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The information content of implied volatility and jumps in forecasting volatility: Evidence from the Shanghai gold futures market

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ABSTRACT

This paper investigates the information content of the CBOE Gold ETF Volatility Index (GVZ) and jumps in forecasting realized volatility of the Shanghai gold futures market. We find strong in-sample evidence that the GVZ and jumps are significant and both greatly improve next day volatility forecasts. Also, these results are robust when the recent financial crisis is considered. Further, out-of-sample analysis confirms that the GVZ and jumps are important factors in forecasting future volatility. More important, we show that the GVZ outperforms jumps in terms of forecasting performance.

1. Introduction

Recently, there is a fast growing literature on gold market (Lucey et al., 2014; Auer, 2016; Hoang et al., 2015; Malliaris and Malliaris, 2015; Hauptfleisch et al., 2016). Importantly, O'Connor et al. (2015) provide a comprehensive review of research on gold as an investment. However, it seems that there is no study on forecasting volatility of the Shanghai gold market. In fact, more attention has been paid to volatility forecasting in commodity markets in recent years. For example, Martens and Zein (2004) and Haugom et al. (2014) document that implied volatility calculated from options market has predictive power for realized volatility in the U.S. oil market. Moreover, on April 19, 2016, the Shanghai Gold Exchange launched a yuan-denominated Benchmark Price which indicates that it is urgent to have a better understanding of the Shanghai gold market.

We try to fill this gap by investigating the information content of implied volatility and jumps in forecasting realized volatility of the Shanghai gold futures. Particularly, we decompose realized volatility into its jump and continuous components (Busch et al., 2011) and employ the CBOE gold ETF Volatility Index (GVZ) from the U.S. options market (Luo and Ye, 2015; Song et al., 2016). We find strong in-sample and out-of-sample evidence that both the GVZ and jumps are important in predicting future volatility. Further, we confirm the importance of the GVZ and jumps by considering both within

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the recent financial crisis and post-crisis periods. More important, we show that the GVZ outperforms jumps in terms of forecasting performance.

Our findings relate to recent literature on gold's safe haven property and spillovers between different gold markets. For example, Baur and Lucey (2010) document that gold is a safe haven for stocks in extreme negative returns for a short period. We find that the predictability of the Shanghai gold volatility during recent financial crisis is higher than that in post-crisis period, which supports Baur and Lucey's (2010) observation. Further, Lucey et al. (2014) conduct a comprehensive investigation on spillovers in both returns and volatility among gold markets in London, New York, Tokyo, and Shanghai. They show that London and New York are dominant markets while Shanghai is disconnected from the other three markets when cash market and futures market data are used. However, our results indicate that the U.S. gold options market contains incremental information in forecasting volatility of the Shanghai gold futures market. In this sense, we shed some new light on the linkages between gold markets.

2. Data and model framework

2.1. Data

This study uses high frequency data on gold futures contracts traded in Shanghai Futures Exchange (SHFE) and daily data of the GVZ from June 3, 2008 to Dec 31, 2014, yielding a total of 1548 trading days and 348,300 observations. The data are obtained from the Monopoly Financial Data Center and the website of the CBOE.[1] In order to investigate impact of the recent financial crisis, we divide our samples into crisis period from June 3, 2008 to June 31, 2009 and post-crisis period from July 1, 2009 to Dec 31, 2014.[2]

2.2. Realized volatility, jumps and implied volatility

Following Busch et al. (2011), we define realized variance as follows:

$$RV_t = \sum_{j=1}^{M} {r_{t,j}}^2, t = 1, \dots, T \tag{1}$$

$$r_{t,j} = \ln P_{t,j} - \ln P_{t,j-1}, \;\; j = 1, \dots, \mathrm{M} \tag{2}$$

where RV_t is the daily realized variance of gold futures, M stands for the sampling frequency and $P_{t,j}$ denotes the closing price for period j on day t. Furthermore, we separate the realized variance into its jumps and continuous components:

$$BV_t = \mu_1^{-2} \frac{M}{M-(k+1)} \sum_{j=k+2}^{M} \left|r_{t,j}\right|\left|r_{t,j-k-1}\right|, \;\; t = 1, \dots, T \tag{3}$$

$$TQ_t = \mu_{4/3}^{-3} \frac{M^2}{M-2\times(k+1)} \sum_{j=2k+3}^{M} \left(\left|r_{t,j}\right|\left|r_{t,j-k-1}\right|\left|r_{t,j-2k-2}\right|\right)^{4/3}, t = 1, \dots, T \tag{4}$$

$$Z_t = \sqrt{M} \times \frac{(RV_t - BV_t)\times RV_t^{-1}}{\left(\left(\mu_1^{-4} + 2\mu_1^{-2} - 5\right) \times \max\left(1, TQ_t \times BV_t^{-2}\right)\right)^{1/2}} \tag{5}$$

$$\begin{cases} J_t = I_{\{Z_t > \emptyset_{1-\alpha}\}}(RV_t - BV_t) \\ C_t = RV_t - J_t \end{cases} \tag{6}$$

where BV_t is the staggered (skip-k, with $k \geqq 0$) realized bipower variation, TQ_t is the staggered realized tripower quarticity, Z_t is the (ratio) test statistic, $\mu_1 = \sqrt{\pi/2}$, $\mu_{4/3}^{-3} = 2^{\frac{2}{3}}\Gamma(7/6)\Gamma(1/2)$, and J_t and C_t are the jump and continuous components of the realized variance respectively. Following Andersen et al. (2001), we choose a sampling frequency of 5 min.[3]

On June 3, 2008, the CBOE began calculating the GVZ, which is the implied volatility derived from gold ETF options market. The GVZ measures the market's expectation for next 30-day volatility of gold prices.

Fig. 1 displays the daily RV and the implied variance (the squared GVZ) from June 3, 2008 to Dec 31, 2014. Fig. 2 shows time series of jump and continuous components of the RV over the sampling period.

[1] The Monopoly Financial Data Center is a third party data provider in China and its Chinese website is http://www.licai668.cn.

[2] The NBER gives the dates of the crisis as beginning with a peak in December 2007 and continuing to the bottom in June 2009, which can be seen from website: http://www.nber.org/cycles.html.

[3] To test the robustness, we also calculate the RV for 15- and 25-min intervals. It turns out that the in-sample and out-of-sample results remain consistent.

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