

## VIX FUTURES AND THE HEDGING OF BOND PORTFOLIOS

Equity volatility, as replicated by widely traded ETFs and ETNs linked to the S&P 500<sup>®</sup> VIX<sup>®</sup> Futures Index Series, is frequently used to hedge equity portfolios. But is it appropriate for bond portfolios?

The bond market is broad and diverse, ranging from low-risk government bonds to relatively high-risk high-yield corporate bonds and emerging market bonds. As a result, equity volatility relates to each segment of the bond market in the following different ways:

- Treasury and municipal bonds are positively correlated with equity volatility because they often serve as safe-haven choices when equity risk is at heightened levels. Therefore, adding S&P 500 VIX Futures Index Series exposure to a portfolio of treasury and municipal bonds does not provide diversification benefits.
- Investment-grade corporate bonds have a weakly positive correlation with equity volatility futures, while high-yield corporate bonds have a weakly negative correlation. During extreme downturns, equity volatility futures can offer corporate bond portfolios some tail risk hedging benefits, but there are occasions when these benefits may not be realized. Risk-return benefits can also be obtained by adding a dynamic allocation of the S&P 500 VIX Futures Index Series to a corporate bond portfolio.
- The most beneficial application of the S&P 500 VIX Futures Index Series is in emerging market bond portfolios. Adding the S&P 500 VIX Futures Index Series generally provides a clear tail risk hedging benefit. Over the period of study, equity volatility futures provided downside protection on all but four of the worst 25 days for emerging market bonds. An ongoing dynamic allocation to the S&P 500 VIX Futures Index Series has also produced better risk-adjusted returns, with statistically significant outperformance.

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## 1. Introduction

Volatility has emerged as an important asset class in its own right over the past decade. Book-ended by two equity bear markets, the past decade (2000 – 2010) saw heightened financial stresses and large losses in investment portfolios. The investment community's need for tools and instruments to protect downside risks had never been more acutely felt. As the saying goes, necessity is the mother of invention, and this sentiment holds true in the realm of financial engineering.

Since its introduction in 1993, the VIX, the Chicago Board of Options Exchange's (CBOE's) volatility index, has become widely considered the "fear gauge" of the market. The VIX measures the implied volatility of S&P 500 index options, representing the market expectation of stock market volatility for the next 30 days. Market participants quickly discovered the value of the VIX index in hedging portfolio risks, since the VIX was found to be negatively correlated with the returns of the equity market, as measured by the S&P 500. Furthermore, the level of correlation increases as the equity market sells off. Due to this asymmetry in correlation, the VIX is an ideal hedge for a long-only equity portfolio.

Recognizing the importance of the VIX index, a host of new products based on the VIX were introduced in the past decade. In 2004, the CBOE Futures Exchange (CFE) introduced futures trading on the VIX, and the CBOE listed an options contract on the VIX in 2006. In 2009, S&P Indices introduced the S&P 500 VIX Futures Index Series, which is now the basis for a growing list of more than two dozen ETNs and ETFs, linked to more than US\$ 2 billion in assets (Liu and Dash, 2011). These instruments have driven the VIX's evolution from a market indicator to a hedging vehicle.

A number of authors have studied the hedging advantages of VIX-related products. Dash and Moran (2005) considered the diversification benefits that VIX could lend to a hedge fund portfolio. Moran and Dash (2006) and Black (2006) showed the risk-reduction benefits of adding VIX futures to an equity portfolio. More recently, Liu and Dash (2010), DeLisle, Doran and Krieger (2010), Stanton (2011) and Jones (2011) further explored the hedging benefits of VIX assets.

Because the VIX is derived from equity index options, previous studies have focused primarily on equity or equity-centric portfolios. However, the VIX also has a place in fixed income-based portfolios. Because the fixed income market covers a diverse array of investment vehicles, from low-risk government bonds to higher-risk, high-yield and emerging market bonds, each segment of the bond market has a distinct relationship to the VIX. In this study, the following benchmarks were used to measure various bond market segments:

- S&P/BGCantor US Treasury Bond Index, representing U.S. government bonds (referred to as "Gov Bond");
- S&P AMT-Free National Municipal Bond Index, representing U.S. municipal bonds (referred to as "Muni Bond");
- Markit iBoxx<sup>®</sup> \$ Liquid Investment Grade Index, representing U.S. investment-grade corporate bonds (referred to as "IG Bond");
- Markit iBoxx<sup>®</sup> \$ Liquid High Yield Index, representing U.S. high-yield corporate bonds (referred to as "HY Bond");
- JP Morgan Emerging Market Bond EMBI CORE Index, representing emerging market bonds (referred to as "EM Bond").

Since spot VIX is not replicable, we have used the S&P 500 VIX Short-Term Futures Index as a tradable proxy. The index tracks a position in near- and second-term VIX futures with a weighted average maturity of 30 days. In their 2010 paper, Liu and Dash (2010) showed that the index does not track spot VIX perfectly, but that it maintains many of the distributional properties of spot VIX which make it an attractive tool for trading and hedging strategies.

In the next section, we show the correlation pattern of equity volatility with each bond market segment. In section 3, we explore using VIX as a tactical tail risk hedging tool for bonds. In section 4, we compare the diversification benefits of adding a small static or dynamic allocation of VIX futures to a bond portfolio.

## 2. Correlation Analysis

To recap the previous studies, the VIX's relationship to the equity market is characterized by the following general properties:

1. VIX and VIX futures are negatively correlated with equity market returns;
2. The correlation of VIX products with the equity market is asymmetric; as the equity market returns become more negative, the inverse correlation becomes greater;

Sub-sections 2.1 to 2.5 include the following analyses:

1. The relationship between returns of bonds and equity volatility, presented through scatter plots of daily bond returns versus S&P 500 VIX Short-Term Futures Index daily returns;
2. Rolling one-month short-term correlations of daily bond returns versus daily returns of the S&P 500 VIX Short-Term Futures Index.

Exhibit 1 below shows the probability of the S&P 500 VIX Short-Term Futures Index rising or declining on days where bond returns are up or down by varying levels of sigma (standard deviation). This table demonstrates the asymmetry of the co-movements of bond returns and the S&P 500 VIX Short-Term Futures Index returns.

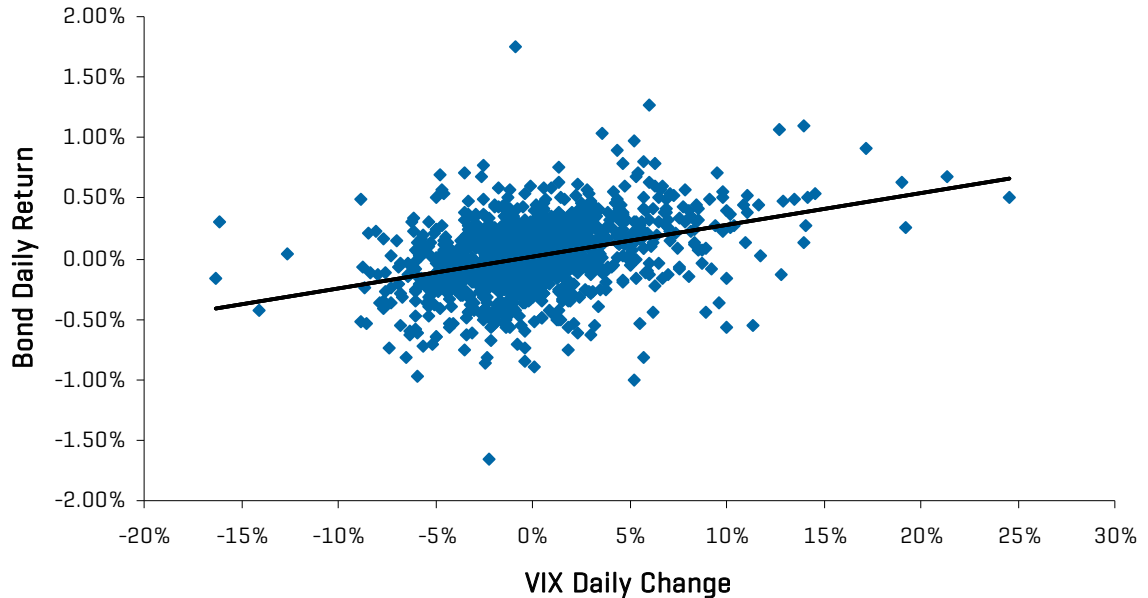
<b>Exhibit 1: Relationship of Bond Returns to the S&amp;P 500 VIX Short-Term Futures Index Returns to Various Bond Market Environments</b>					
<b>Probability of S&amp;P 500 VIX Short-Term Index Declining</b>					
<b>Bond Daily Return Scenarios</b>	<b>EM Bond</b>	<b>HY Bond</b>	<b>IG Bond</b>	<b>Muni Bond</b>	<b>Gov Bond</b>
> 0	66.8%	60.1%	52.0%	52.3%	46.4%
> 0.5 * $\sigma$	77.4%	61.5%	48.9%	43.0%	40.3%
> 1 * $\sigma$	83.5%	60.4%	54.0%	45.2%	26.1%
>1.5 * $\sigma$	85.7%	53.2%	52.5%	52.6%	25.0%
$\sigma$ (daily)	0.496%	0.434%	0.382%	0.418%	0.276%
<b>Probability of S&amp;P 500 VIX Short-Term Index Rising</b>					
<b>Bond Daily Return Scenarios</b>	<b>EM Bond</b>	<b>HY Bond</b>	<b>IG Bond</b>	<b>Muni Bond</b>	<b>Gov Bond</b>
< 0	57.2%	48.2%	37.6%	33.6%	30.4%
< - 0.5 * $\sigma$	68.6%	51.8%	33.0%	37.3%	27.2%
< -1 * $\sigma$	81.0%	55.9%	35.1%	45.5%	26.8%
<-1.5 * $\sigma$	77.5%	62.1%	38.3%	51.9%	27.4%

Source: Bloomberg, Standard & Poor's. Data from December 20, 2005 to August 31, 2011. U.S. Municipal Bond data from August 31, 2007 to August 31, 2011. Tables are provided for illustrative purposes. Past performance is not a guarantee of future results. Some of the data reflected in this chart may reflect hypothetical historical performance. Please see the Performance Disclosure at the end of this document for more information on some of the inherent limitations associated with back-tested Index data and performance information.

### 2.1. U.S. Government Bonds

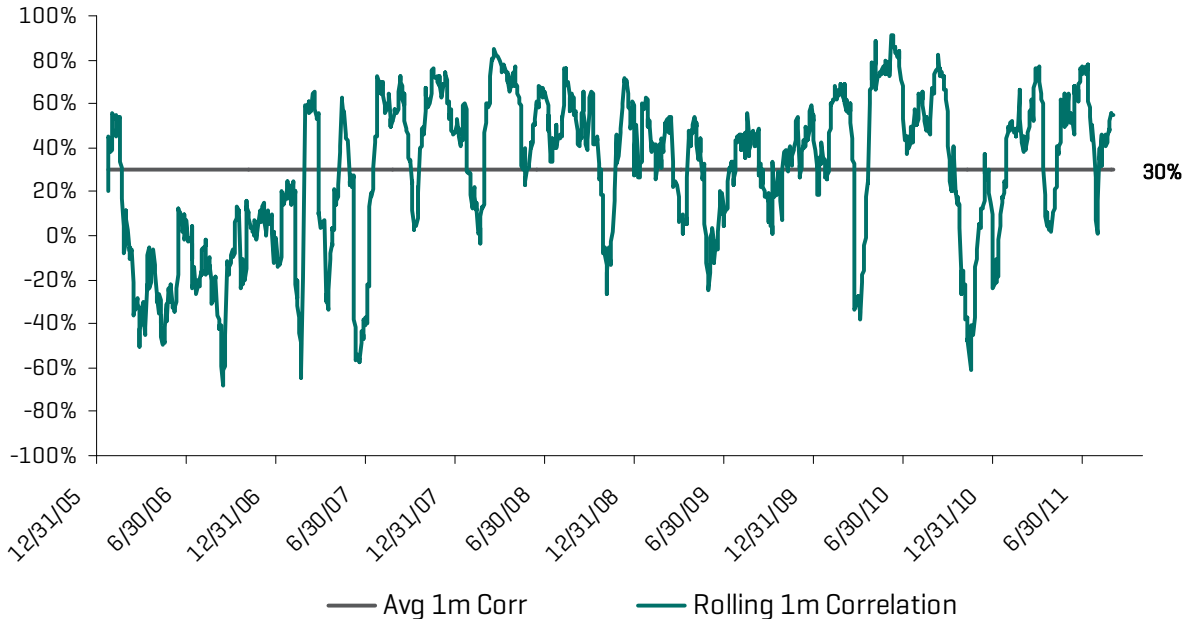
U.S. government bonds, as represented by the S&P/BGCantor US Treasury Bond Index, exhibit a positive correlation to VIX futures, as represented by the S&P 500 VIX Short-Term Futures Index. This relationship arises because when the equity market becomes volatile and market fear increases, the flight to quality leads investors to seek safe havens such as U.S. government bonds. Furthermore, as shown in Exhibit 1 above, the S&P 500 VIX Short-Term Futures Index rises 73.9% of the times when U.S. Treasury bonds are up by at least one standard deviation.

**Exhibit 2: Daily Returns of U.S. Government Bonds versus Daily Returns of S&P 500 VIX Short-Term Futures Index**



Source: Bloomberg, Standard & Poor's. Data from December 20, 2005 to August 31, 2011. Linear regression line included. Charts are provided for illustrative purposes. Past performance is not a guarantee of future results. Some of the data reflected in this chart may reflect hypothetical historical performance. Please see the Performance Disclosure at the end of this document for more information on some of the inherent limitations associated with back-tested Index data and performance information.

**Exhibit 3: Rolling 1-Month Correlation of U.S. Government Bonds with S&P 500 VIX Short-Term Futures Index**

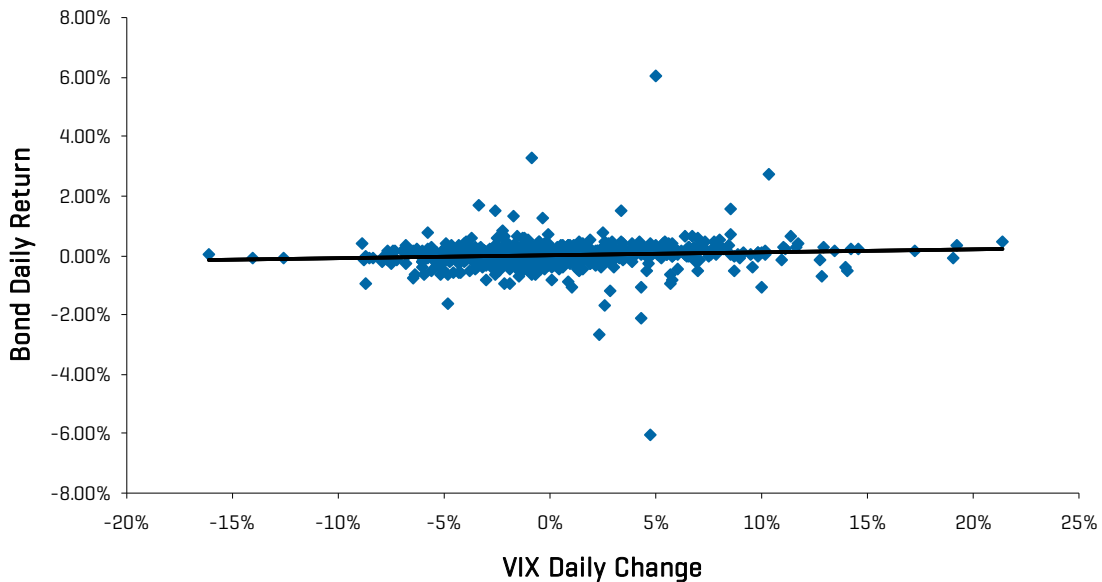


Source: Bloomberg, Standard & Poor's. Data from December 20, 2005 through August 31, 2011. Charts are provided for illustrative purposes. Past performance is not a guarantee of future results. Some of the data reflected in this chart may reflect hypothetical historical performance. Please see the Performance Disclosure at the end of this document for more information on some of the inherent limitations associated with back-tested index data and performance information.

## 2.2. U.S. Municipal Bonds

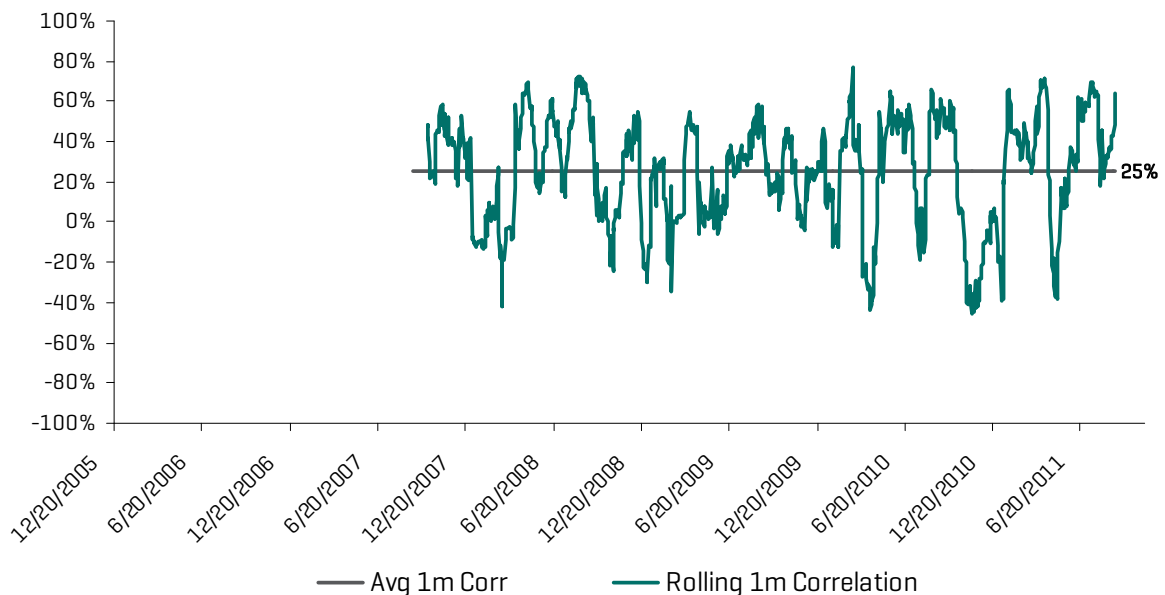
U.S. municipal bonds, as measured by the S&P AMT-Free National Municipal Bond Index, seem to have a very low correlation to equity volatility, as shown in Exhibit 4.

**Exhibit 4: Daily Returns of Municipal Bonds versus Daily Returns of S&P 500 VIX Short-Term Futures Index**



Source: Bloomberg, Standard & Poor's. Data from August 31, 2007 to August 31, 2011. Linear regression line included. Charts are provided for illustrative purposes. Past performance is not a guarantee of future results. Some of the data reflected in this chart may reflect hypothetical historical performance. Please see the Performance Disclosure at the end of this document for more information on some of the inherent limitations associated with back-tested index data and performance information.

**Exhibit 5 Rolling 1-Month correlation of Municipal Bonds with S&P 500 VIX Short-Term Futures Index**

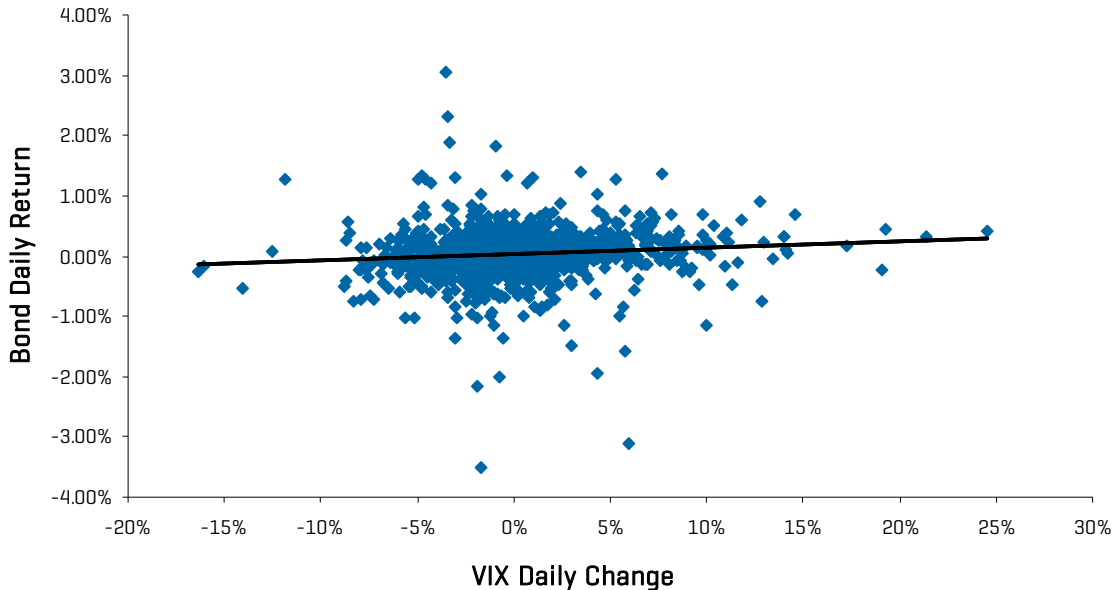


Source: Bloomberg, Standard & Poor's. Data from August 31, 2007 to August 31, 2011. Charts are provided for illustrative purposes. Past performance is not a guarantee of future results. Some of the data reflected in this chart may reflect hypothetical historical performance. Please see the Performance Disclosure at the end of this document for more information on some of the inherent limitations associated with back-tested index data and performance information.

### 2.3. Investment-Grade Corporate Bonds

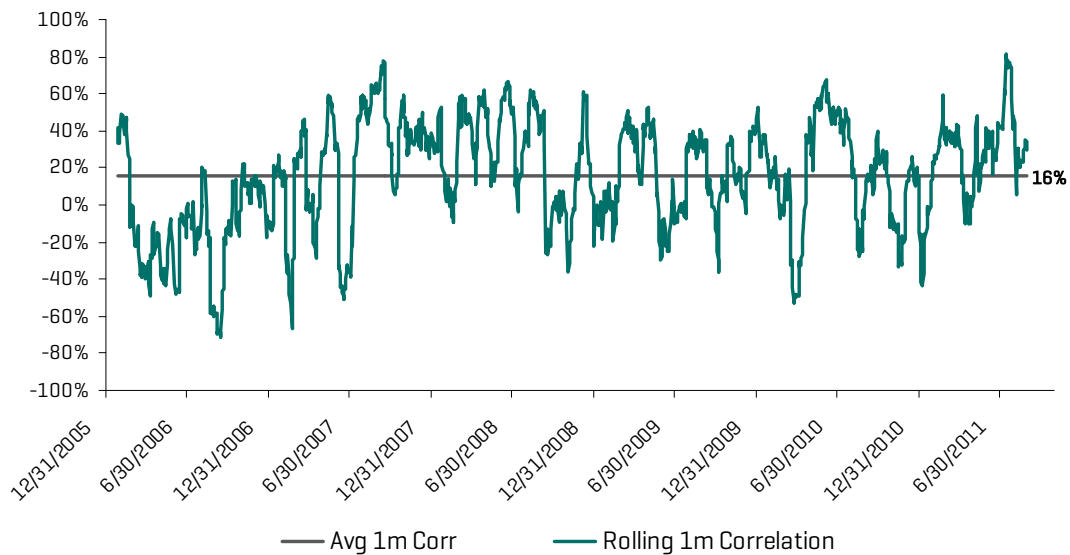
Investment-grade corporate bonds, as measured by the Markit iBoxx \$ Liquid Investment Grade Index, also demonstrate a very low correlation to equity volatility, as shown in Exhibit 6.

**Exhibit 6: Daily Returns of Investment-Grade Corporate Bonds versus Daily Returns of S&P 500 VIX Short-Term Futures Index**



Source: Bloomberg, Standard & Poor's. Data from December 20, 2005 to August 31, 2011. Linear regression line included. Charts are provided for illustrative purposes. Past performance is not a guarantee of future results. Some of the data reflected in this chart may reflect hypothetical historical performance. Please see the Performance Disclosure at the end of this document for more information on some of the inherent limitations associated with back-tested index data and performance information.

**Exhibit 7: Rolling 1-Month Correlation of Investment-Grade Corporate Bonds with S&P 500 VIX Short-Term Futures Index**

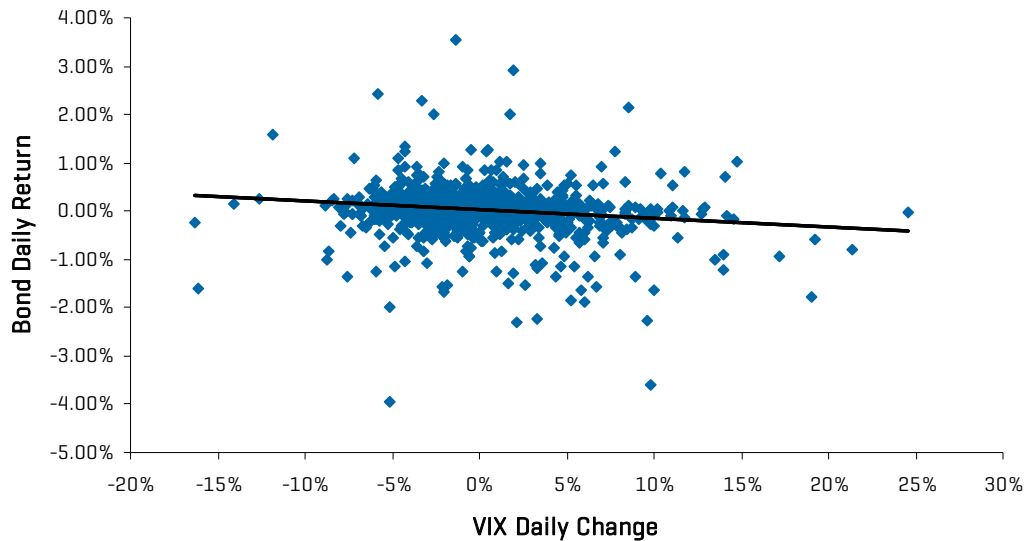


Source: Bloomberg, Standard & Poor's. Data from December 20, 2005 to August 31, 2011. Charts are provided for illustrative purposes. Past performance is not a guarantee of future results. Some of the data reflected in this chart may reflect hypothetical historical performance. Please see the Performance Disclosure at the end of this document for more information on some of the inherent limitations associated with back-tested index data and performance information.

## 2.4. High-Yield Corporate Bonds

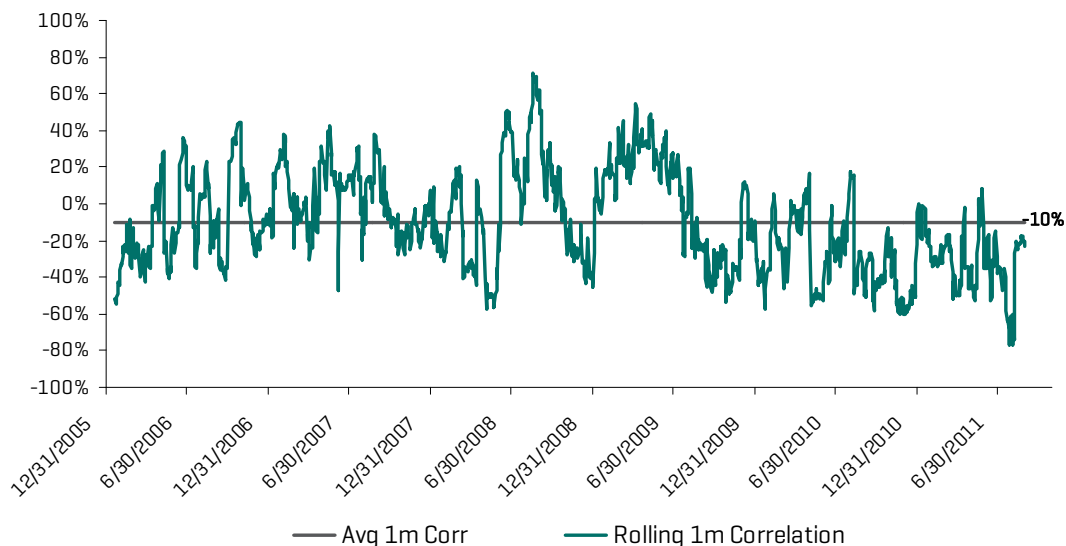
High-yield corporate bonds exhibit some equity-like properties and, as a result, show an overall negative correlation with equity volatility, as shown in Exhibit 8. As shown in Exhibit 1, this negative relationship is slightly more prominent when the high-yield corporate bond market sells off, with the S&P 500 VIX Short-Term Futures Index rising on 55.9% of occasions when there is a negative move of at least one standard deviation in high-yield corporate bonds.

**Exhibit 8: Daily Returns of High-Yield Corporate Bonds versus Daily Returns of S&P 500 VIX Short-Term Futures Index**



Source: Bloomberg, Standard & Poor's. Data from December 20, 2005 to August 31, 2011. Linear regression line included. Charts are provided for illustrative purposes. Past performance is not a guarantee of future results. Some of the data reflected in this chart may reflect hypothetical historical performance. Please see the Performance Disclosure at the end of this document for more information on some of the inherent limitations associated with back-tested index data and performance information.

**Exhibit 9: Rolling 1-Month Correlations of High-Yield Corporate Bonds with S&P 500 VIX Short-Term Futures Index**

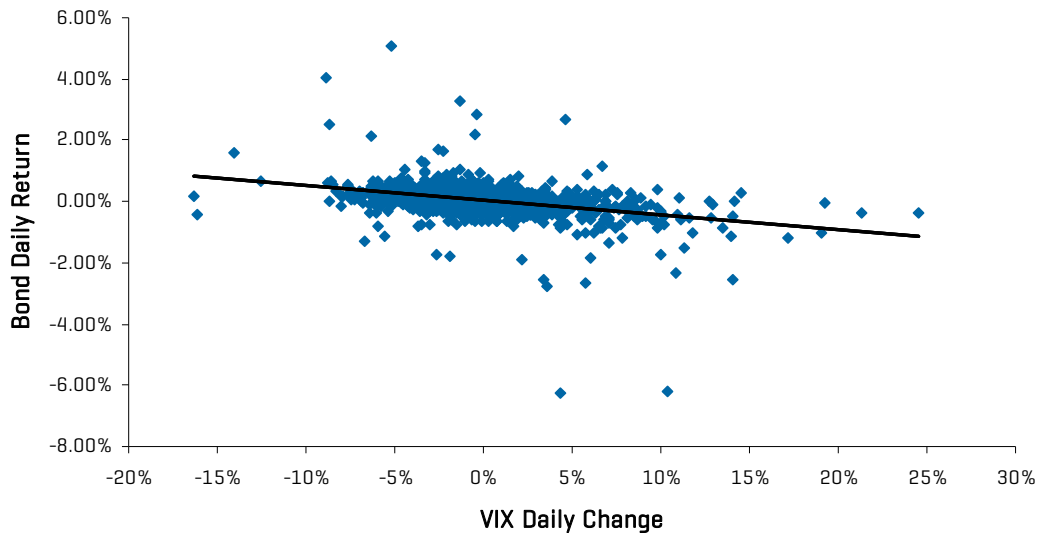


Source: Bloomberg, Standard & Poor's. Data from December 20, 2005 to August 31, 2011. Linear regression line included. Charts are provided for illustrative purposes. Past performance is not a guarantee of future results. Some of the data reflected in this chart may reflect hypothetical historical performance. Please see the Performance Disclosure at the end of this document for more information on some of the inherent limitations associated with back-tested index data and performance information.

## 2.5. Emerging Market Bonds

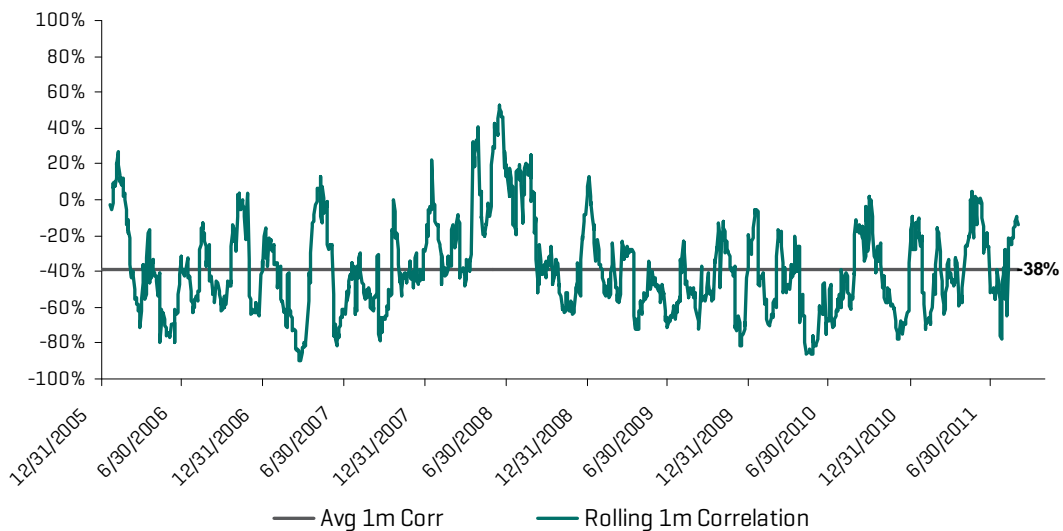
Emerging market bonds have more equity-like risk characteristics, and therefore demonstrate a negative correlation to equity volatility, as shown in Exhibit 10. Exhibit 1 shows that the S&P 500 VIX Short-Term Futures Index rises more than 80% of the time when there is a negative move of at least one standard deviation in the emerging market bond market.

**Exhibit 10: Daily Returns of High-Yield Corporate Bonds versus Daily Returns of S&P 500 VIX Short-Term Futures Index**



Source: Bloomberg, Standard & Poor's. Data from December 20, 2005 to August 31, 2011. Linear regression line included. Charts are provided for illustrative purposes. Past performance is not a guarantee of future results. Some of the data reflected in this chart may reflect hypothetical historical performance. Please see the Performance Disclosure at the end of this document for more information on some of the inherent limitations associated with back-tested index data and performance information.

**Exhibit 11: Rolling 1-Month Correlation of Emerging Market Bonds with S&P 500 VIX Short-Term Futures Index**



Source: Bloomberg, Standard & Poor's. Data from December 20, 2005 to August 31, 2011. Linear regression line included. Charts are provided for illustrative purposes. Past performance is not a guarantee of future results. Some of the data reflected in this chart may reflect hypothetical historical performance. Please see the Performance Disclosure at the end of this document for more information on some of the inherent limitations associated with back-tested index data and performance information.



### *3. S&P 500 VIX Short-Term Futures Index as a Tactical Tail Risk Hedge*

Tail risks, whereby bond portfolios suffer large losses, are of special interest to portfolio managers. Based on the correlation and co-movement analyses, it appears that the S&P 500 VIX Short-Term Futures Index may hold tail risk hedging opportunities for three categories of bonds: investment-grade, high-yield and emerging market. The relationship between the S&P 500 VIX Short-Term Futures Index and the emerging market bond market may be especially beneficial to investors.

Based on an average of the 25 worst days for high-yield bonds, the bond market lost 1.81% while the S&P 500 VIX Short-Term Futures Index showed a gain of 2.26% (see Exhibit 13). Similarly, on average, emerging market bonds lost 1.97% on their 25 worst days, while the S&P 500 VIX Short-Term Futures Index showed a gain of 6.64% (see Exhibit 14). This effect also holds for investment-grade bonds, but to a lesser extent. On average, investment-grade bonds lost 1.38% on their 25 worst days, while the S&P 500 VIX Short-Term Futures Index showed an average gain of 0.66% (see Exhibit 12).

As shown in Exhibit 14, the S&P 500 VIX Short-Term Futures Index would have served as a good tail risk hedge for emerging market bonds over the period studied. Over the period of study, equity volatility provided downside protection for emerging market bonds on all but four of the worst 25 days. However, Exhibits 12 and 13 show that hedging characteristics are not as strong for investment-grade and high-yield bonds.

<b>Exhibit 12: Investment-Grade Bonds' Worst 25 Daily Moves and Corresponding Movement of S&amp;P 500 VIX Short-Term Futures Index</b>				
<b>Rank</b>	<b>Date</b>	<b>IG Bond Daily Return</b>	<b>S&amp;P 500 VIX Short-Term Futures Index Change (%)</b>	
1	6/26/09	-3.50%		-1.72%
2	9/15/08	-3.11%		6.00%
3	9/16/08	-2.17%		-1.88%
4	6/18/09	-1.99%		-0.77%
5	10/10/08	-1.95%		4.34%
6	9/17/08	-1.57%		5.72%
7	5/27/09	-1.49%		3.00%
8	9/25/08	-1.36%		-3.04%
9	2/19/09	-1.35%		-0.58%
10	9/26/08	-1.16%		2.65%
11	3/6/09	-1.16%		-1.01%
12	10/9/08	-1.15%		9.97%
13	3/11/08	-1.04%		-5.60%
14	11/21/08	-1.03%		-5.17%
15	8/24/11	-1.02%		-1.94%
16	12/8/10	-1.02%		-2.98%
17	8/12/11	-1.01%		0.51%
18	6/4/09	-1.01%		-1.18%
19	5/21/09	-0.99%		5.52%
20	2/25/09	-0.96%		-2.14%
21	1/22/09	-0.94%		-1.10%
22	3/9/09	-0.91%		1.39%
23	3/25/10	-0.85%		1.11%
24	7/15/09	-0.85%		-3.06%
25	10/8/08	-0.84%		5.72%
	<b>Avg</b>	<b>-1.38%</b>		<b>0.55%</b>

Source: Bloomberg, Standard & Poor's. Data from December 20, 2005 to August 31, 2011. Tables are provided for illustrative purposes. Past performance is not a guarantee of future results. Some of the data reflected in this chart may reflect hypothetical historical performance. Please see the Performance Disclosure at the end of this document for more information on some of the inherent limitations associated with back-tested index data and performance information.

<b>Exhibit 13: High-Yield Bonds' Worst 25 Daily Moves and Corresponding Movement of S&amp;P 500 VIX Short-Term Futures Index</b>			
<b>Rank</b>	<b>Date</b>	<b>HY Bond Daily Return</b>	<b>S&amp;P 500 VIX Short-Term Futures Index Change (%)</b>
1	10/14/08	-3.96%	-5.19%
2	11/19/08	-3.59%	9.79%
3	10/16/08	-2.29%	2.17%
4	10/7/08	-2.25%	9.60%
5	10/3/08	-2.22%	3.35%
6	11/21/08	-1.99%	-5.17%
7	3/14/08	-1.87%	5.97%
8	11/20/08	-1.83%	5.28%
9	8/8/11	-1.78%	19.06%
10	6/11/07	-1.68%	-2.02%
11	10/9/08	-1.64%	9.97%
12	10/27/08	-1.63%	5.83%
13	8/9/11	-1.61%	-16.12%
14	2/25/09	-1.58%	-2.14%
15	10/2/08	-1.56%	6.67%
16	9/16/08	-1.53%	-1.88%
17	9/26/08	-1.52%	2.65%
18	11/18/08	-1.49%	1.66%
19	3/4/09	-1.36%	-7.54%
20	5/7/10	-1.36%	8.96%
21	10/10/08	-1.36%	4.34%
22	7/31/07	-1.34%	6.20%
23	8/11/09	-1.27%	1.94%
24	3/6/09	-1.27%	-1.01%
25	9/30/08	-1.26%	-5.94%
	<b>Avg</b>	<b>-1.81%</b>	<b>2.26%</b>

Source: Bloomberg, Standard & Poor's. Data from December 20, 2005 to August 31, 2011. Tables are provided for illustrative purposes. Past performance is not a guarantee of future results. Some of the data reflected in this chart may reflect hypothetical historical performance. Please see the Performance Disclosure at the end of this document for more information on some of the inherent limitations associated with back-tested index data and performance information.

**Exhibit 14: Emerging Market Bonds' Worst 25 Daily Moves and Corresponding Movement of S&P 500 VIX Short-Term Futures Index**

Rank	Date	EM Bond Daily Return	S&P 500 VIX Short-Term Futures Index Change (%)
1	10/10/08	-6.25%	4.34%
2	10/22/08	-6.18%	10.34%
3	10/6/08	-2.79%	3.60%
4	10/8/08	-2.66%	5.72%
5	10/15/08	-2.57%	14.03%
6	10/23/08	-2.57%	3.40%
7	11/12/08	-2.31%	10.88%
8	10/16/08	-1.92%	2.17%
9	9/15/08	-1.85%	6.00%
10	9/16/08	-1.79%	-1.88%
11	10/21/08	-1.76%	-2.60%
12	10/9/08	-1.71%	9.97%
13	10/24/08	-1.51%	11.34%
14	7/26/07	-1.36%	7.08%
15	11/13/08	-1.27%	-6.68%
16	5/6/10	-1.21%	17.21%
17	8/16/07	-1.21%	7.87%
18	10/20/08	-1.15%	-5.60%
19	9/29/08	-1.13%	14.00%
20	11/20/08	-1.10%	5.28%
21	11/6/08	-1.05%	11.76%
22	6/7/07	-1.03%	6.22%
23	9/17/08	-1.01%	5.72%
24	8/8/11	-1.01%	19.06%
25	10/2/08	-0.88%	6.67%
	Avg	-1.97%	6.64%

Source: Bloomberg, Standard & Poor's. Data from December 20, 2005 to August 31, 2011. Tables are provided for illustrative purposes. Past performance is not a guarantee of future results. Some of the data reflected in this chart may reflect hypothetical historical performance. Please see the Performance Disclosure at the end of this document for more information on some of the inherent limitations associated with back-tested index data and performance information.

## 4. Do Bond Portfolios Benefit from Allocating to VIX Futures?

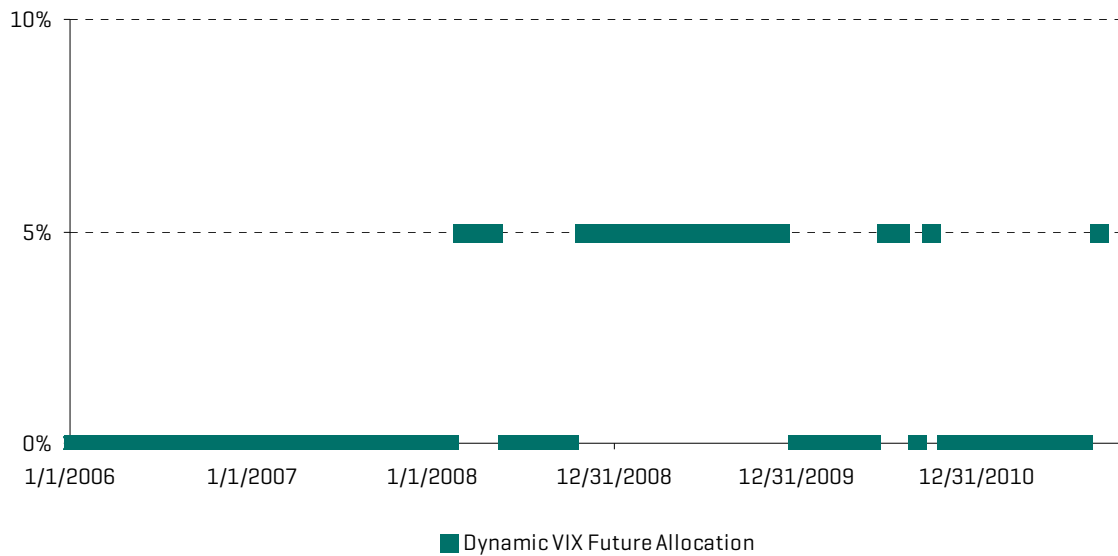
The diversification benefits of adding VIX products to an equity portfolio can be summarized as follows:

- A small (0-10%), static allocation of S&P 500 VIX Futures Index products in an equity portfolio may reduce portfolio volatility, but will suffer from constant roll loss.
- Dynamic allocations to VIX products may provide further downside protection and increase portfolio efficiency in terms of risk-return profile.

To determine whether these benefits carry over to bond portfolios, we examine two scenarios:

1. Allocating a static 5% weight to VIX futures in a bond portfolio.
2. Dynamically allocating weight to VIX futures in a bond portfolio. In this scenario, the allocation of equity volatility is set dynamically according to the observed spot VIX level. If, at month-end, spot VIX is equal to or above 25%, the allocation to VIX futures for the next month is 5%. If spot VIX at month-end is less than 25%, the allocation to VIX futures is 0.

Exhibit 15: Dynamic Weight Allocation to VIX Futures

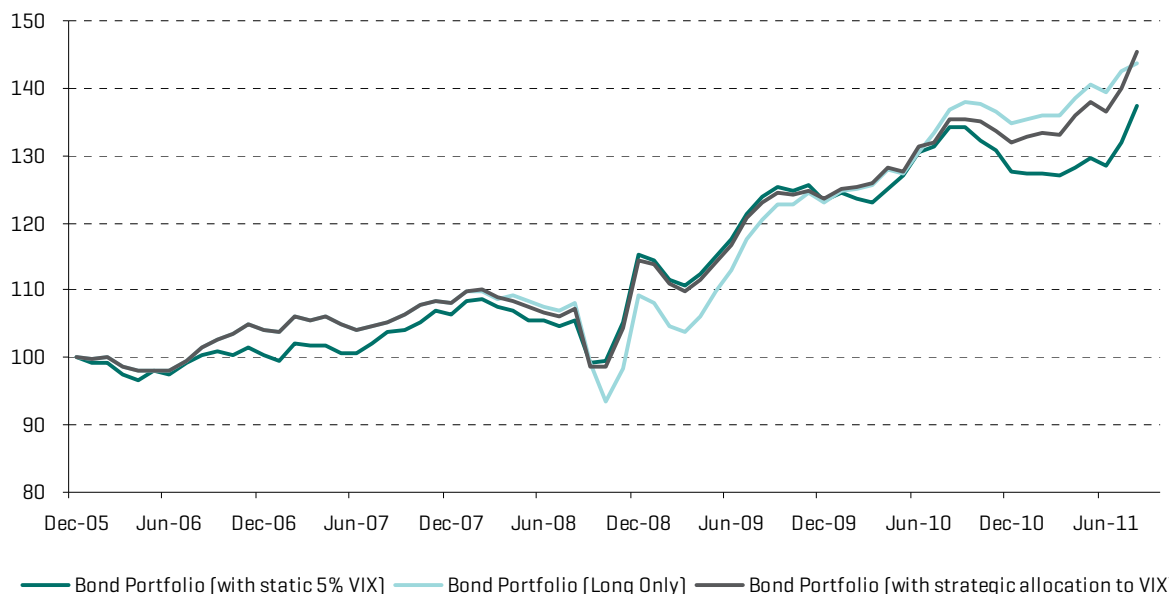


Source: Bloomberg, Standard & Poor's. Data from December 20, 2005 to August 31, 2011. Tables are provided for illustrative purposes. Past performance is not a guarantee of future results. Some of the data reflected in this chart may reflect hypothetical historical performance. Please see the Performance Disclosure at the end of this document for more information on some of the inherent limitations associated with back-tested index data and performance information.

### 4.1. Strategic Allocation of Equity Volatility to a Portfolio of Investment-Grade Corporate Bonds

Although the correlation of investment-grade corporate bonds to the S&P 500 VIX Short-Term Futures Index is flat, Exhibit 17 shows that adding a small allocation to the investment-grade corporate bond portfolio may reduce portfolio risk. Through dynamic allocation, investors can also improve portfolio efficiency, with less portfolio risk and higher returns than a long-only bond portfolio. T-tests also show that at a 99% confidence level, the dynamic 5% VIX portfolio differs from the long-only bond portfolio.

**Exhibit 16: Performance of Investment-Grade Corporate Bond Portfolios with Static and Dynamic Allocations to S&P 500 VIX Short-Term Futures Index**



Source: Bloomberg, Standard & Poor's. Data from December 20, 2005 to August 31, 2011. Charts are provided for illustrative purposes. Past performance is not a guarantee of future results. Some of the data reflected in this chart may reflect hypothetical historical performance. Please see the Performance Disclosure at the end of this document for more information on some of the inherent limitations associated with back-tested index data and performance information.

**Exhibit 17: Return and Risk of Investment-Grade Corporate Bond Portfolios with Static and Dynamic Allocations to S&P 500 VIX Short-Term Futures Index**

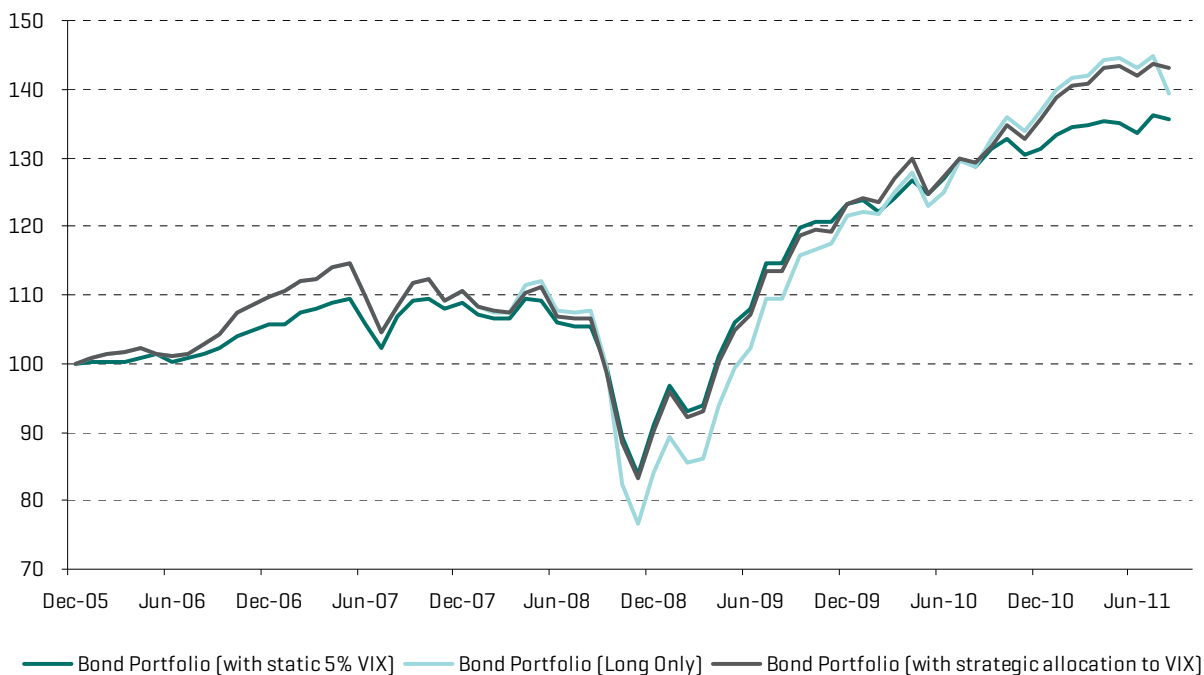
	Dynamic 5% Allocation to VIX Futures	Static 5% Allocation to VIX Futures	Long Only IG Bond Portfolio
<b>Annualized Return</b>	6.74%	5.67%	6.52%
<b>Annualized Volatility</b>	7.27%	7.11%	8.14%
<b>Risk/Return Ratio</b>	0.93	0.80	0.80
<b>Maximum Drawdown</b>	10.49%	8.74%	15.02%
<b>t-test</b>	0.14%	9.49%	

Source: Bloomberg, Standard & Poor's. Data from December 20, 2005 to August 31, 2011. Tables are provided for illustrative purposes. Past performance is not a guarantee of future results. Some of the data reflected in this chart may reflect hypothetical historical performance. Please see the Performance Disclosure at the end of this document for more information on some of the inherent limitations associated with back-tested index data and performance information.

## 4.2. Strategic Allocation of Equity Volatility to a Portfolio of High-Yield Corporate Bonds

Since high-yield corporate bonds behave more like equity than typical bonds, it may be beneficial to add a small allocation of equity volatility to reduce the portfolio risk. A static 5% allocation produces a lower level of risk, but also reduces portfolio returns. The dynamic allocation marginally increases portfolio risk, but the pick-up in return is substantial. The differences in performance are statistically significant according to t-tests at 90% confidence intervals.

**Exhibit 18: Performance of High-Yield Corporate Bond Portfolios with Static and Dynamic Allocations to S&P 500 VIX Short-Term Futures Index**



Source: Bloomberg, Standard & Poor's. Data from December 20, 2005 to August 31, 2011. Charts are provided for illustrative purposes. Past performance is not a guarantee of future results. Some of the data reflected in this chart may reflect hypothetical historical performance. Please see the Performance Disclosure at the end of this document for more information on some of the inherent limitations associated with back-tested index data and performance information.

**Exhibit 19: Risk and Return of High-Yield Corporate Bond Portfolios with Static and Dynamic Allocations to S&P 500 VIX Short-Term Futures Index**

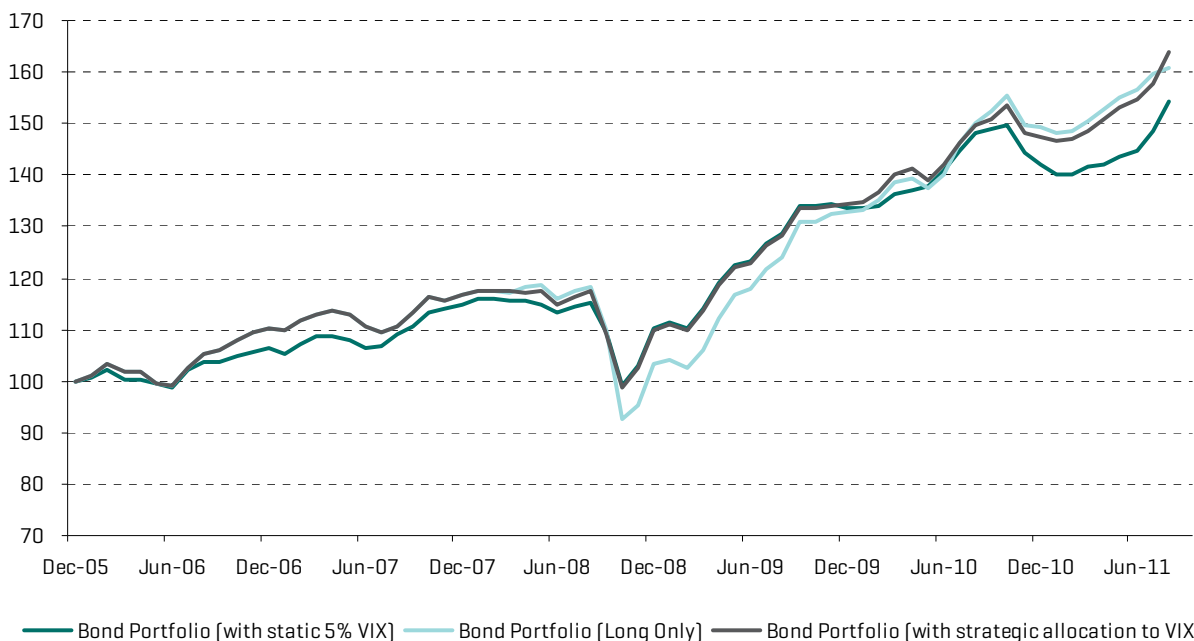
	Dynamic 5% Allocation to VIX Futures	Static 5% Allocation to VIX Futures	Long Only HY Bond Portfolio
<b>Annualized Return</b>	6.43%	5.42%	5.93%
<b>Annualized Volatility</b>	10.76%	9.91%	13.23%
<b>Risk/Return Ratio</b>	0.60	0.55	0.45
<b>Maximum Drawdown</b>	25.15%	23.20%	31.66%
<b>t-test</b>	5.47%	0.04%	

Source: Bloomberg, Standard & Poor's. Data from December 20, 2005 to August 31, 2011. Tables are provided for illustrative purposes. Past performance is not a guarantee of future results. Some of the data reflected in this chart may reflect hypothetical historical performance. Please see the Performance Disclosure at the end of this document for more information on some of the inherent limitations associated with back-tested index data and performance information.

### 4.3. Emerging Market Bonds

Emerging market bonds behave even more like equity than high-yield bonds. Therefore, it may be beneficial to add a small allocation of equity volatility to the emerging market bond portfolio. As in the high-yield case, a static 5% allocation produces the lowest level of risks but it also reduces portfolio returns. Dynamic allocations marginally increase portfolio risk, but the pick-up in return is substantial. The differences in performance are statistically significant according to t-tests at 99% confidence intervals.

**Exhibit 20: Performance of Emerging Market Bond Portfolios with Static and Dynamic Allocations to S&P 500 VIX Short-Term Futures Index**



Source: Bloomberg, Standard & Poor's. Data from December 20, 2005 to August 31, 2011. Charts are provided for illustrative purposes. Past performance is not a guarantee of future results. Some of the data reflected in this chart may reflect hypothetical historical performance. Please see the Performance Disclosure at the end of this document for more information on some of the inherent limitations associated with back-tested index data and performance information.

**Exhibit 21: Risk and Return of Emerging Market Bond Portfolios with Static and Dynamic Allocations to S&P 500 VIX Short-Term Futures Index**

	Dynamic 5% Allocation to VIX Futures	Static 5% Allocation to VIX Futures	Long Only EM Bond Portfolio
<b>Annualized Return</b>	8.98%	7.81%	8.60%
<b>Annualized Volatility</b>	8.27%	7.69%	10.38%
<b>Risk/Return Ratio</b>	1.09	1.02	0.83
<b>Maximum Drawdown</b>	15.75%	13.78%	21.93%
<b>t-test</b>	0.38%	0.20%	

Source: Bloomberg, Standard & Poor's. Data from December 20, 2005 to August 31, 2011. Tables are provided for illustrative purposes. Past performance is not a guarantee of future results. Some of the data reflected in this chart may reflect hypothetical historical performance. Please see the Performance Disclosure at the end of this document for more information on some of the inherent limitations associated with back-tested index data and performance information.



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## Performance Disclosure

The S&P 500 VIX Futures Index Series was launched on January 22, 2009 at the market close, with a base date of December 20, 2005. All information presented prior to the index inception date is back-tested. The back-test calculations are based on the same methodology that was in effect when the index was officially launched. Complete index methodology details are available at [www.indices.standardandpoors.com](http://www.indices.standardandpoors.com).

Past performance is not an indication of future results. Prospective application of the methodology used to construct this index may not result in performance commensurate with the back-test returns shown. The back-test period does not necessarily correspond to the entire available history of the index. Please refer to the methodology paper for the index, available at [www.standardandpoors.com](http://www.standardandpoors.com) for more details about the index, including the manner in which it is rebalanced, the timing of such rebalancing, criteria for additions and deletions, as well as all index calculations. It is not possible to invest directly in an Index.

Also, another limitation of hypothetical information is that generally the index is prepared with the benefit of hindsight. Back-tested data reflect the application of the index methodology and selection of index constituents in hindsight. No hypothetical record can completely account for the impact of financial risk in actual trading. For example, there are numerous factors related to the equities (or fixed income, or commodities) markets in general which cannot be, and have not been accounted for in the preparation of the index information set forth, all of which can affect actual performance.

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