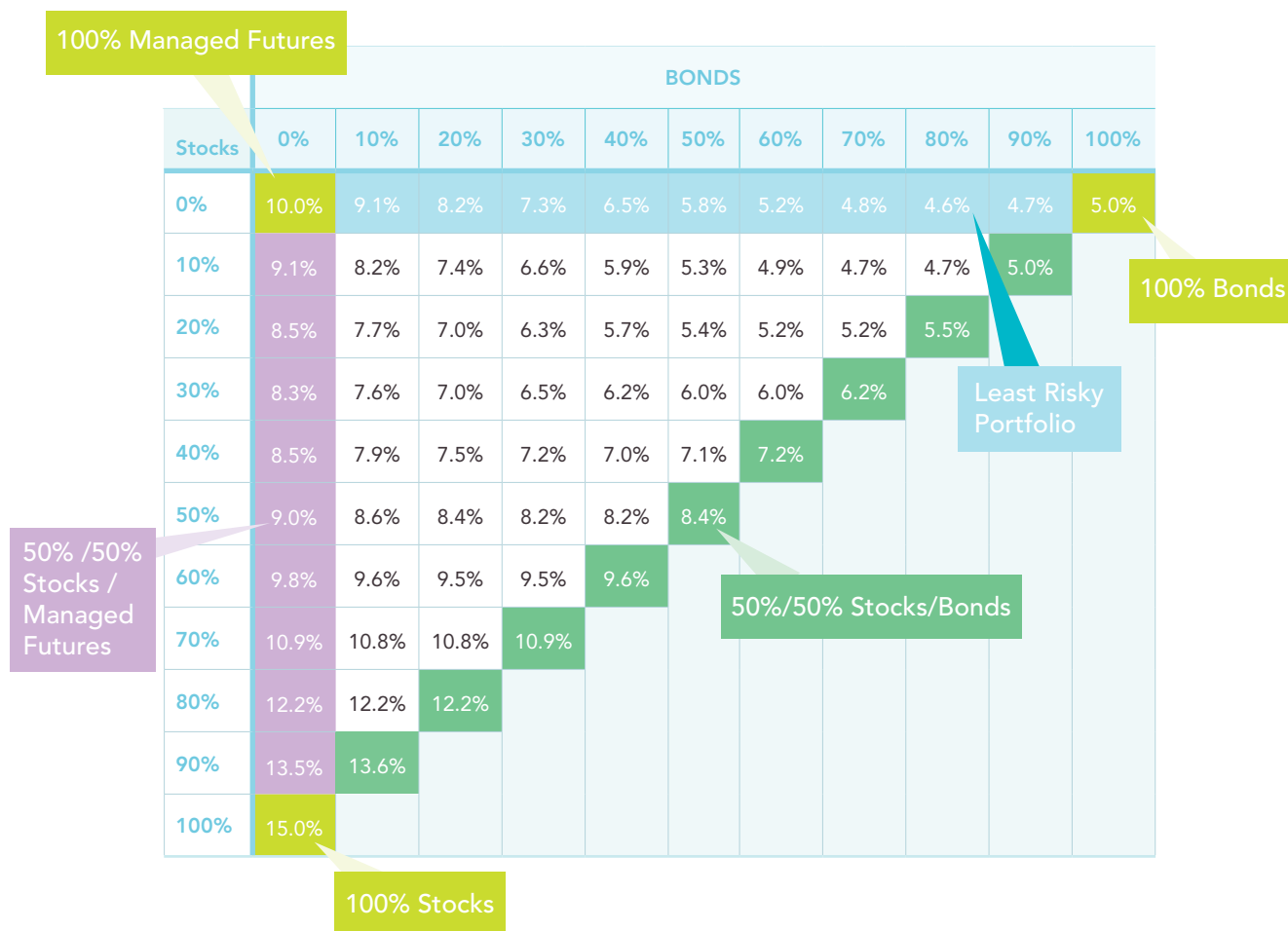
⁴For the sake of consistency, we use the same values for stocks and bonds that we used in our previous Insight.

⁵We discuss Sharpe Ratio later in the paper. This assumption of equal Sharpe Ratios has the effect of seeking to minimize the bias in favor of any asset class. The expected returns we assume are loosely based on their historical realized values. The substantive conclusions of this Insight do not depend on the assumptions, however.

⁶The green-shaded numbers are identical to those shown in our previous Insight.

TABLE 2

Total Risk of Various Hypothetical Stock/Bond/Managed Futures Portfolios



The 50/50 stock/bond portfolio's risk is 8.4% compared to the average risk of stocks and bonds, which is 10% (the average of 5% and 15%); this represents a 16% reduction in risk. The correlation of stocks and bonds is assumed to be 20% in Table 1. Stocks and managed futures are assumed to have a correlation of zero. The risk of the 50/50 stocks/managed futures portfolio is 9%, which is 28% lower than their average risk, which is 12.5% (the average of 10% and 15%). This larger reduction in risk, 28% vs. 16%, is a consequence of the lower correlation of 0% vs 20%.

How would an investor decide which of these portfolios he/she prefers? Should it be the portfolio with the lowest risk? That turns out to be the 80/20 bonds/managed futures portfolio, with a risk of 4.6%. However, this is mainly a

consequence of the fact that bonds are generally the least risky of the three asset classes. We should also expect this low-risk portfolio to have a fairly low—perhaps the lowest—expected return, possibly too low for an investor who is more aggressive. As we have said before, looking at just portfolio risk without considering return—or looking at return without considering risk—only tells half the story. 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, life-cycle status, wealth, liquidity needs, and attitude towards risk.

Source: Equinox Institutional Asset Management, LP.
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TABLE 3

Expected Returns of Various Stock/Bond/Managed Futures Portfolios

Stocks	BONDS										
	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
0%	7.0%	6.7%	6.4%	6.1%	5.8%	5.5%	5.2%	4.9%	4.6%	4.3%	4.0%
10%	7.3%	7.0%	6.7%	6.4%	6.1%	5.8%	5.5%	5.2%	4.9%	4.6%	
20%	7.6%	7.3%	7.0%	6.7%	6.4%	6.1%	5.8%	5.5%	5.2%		
30%	7.9%	7.6%	7.3%	7.0%	6.7%	6.4%	6.1%	5.8%			
40%	8.2%	7.9%	7.6%	7.3%	7.0%	6.7%	6.4%				
50%	8.5%	8.2%	7.9%	7.6%	7.3%	7.0%					
60%	8.8%	8.5%	8.2%	7.9%	7.6%						
70%	9.1%	8.8%	8.5%	8.2%							
80%	9.4%	9.1%	8.8%								
90%	9.7%	9.4%									
100%	10.0%										

Let us now turn to the expected returns (based on our assumptions from Table 1) of these portfolios, which are shown in Table 3. As expected, portfolios with higher stock allocations tend to have higher returns, while those with higher bond allocations tend to have lower returns. Note that the expected return of any 50/50 portfolio is simply the average of the returns for its component asset classes; there is no "diversification" advantage (or disadvantage) for portfolio expected return as there is for portfolio risk.

One way to combine the information in Tables 2 and 3 in an effort to seek out an "optimal" portfolio is to calculate the Sharpe Ratio for each portfolio. This ratio is simply a measure of how much "risk premium" a portfolio earns per unit of risk that it takes. To keep things simple, we assume a risk-free rate of 1%, and calculate the Sharpe Ratio for each portfolio:

$$\text{Sharpe Ratio} = (\text{Portfolio Expected Return} - 1\%) / \text{Portfolio Risk}$$

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For example, the 50/50 stock/bond portfolio has a Sharpe Ratio equal to 7% minus 1%, which is 6%, divided by its risk of 8.4%, which gives 0.72. All else equal, a higher Sharpe Ratio implies a more desirable portfolio.

In Table 4, we show the Sharpe Ratios for the various portfolios. The “corner” portfolios, with 100% in a single asset class, all have the same Sharpe Ratio of 0.60, which was our assumption in Table 1. The portfolio with the

highest Sharpe Ratio, 0.95, turns out to be the 20/50/30 stock/bond/managed futures portfolio. Individually, this portfolio has an expected return of 6.1%, which is not highest. Nor is its volatility of 5.4% the lowest among all portfolios. It does have the highest reward-to-risk ratio, however, and is therefore in some sense the “optimal” or best portfolio in terms of the trade-off between risk and return.

TABLE 4

Sharpe Ratios of Various Stock/Bond/Managed Futures Portfolios

Stocks	BONDS										
	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
0%	0.60	0.63	0.66	0.70	0.74	0.77	0.80	0.81	0.77	0.70	0.60
10%	0.69	0.73	0.77	0.82	0.87	0.91	0.92	0.90	0.82	0.72	
20%	0.77	0.82	0.86	0.91	0.94	0.95	0.93	0.86	0.77		
30%	0.83	0.87	0.90	0.92	0.92	0.90	0.85	0.77			
40%	0.85	0.87	0.88	0.88	0.85	0.81	0.75				
50%	0.83	0.83	0.83	0.80	0.77	0.72					
60%	0.79	0.78	0.76	0.73	0.69						
70%	0.74	0.72	0.69	0.66							
80%	0.69	0.67	0.64								
90%	0.64	0.62									
100%	0.60										

Let us try to explain why this might be the case, by addressing the question we set out to answer at the outset: The relative risk contributions of the three component

asset classes to the overall risk of the portfolio. We show these data in the three panels of Table 5.

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TABLE 5

Risk Contribution of Stocks, Bonds, and Managed Futures to Various Portfolios

Panel A Risk Contribution of Stocks

Stocks	BONDS										
	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
10%	3%	4%	5%	6%	8%	11%	13%	15%	15%	14%	
20%	12%	16%	20%	25%	31%	36%	40%	41%	38%		
30%	29%	35%	43%	51%	58%	62%	63%	60%			
40%	50%	58%	66%	73%	77%	78%	76%				
50%	69%	76%	83%	87%	87%	86%					
60%	84%	89%	92%	93%	92%						
70%	92%	95%	96%	95%							
80%	97%	98%	98%								
90%	99%	99%									
100%	100%										

Panel B Risk Contribution of Bonds

Stocks	BONDS										
	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
0%	0%	1%	3%	6%	12%	22%	37%	57%	78%	93%	100%
10%	0%	1%	4%	8%	16%	29%	45%	64%	79%	86%	
20%	0%	2%	5%	10%	18%	30%	43%	54%	62%		
30%	0%	2%	5%	10%	17%	25%	33%	40%			
40%	0%	2%	5%	9%	14%	19%	24%				
50%	0%	2%	4%	7%	11%	14%					
60%	0%	1%	3%	6%	8%						
70%	0%	1%	3%	5%							
80%	0%	1%	2%								
90%	0%	1%									
100%	0%										

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Panel C

Risk Contribution of Managed Futures

Stocks	BONDS										
	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
0%	100%	99%	97%	94%	88%	78%	63%	43%	22%	7%	0%
10%	97%	95%	91%	86%	76%	60%	42%	21%	6%	0%	
20%	88%	82%	75%	65%	51%	34%	17%	5%	0%		
30%	71%	63%	52%	39%	25%	13%	4%	0%			
40%	50%	40%	29%	18%	9%	3%	0%				
50%	31%	22%	13%	6%	2%	0%					
60%	16%	10%	5%	1%	0%						
70%	8%	4%	1%	0%							
80%	3%	1%	0%								
90%	1%	0%									
100%	0%										

Consider the 20/50/30 portfolio from Table 4, which had the highest Sharpe Ratio. It turns out that the three asset classes contribute almost equally to the risk of this portfolio: stocks contribute 36%, bonds 30% and managed futures 34%. A portfolio in which the risk contributions of various components are equalized is sometimes called a “risk parity” portfolio.⁷ This turns out to be a very rough rule-of-thumb: it is not always necessary that the portfolio with the highest Sharpe Ratio is the “risk parity” portfolio, which is a term used to define the portfolio in which all the individual components contribute equally toward the total risk.

Using some very simple assumptions, we have shown that a “more diversified” portfolio, whose risk contributions are spread out across its component asset classes, turns out to have a higher reward-to-risk ratio than one with a significantly higher risk contribution from one asset class such as stocks. This reiterates one of the teachings of Modern Portfolio Theory (MPT): Diversification helps.

⁷Since there can be different measures of risk, there is no unique definition of risk parity.

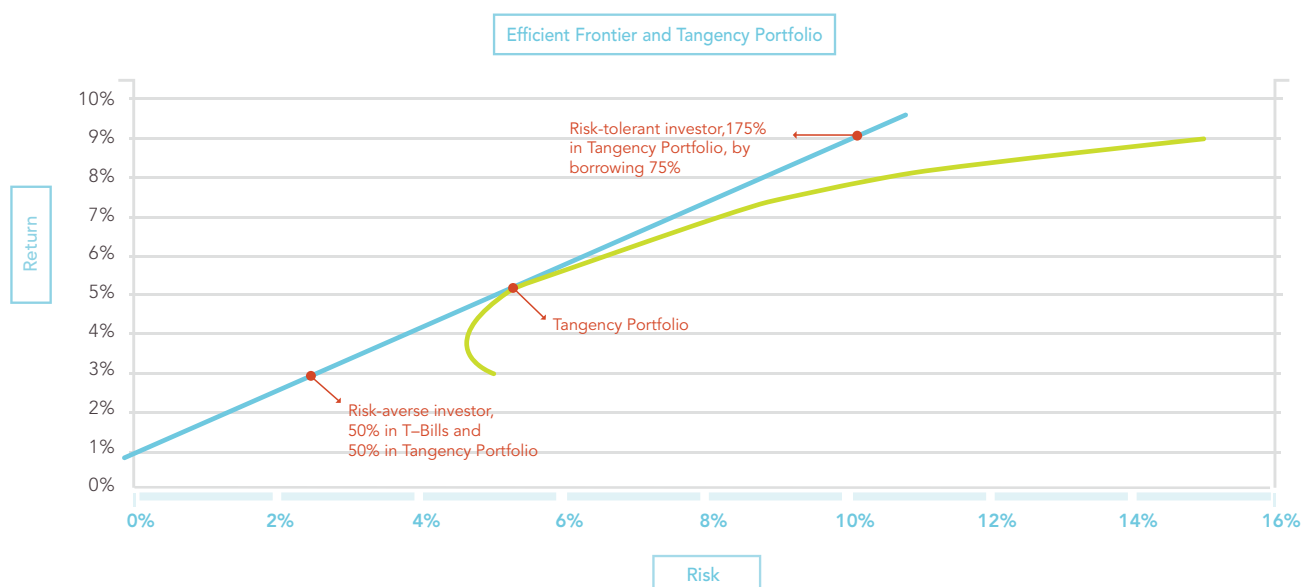
Stocks: S&P 500® Total Return Index, **Bonds:** Barclay US Aggregate Bond Index®, **Managed Futures:** BTOP50® Index

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A Graphical Illustration of Modern Portfolio Theory



MPT goes on to state that the portfolio with the highest Sharpe Ratio, also called the “tangency portfolio,” is the optimal risky portfolio for all investors. Each investor has the ability to combine this portfolio (which turns out in equilibrium to be the “market portfolio”) with risk-free lending or borrowing, so that he/she ends up holding an overall portfolio still with the highest Sharpe Ratio, but with an appropriate level of risk. Relatively risk-averse investors combine the market portfolio with risk-free lending (i.e., investing in cash or T-Bills) to “dilute” their risk and earn a lower return. As shown above, a risk-averse investor can invest 50% of her total wealth in T-Bills earning 1% and 50% in the tangency portfolio, thereby reducing risk to about 2.7% with an expected return of about 3%. A more risk-tolerant investor can, in theory, borrow say 75% at the risk-free rate and leverage the risky portfolio to 175%, taking on greater risk of about 9.5% while seeking to earn a higher return of close to 9%.⁸

One constraint that MPT imposes on the tangency portfolio is that the allocations sum up to 100%, even when borrowing or lending is involved. In the next part of this series of Insights, we will examine the effects of relaxing this constraint: for example, we will examine portfolios with 50% allocated to managed futures, but in a 60/40/50 portfolio rather than a traditional 30/20/50 portfolio. Note that the allocations in the traditional portfolio add up to 100%, while those in the other portfolio add up to 150%.

We call this idea “**extended diversification**” or the “**Power of &.**”

⁸Of course, these prescriptions are based on a number of simplifying assumptions, many of which are not necessarily reflective of financial markets in practice.

Stocks: S&P 500® Total Return Index, **Bonds:** Barclay US Aggregate Bond Index®, **Managed Futures:** BTOP50® Index

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Extended diversification may enable investors to potentially harness the combined benefit of their current portfolio AND managed futures. The traditional “OR” decision involves selling part of the existing stock and/or bond holdings in order to gain exposure to a diversifying asset class such as managed futures: the portion that is allocated involves a choice between managed futures OR stocks/bonds. Thus, the allocation to managed futures may incur the opportunity cost of forgoing the returns that stocks and bonds might have continued to earn. **Extended diversification seeks to allow investors to hold on to their stocks and bonds AND allocate to managed futures, without the opportunity cost of selling stocks and bonds.** In many cases, by managing allocations appropriately, this can potentially be achieved without taking on the significant increase in risk of a portfolio that is leveraged traditionally through borrowing.⁹

⁹This may be possible for an asset class such as managed futures, where only a small amount of margin or collateral needs to be posted in order to gain exposure. Extended diversification may afford investors the opportunity to post their existing stocks and bonds as collateral rather than having to sell them.

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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.

Modern Portfolio Theory (MPT) is a theory on how risk-averse investors can construct portfolios to optimize or maximize expected return based on a given level of market risk, emphasizing that risk is an inherent part of higher reward.

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.

Sharpe Ratio is a measure that indicates the average return minus the risk-free return divided by the standard deviation of return on an investment.

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 **BTOP50® Index** seeks to replicate the overall composition of the managed futures industry with regard to trading style and overall market exposure.

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.

NOTES



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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