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Is market fear persistent? A long-memory analysis

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ABSTRACT

This paper investigates the degree of persistence of market fear in the VIX index over the sample period 2004–2016, as well as some sub-periods. The findings indicate that its properties change over time: in normal periods it exhibits anti-persistence, whilst during crisis period the level of persistence is increasing. These results can be informative about the nature of financial bubbles and anti-bubbles, and provide evidence on whether there exist market inefficiencies that could be exploited to make abnormal profits by designing appropriate trading strategies.

1. Introduction

According to an old saying on Wall Street the market is driven by just two emotions: fear and greed. Shefrin (2000) in his famous book "Beyond Greed and Fear" claims that they are the most important of a number of heuristic-driven biases influencing investors and resulting in market inefficiencies. Zweig (2007) points out that agents are often in the grip of emotions without even realising it and provides an interesting example: a survey of 1,000 investors suggested that there is a 51% chance that in any given year the US stock market will drop by one third, whilst on the basis of historical data the odds that US stocks will lose one third of their value in any given year are only around 2%. This misperception of reality is a direct result of fear and represents evidence that investors are not fully rational.

Shefrin (2000) points to behavioural anomalies in individual investors, institutional money managers, and corporate managers regardless of their training or experience; moreover, such anomalies can be observed in all market sectors, including equities, fixed income, foreign exchange, commodities, and options. Shiller (2003) argues that some changes in prices occur not for fundamental reasons, but because of mass psychology instead. Other behavioural finance studies have provided more evidence that is inconsistent with the Efficient Market Hypothesis (EMH), according to which investors are rational, and asset prices fully reflects all available information and therefore should follow a random walk (see Malkiel and Fama, 1970).

Analysing investor sentiment and fear in particular is therefore crucial. Surprisingly, to date there is no study investigating the long-memory properties of the latter. The present paper aims to fill this gap in the literature by examining the degree of persistence of the very popular VIX index, also known as CBOE Volatility Index. This can be interpreted as a "fear" index, since according to Whaley (2000) it is an 'investor fear gauge' that reaches higher levels during periods of market turmoil. We use two different long-memory approaches (R/S analysis with the Hurst exponent method and fractional integration) to analyse persistence of the VIX over

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the sample period 2004–2016, as well as some sub-periods (pre-crisis, crisis and post-crisis) to see whether it varies over time depending on market conditions.

The results of our analysis are of interest to both academics and practitioners. They can be informative about the nature of financial bubbles and anti-bubbles, and provide evidence on whether there exist market inefficiencies that could be exploited to make abnormal profits by designing appropriate trading strategies. A better understanding of financial markets can be gained by applying quantitative methods to behavioural finance to analyse investor sentiment as in our study. Its layout is the following: Section 2 provides a brief review of the literature on market fear; Section 3 describes the data and outlines the methodology; Section 4 presents the empirical results; Section 5 provides some concluding remarks.

2. Literature review

Fear is an unpleasant feeling of anticipation or awareness of danger. Sustained losses in financial markets can cause fear of further losses among investors. As a result phenomena such as financial bubbles (anti-bubbles) and their bust, volatility explosions, trends etc. may occur. When feeling fear investors move from risky assets (usually stocks) to less risky ones (money market securities, as well as so-called safe heavens, for example gold, the Swiss franc, the Japanese yen etc.). The mass exodus of investors from certain markets may cause market crashes or even financial crises. Fear is one of the reasons for market overreactions. A typical example is Black Monday (the Flash Crash in the US stock market on 19 October 1987): this single market drop mostly caused by the emotional reactions of investors affected their behaviour for years (for more details see Keim and Madhavan, 2000). According to Shiv et al. (2005) after incurring losses agents are less inclined to invest and prefer to stay out of the market. There is plenty of evidence that losing streaks influence their behaviour (see, e.g., Zalla et al., 2000; Breiter et al., 2001 etc.).

Losses or market instability make investors more vulnerable to fear, which often results in irrational behaviour and costly mistakes. Johnson and Tversky (1983) find that 50% of agents can recognise when they have been affected by a bit of negative news, but only 3% admit that this may influence their degree of risk aversion. Slovic (1987) proves that fast and finite dangers (fireworks, skydiving, train crashes, etc.) feel more “knowable” (and less worrisome) than vague, open-ended risks such as genetically modified foods or global warming. Agents underestimate the likelihood and severity of common risks, and overestimate those of rare risks (see Zweig, 2007).

A few studies have attempted to analyse market fear empirically using measures such as the VIX index (also known as the CBOE Volatility Index or Fear index), the CNN Money Fear & Greed Index, the IVX and the CBOE Skew Index. By far the most popular is the VIX, which is derived from the prices of S&P 500 options and yields the expected annualised change in the S&P 500 index over the following 30 days. It is an implied volatility index: the lower its level, the lower is demand from investors seeking to buy protection against risk and thus the lower is the level of market fear.

The VIX is based on S&P 500 data. The long-memory properties of this index have been investigated in numerous empirical studies that have provided mixed results. For example Peters (1991, 1994) used S&P 500 data to test for persistence in the US stock market and found evidence of long memory. Granger and Ding (1995) used about 17,000 daily observations on the S&P 500 index returns and concluded that absolute returns exhibit long-memory properties; a later study by Granger and Hyung (2004) confirmed these findings. Alvarez-Ramirez et al. (2008) used daily data for the period 1950–2007 and reported that the long-term memory properties of the S&P 500 change over time, especially during crisis periods. Similar conclusions were reached by Dominique and Rivera (2011), who showed that the S&P 500 Index is persistent, but its degree of persistence changes over the time.

In contrast to the abovementioned studies, Chow et al. (1996) did not find long-term dependence in stock returns. The same conclusion was reached by Caporale and Gil-Alana (2004a) and Lu and Perron (2010), both these papers not finding evidence of long memory in daily S&P 500 returns.

Most papers analysing the VIX have focused on its predictive power for future returns. Giot (2005) finds that high (low) levels of the VIX correspond to positive (negative) future returns. Guo and Whitelaw (2006) and Chow et al. (2014) also show that there is a positive relationship between market returns and the VIX. Heydon et al. (2000) find that global equity markets outperform bond markets after periods of relatively high expected volatility in the US market and vice versa. Chow et al. (2016) estimate that approximately one-third of the VIX is attributable to the tail risk premium. Fleming et al. (1995) were the first to analyse the persistence of this index and found that its daily changes follow an AR(1) process, whilst its weekly changes exhibit mean reversion, and there is no evidence of seasonality. Long-memory behaviour in the VIX was also detected by Koopman et al. (2005) and Corsi (2009). Huskaj (2013) estimates GARCH, APARCH, FIGARCH and FIAPARCH models, and reports that long memory in the volatility has no significant impact on the prices of hypothetical VIX options. Jo-Hui and Yu-Fang (2014) apply ARFIMA and FIGARCH models to VIX-ETFS data and find no signs of long memory, whilst Fernandes et al. (2014) detect long-range dependence using a HAR model. Overall, the evidence on the properties of the VIX is rather mixed.

Research on the VIX and its properties is important because this index can be used as a predictor for S&P 500 returns, stock market volatility, economic activity, financial instability, financial crises etc. It can also be used as a measure of economic instability and to improve the classical CAPM and Black–Scholes models (see Cipollini and Manzini, 2007 for details).

The most common use of the VIX is for predicting stock returns. Bollerslev et al. (2009) provide empirical evidence that indeed stock market returns are predictable by using data from VIX. Munenzon (2010) goes even further and shows that the level of the VIX has important implications for return expectations for all asset classes, not just equities. According to Christensen and Prabhala (1998) and Chernov (2007), the VIX contains information about future stock market volatility.

Bekaert and Hoerova (2013) show that the VIX is a significant predictor of stock returns and industrial production growth (key indicator of economic activity), as well as financial instability; specifically, it has high predictive power for the one- and three-months ahead indicator of financial stress created by the European Central Bank (ECB).