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Are VIX futures prices predictable? An empirical investigation

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Abstract

This paper investigates whether volatility futures prices per se can be forecasted by studying the fast-growing VIX futures market. To this end, alternative model specifications are employed. Point and interval out-of-sample forecasts are constructed and evaluated under various statistical metrics. Next, the economic significance of the forecasts obtained is also assessed by performing trading strategies. Only weak evidence of statistically predictable patterns in the evolution of volatility futures prices is found. No trading strategy yields economically significant profits. Hence, the hypothesis that the VIX volatility futures market is informationally efficient cannot be rejected.

Keywords: Bootstrapping; Interval forecasts; Market efficiency; Predictability; Performance measures; VIX; Volatility futures

1. Introduction

Volatility derivatives have attracted a considerable amount of attention in past years, since they enable trading and hedging against changes in volatility. Brenner and Galai (1989, 1993) first suggested derivatives written on some measure of volatility that would serve as the underlying asset. Since then, a number of volatility derivatives have been traded in the over-the-counter market. On March 26, 2004, volatility futures on the implied volatility index VIX were introduced by the Chicago Board Options Exchange (CBOE).[1] Volatility futures on a number of other implied volatility indices have also been introduced since then. The liquidity of volatility futures markets is steadily growing, with the VIX futures market being the most liquid one.[2] This paper focuses on the VIX futures market and for

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[1] VIX is an implied volatility index that tracks the implied volatility of a synthetic option on the S&P 500 with thirty days to maturity.

[2] The CBOE launched the VXD and VXN volatility futures on April 25, 2005, and July 6, 2007, respectively. The VXD and VXN are implied volatility indices that track the implied volatility of a synthetic option on the Dow Jones Industrial Average and the Nasdaq 100, respectively, with a constant time to maturity (thirty days). Regarding the liquidity of volatility futures, on January 2, 2008, the open interest for VIX futures was 55,792 contracts, or

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the first time addresses the question of whether VIX futures prices per se can be predicted.[3] The answer to the question of whether or not volatility futures prices can be predicted is of importance to both academics and practitioners, because it contributes to our understanding of whether volatility futures markets are efficient, and helps market participants to develop profitable volatility trading strategies and set successful hedging schemes.

There is already an extensive body of literature that has investigated whether the prices of stock indexes, interest rates, currencies, and commodity futures can be forecasted. The significance of the results has been evaluated using either a statistical or an economic (trading profits) metric. A number of studies have documented a statistically predictable pattern in futures returns. In particular, Bessembinder and Chan (1992) found that the monthly nearest maturity commodity and currency futures returns can be forecasted within-sample in a statistical sense. They concluded that this predictability could be attributed to an asset pricing model with time-varying risk-premia. Similar findings were documented by Miffre (2001a) for the FTSE 100 futures and by Miffre (2001b) for commodity and financial futures.

On the other hand, the empirical evidence on the predictability in futures markets under an economic metric is mixed. For instance, Hartzmark (1987) found that in aggregate, speculators do not earn significant profits in commodity and interest rate futures markets; daily data of all contract maturities were employed. Yoo and Maddala (1991), however, studied commodity and currency futures and found that speculators tend to be profitable; daily data for a number of futures maturities were considered. Similar findings were reported by Kearns and Manners (2004), Kho (1996), Taylor (1992) and Wang (2004). In particular, all of these studies found that economically significant profits can be obtained by employing various trading rules in currency futures markets; daily data were used by Taylor (1992), and weekly data by Kearns and Manners (2004), Kho (1996), and Wang (2004). A number of futures maturities were examined by Kearns and Manners (2004) and Taylor (1992), while Kho (1996) and Wang (2004) focused on the shortest maturity series. Significant profits were also reported by Hartzmark (1991) and Miffre (2002), who examined the commodity and financial futures markets; the latter study focused only on the shortest maturity contracts. Regarding the source of the identified trading profits, Kearns and Manners (2004) and Taylor (1992) attributed them to the inefficiency of the currency futures market. On the other hand, Kho (1996), Miffre (2002), Wang (2004) and Yoo and Maddala (1991) found that the reported profits were not abnormal, and Hartzmark (1991) found that profitability is determined by luck rather than superior forecast ability; hence, the considered markets were efficient á la Jensen (1978).

In contrast to the number of papers devoted to the topic of predictability in the previously mentioned futures markets, the research as to whether there exist predictable patterns in the evolution of volatility futures prices is still at its infancy. The literature on volatility futures has primarily focused on developing pricing models (see e.g. Brenner, Shu, & Zhang, 2008; Dotsis, Psychoyios, & Skiadopoulos, 2007; Grünbichler & Longstaff, 1996; Lin, 2007; Zhang & Zhu, 2006) and assessing their hedging performances (see e.g. Jiang & Oomen, 2001). On the other hand, to the best of our knowledge, Konstantinidi, Skiadopoulos, and Tzagkaraki (2008) is the only related study that has explored the issue of the predictability of volatility futures prices. However, this was done indirectly, and only under a financial measure. The authors developed trading strategies with VIX and VXD volatility futures based on point and interval forecasts which were formed for the corresponding *underlying* implied volatility indices. They found that the Sharpe ratios obtained were not statistically different from zero, and hence the volatility futures markets are efficient.

$1.3 billion in terms of market value; this corresponds to a 59% increase from January 3, 2007, when the trading volume was 2481 contracts or $57 million in terms of market value. On the same date, the open interest of VXD and VXN futures was $19 and $4 million, respectively.

[3] This question is distinct from the question of whether futures markets are efficient in the sense that the futures price is an optimal forecast of the underlying spot price to be realized on the contract expiry date (see e.g. Coppola, 2008; Kellard, Newbold, Rayner, & Ennew, 1999, and references therein; and Nossman & Vilhelmsson, 2009, for a study using VIX futures). In our study, Jensen's (1978) definition of futures market efficiency is adopted: a market is efficient with respect to the information set I_t in the case where it is impossible to make economic profits by trading on the basis of this information set.