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# Implied volatility and future portfolio returns

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**Abstract**

Prior studies find that the CBOE volatility index (VIX) predicts returns on stock market indices, suggesting implied volatilities measured by VIX are a risk factor affecting security returns or an indicator of market inefficiency. We extend prior work in three important ways. First, we investigate the relationship between future returns and current implied volatility levels and innovations. Second, we examine portfolios sorted on book-to-market equity, size, and beta. Third, we control for the four Fama and French [Fama, E., French, K., 1993. Common risk factors in the returns on stocks and bonds. Journal of Financial Economics 33, 3–56.] and Carhart [Carhart, M., 1997. On persistence in mutual fund performance. Journal of Finance, 52, 57–82.] factors. We find that VIX-related variables have strong predictive ability.


*JEL classification:* G11; G1

*Keywords:* Risk premium; Implied volatility; VIX index; Portfolio returns

## 1. Introduction

The CBOE volatility index (VIX) is a measure of market expectations of stock return volatility over the next 30 calendar days and is calculated from S&P 100 (OEX) stock index options. It was introduced in 1993 and originally computed on a minute-by-minute basis from the implied volatility of eight option series that are near-the-money, nearby, and second-nearby OEX option series, and was weighted to reflect the implied volatility

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of a 30 calendar-day at-the-money OEX option.[1] The option valuation model used in the calculation is a cash dividend adjusted binomial method based on Black and Scholes (1973). VIX has been referred to as the 'investor fear gauge' (Whaley, 2000), since high levels of VIX coincided with high degrees of market turmoil. In addition to VIX being used to gauge market volatility, some traders advocate the use of VIX as a stock market timing tool. This is based on the observation that high levels of VIX often coincide with market bottoms, and seem to indicate ''oversold'' markets. Traders can take long positions in the market in anticipation of an increase after VIX is high.

Giot (2005) tests if high levels of VIX indicate oversold stock markets by dividing the VIX price history into 21 equally spaced rolling percentiles and examining the returns on the S&P 100 for various future holding periods up to 60 days for each of these 21 percentiles. He finds that for very high (low) levels of VIX, future returns are always positive (negative). His findings suggest that extremely high levels of VIX may signal attractive buying opportunities. This is surprising, since VIX information is readily available and should not allow for timing profits if market participants are rational. Another explanation is that the volatility of the market, as represented by VIX, is a systematic risk factor, and there would be no abnormal returns after adjusting for this factor. A negative market price of volatility risk is found by Jackwerth and Rubinstein (1996), Coval and Shumway (2001), Bakshi and Kapadia (2003) and others. If investors have aversion to volatility, high levels of volatility will translate to high price risk premiums since prices and volatility are negatively correlated.

Giot's (2005) findings are based on the S&P 100, and not on segments of the market grouped by characteristics of stocks. Copeland and Copeland (1999) also focus on indices rather than portfolios; they examine BARRA's indices (value and growth stocks), S&P 500 futures (large stocks), and Value Line futures (small stocks). They advocate the use of VIX as a size and style rotation tool and find that large and value stocks earn high returns after VIX is high, attributing this to investors seeking safer portfolios after increases in implied volatility. Guo and Whitelaw (2006) find that market returns are positively related to implied volatilities.

We expand on prior studies in three important ways. First, we examine the relationship between future returns and both current levels and innovations of implied volatility. Second, we analyze portfolios grouped by characteristics. We examine the future returns of portfolios sorted by beta, size, and book-to-market equity. Beta is chosen as a grouping characteristic because of the positive relationship shown in prior studies between levels of VIX and future market returns. As such, we sort on beta to determine if high beta firms have a stronger return relationship with VIX than low beta firms. Size and book-to-market equity are chosen as grouping characteristics since these attributes are commonly associated with the cross-section of returns. Further, Copeland and Copeland (1999) find that alternative indices associated with firm size and value versus growth characteristics have different returns following high VIX levels. Finally, behavioral finance suggests that investor sentiment may affect stock returns differently depending on their size and book-to-market equity

[1] Beginning in 2003, VIX is calculated from the S&P 500 (SPX) index option prices, rather than from the S&P 100. The calculation involves a wide range of strike prices and is independent of any option-pricing model. The CBOE calculates and distributes the original OEX VIX under the new ticker ''VXO''. The old and new VIX series are highly correlated (Carr and Wu, 2004).