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A portfolio insurance strategy for volatility index (VIX) futures

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ABSTRACT

This paper proposes a methodology using VIX futures as an investment asset while controlling downside risk. For this purpose, three portfolio insurance (*PI)* strategies are built by using option-based portfolio insurance (*OBPI)* and constant proportion (*CPPI)* for VIX futures. The effectiveness of the strategy is tested by historical return simulation of eight subsamples and a full sample for the period of Feb. 2007–Jan. 2015. We evaluate the performance of each strategy first as a pure investment tool and then as a diversification tool for S&P500 index. In the subsample simulation, all *PI* strategies perfectly protect its floor. *Protective Put* and *CPPI* appropriately catch up with strong and trendy bull markets of VIX futures. *Resetting* achieves a considerable return for the periods of return-reversal. In the full-sample simulation, the daily mean returns of the *PI* strategy are all greater than the benchmark's. The *PI* strategy is also a good diversification tool for S&P500 index.

1. Introduction

Volatility derivatives on the stock index have attracted much attention to both academics and practitioners over the past two decades. Since the Chicago Board Options Exchange (CBOE) introduced volatility index (known by its ticker symbol VIX) in 1993, there had been a growing demand for instruments to hedge volatility risk. To address this demand, in March 2004, CBOE created the exchange-traded VIX futures and in Feb. 2006, launched VIX options. In particular, the volatility shock that hit the financial markets globally in autumn 2008 had pronounced effects on the trading volume of volatility derivatives.[1]

VIX, often known as "fear index", is the standard measure of volatility risk for investors in the U.S. stock market. VIX is currently based on the S&P500 Index (SPX) and is devised to estimate the expected volatility (i.e., standard deviation) over the next thirty calendar days by averaging the weighted prices of SPX Index options over a wide range of strike prices (CBOE, 2009). The negative correlation of VIX to stock market returns and a mean-reverting feature of VIX have been well documented.[2]

Fig. 1 illustrates the historical behavior of SPX and VIX from Jan. 1, 1990 through Dec. 31, 2014. From the figure, we can observe mean-reversions after several spikes in VIX and a strong negative correlation between the daily movements of SPX and VIX. In particular, the negative correlation intensifies in a market downturn. Moreover, VIX has been five times more volatile than SPX for the period.[3] VIX futures (say, VIXF), of which level represents a forward volatility over thirty calendar day that begins at the expiration date of the futures contract, has a peculiar characteristic. Because VIX itself is not tradable, VIX futures has a very different property from other futures on tradable assets, which is implied by the standard cost-of-carry model. Consequently, as shown in Fig. 2, VIXF does

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[1] The data source for S&P500 Index, VIX, VIX futures and VVIX is the CBOE Futures Exchange (CFE).

[2] See, e.g., Carr and Wu (2006) for more about VIX.

[3] For the period, the correlation between the daily movements of SPX and VIX is −0.59 in days with a negative return on SPX and −0.47 in days with a positive return. The asymmetric relation between market volatility and stock market return has been frequently observed (see Alexander & Korovilas, 2011; Daigler & Rossi, 2006; Fleming et al., 1995; Sarwar, 2012; Schwert, 1990; Whaley, 2000). For the period of Jan. 1990–Dec. 2014, VIX ranges from 9.3% (Dec.22, 1993) to 80.9% (Nov. 20, 2008) and averages to 20.1%; the annualized volatility of SPX and VIX are 18.1% and 98.1%, respectively.

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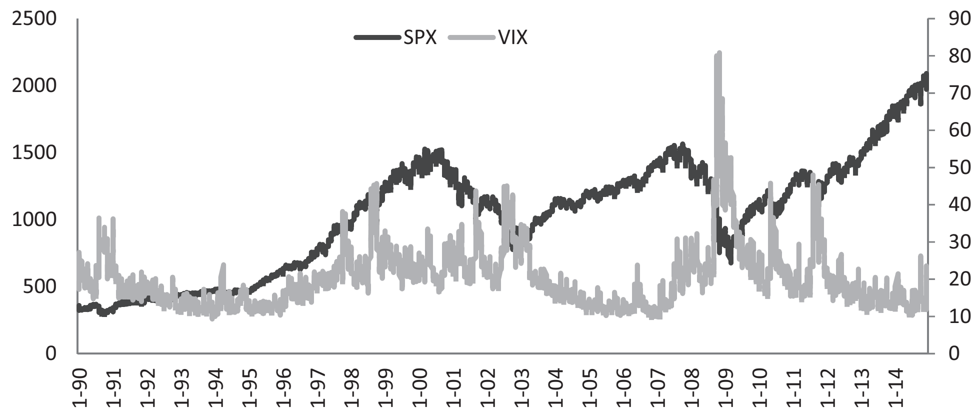

Fig. 1. VIX (right axis) vs. SPX (left axis): January 1, 1990–December 31, 2014.

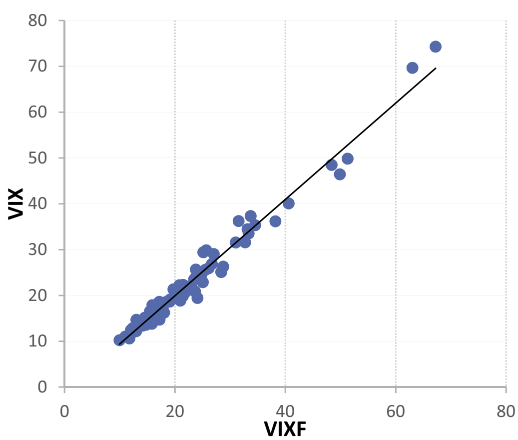

Fig. 2. VIX (close) vs. VIXF (settlement) at the expiration date: February 2007–January 2015.

not converge to VIX even at the expiration date due to the non-tradability of VIX.[4]

Since Brenner and Galai (1989) and Whaley (1993) first introduced the concept on the volatility derivatives, there has been extensive literature on VIX Futures. The literature has mainly focused on building and testing pricing models (e.g., Grünbichler & Longstaff, 1996; Zhang & Zhu, 2006), assessing the forecastability (e.g., Konstantinidi & Skiadopoulos, 2011; Lu & Zhu, 2010; Nossman & Wilhelmsson, 2009), modeling a term structure (e.g., Huskaj & Nossman, 2013; Zhang, Zhu, & Brenner, 2010) and examining a causality between VIX and VIX futures prices (e.g., Shu & Zhang, 2012). In particular, several scholars have noticed the diversification benefit from adding VIX futures to the existing portfolio as one of hedging tools (e.g., Chen, Chung, & Ho, 2011; Deng, McCann, & Wang, 2012; Moran & Dash, 2007; Szado, 2009).

However, in spite of the diversification benefit that previous studies presented, VIX futures has been hardly justified as an investment asset due to its negative expected return. The reason is the contango in the VIX futures market. Related to the issue, Alexander and Korovilas (2011) is pessimistic about using VIX futures even as a diversification tool because negative carry and roll yield on volatility futures during normal periods would outweigh any benefits gained unless volatility trades are carefully timed. As mentioned by Whaley (2013), volatility products 'are not suitable buy-and-hold investments and are virtually guaranteed to lose money through time'. Particularly, the risk premium is negative for short-term VIX futures, which works as an insurance against drops in the stock market (see Nossman & Wilhelmsson, 2009; Huskaj & Nossman, 2013). For instance, Fig. 3 depicts the 3-month buy-and-hold return of VIX futures until the expiration date during the period of May 2007–Feb. 2015. As the chart shows, VIX futures contracts have revealed a negative return for 70% of the contracts and the average loss of the negatively returned contracts was 18.5%. Moreover, the frequency of the loss recently increased further. Given this reality, the role of VIX futures as a diversification tool is also limited because adding VIX futures to an investment portfolio may drag the overall return of the portfolio.[5]

Recognizing the reality, this study begins with an inquiry, "Is there any strategy to use VIX futures as an investment asset with a downside protection?" To answer the inquiry, this study examines whether a dynamic asset allocation strategy for the portfolio insurance ('the *PI* strategy') can be applied to VIX futures. Option-based portfolio insurance (*OBPI*) and constant proportion portfolio insurance (*CPPI*) have been two most prominent dynamic asset allocation strategies that are designed to guarantee a minimum value (called the 'floor') of the portfolio at investment horizon while retaining some exposure to a rising market. Although these strategies have their applications to many of financial products, they have not been used to VIX futures yet. Thus the main purpose of this paper is to implement *OBPI* and *CPPI* on VIX futures and to evaluate their effectiveness as both an investment asset and a diversification tool.

Although taking a futures position does not require investment money except for margin requirement, this paper will treat investing in VIX futures the same way one invests in a portfolio of stock. Therefore, when the exposure to VIX futures is changed to the optimal ratio suggested by the *PI* strategy, it needs to adjust the proportion of its notional value. Since the money market interest rates are currently almost zero in most major markets, it will not make much difference to the simulation results even if we disregard the practice that requires only margin to invest in VIX futures.

The rest of this paper proceeds as follows. In Sections 2 and 3, a methodology to construct *OBPI* and *CPPI* is described. In Section 4, we design the historical return simulation of the *PI* strategies for eight subsamples and a full sample and present the results. The last section summarizes and concludes.

[4] The average deviation between the settlement price of VIXF and the close index of VIX at the expiration date was 4.8% during the period of Feb. 2007–Jan. 2015 (96 observations).

[5] Alexander and Korovilas (2012) find that volatility diversification with VIX futures was only optimal during the periods of the recent credit and banking crises, even after accounting for skewness preference.