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Non-linear volatility dynamics and risk management of precious metals

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ABSTRACT

In this paper, we investigate the value-at-risk predictions of four major precious metals (gold, silver, platinum, and palladium) with non-linear long memory volatility models, namely FIGARCH, FIAPARCH and HYGARCH, under normal and Student-*t* innovations' distributions. For these analyses, we consider both long and short trading positions. Overall, our results reveal that long memory volatility models under Student-*t* distribution perform well in forecasting a one-day-ahead VaR for both long and short positions. In addition, we find that FIAPARCH model with Student-*t* distribution, which jointly captures long memory and asymmetry, as well as fat-tails, outperforms other models in VaR forecasting. Our results have potential implications for portfolio managers, producers, and policy makers.

1. Introduction

Recently, stock markets have experienced unanticipated declines in returns and excessive volatility. Investors have lower diversification benefits from equity investments as correlations between global equity markets rise, especially in times of high volatility. For this reason, financial market participants gravitate toward alternative asset classes to attain higher returns, diversify their portfolios and hedge

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against increased uncertainty in the equity markets. Commodities, such as major energy products and precious metals, are used as diversification and hedging tools as they have lower correlations with stocks (Tang & Xiong, 2010; Hammoudeh, Araújo Santos, & Al-Hassan, 2013). For this reason, modeling and forecasting volatility of commodity prices are of great interest to researchers, investors, portfolio managers and policymakers.

The empirical studies point out some stylized facts in the behavior of commodity prices, such as asymmetry, fat tails and long memory (see among others, Giot and Laurent, 2003; Cunado, Gil-Alana, & Perez de Gracia, 2010; Arouri, Hammoudeh, Lahiani, & Nguyen, 2012; Chang, McAleer, & Tansuchat, 2012; Chkili, Hammoudeh, & Nguyen, 2014). Sophisticated volatility models that capture these characteristics, are found to produce more accurate volatility estimates and outperform other models in terms of forecasting performances. In order to analyze these features, Generalized Autoregressive Conditional Heteroskedastic (GARCH)-class models are widely employed in the literature.

The financial crisis of 2007/2008 had shown the importance of properly assessing risk levels and the quantification of potential losses for investment assets. Accurate volatility estimates are also crucial for risk management. Empirical studies on commodity market risks frequently consider value-at-risk (VaR) approach based on GARCH-type models. VaR is commonly used among researchers and practitioners to measure the possible maximum amount of loss for an asset portfolio over a given period of time within a fixed confidence level.

A wealth of literature focuses on examining the volatility dynamics and/or the VaR predictions of oil and other energy prices (Giot & Laurent, 2003; Sadorsky, 2006; Cheong, 2009; Aloui & Mabrouk, 2010; Kang & Yoon, 2012), whereas related studies on precious metals are very limited. Many studies have shown that adding precious metals in an equity portfolio considerably improves the portfolio performance[1]. Precious metals are also largely used in industries, such as electronics, jewellery and medicine. Hence, investigating precious metals from a risk management perspective is beneficial not only for portfolio managers but also for manufacturers.

The objective of this paper is to fill a gap in the financial economics literature, investigating the value-at-risk (VaR) estimations of four precious metals (gold, silver, platinum and palladium) traded in the London Bullion Market and the London Platinum & Palladium Market, with non-linear long memory volatility models, namely FIGARCH, FIAPARCH and HYGARCH. Despite the role of precious metals in portfolio diversification and hedging, to the best of our knowledge, none of the studies in the previous literature has considered to study on the precious metals volatility, capturing the stylized facts such as, asymmetry, skewed fat-tails as well as long memory[2]. We use daily fixing spot prices from January, 4 1993 to November, 29 2013 and apply normal and Student-*t* distributions to assess the overall performance. We evaluate in-sample and out-of-sample performances of the models at the 1% and 5% tails in the case of both long and short trading positions. In this regard, this study addresses a number of research questions. First, we investigate the long memory behavior in precious metals. Second, we model conditional volatility of precious metals via the aforementioned volatility models, capturing the stylized characteristics which are prominent for both modeling volatility and market risk. Third, we assess the in-sample and out-of-sample VaR performances of the alternative nonlinear GARCH models for both long and short trading positions.

The remainder of the paper is as follows. Section 2 presents the literature review. Section 3 and 4 describe the methodology and preliminary data analysis, respectively. In Section 5, we document the empirical results and discuss the findings. Section 6 concludes.

2. Literature review

As pointed out by Arouri et al. (2012), empirical studies on precious metals can be divided into two lines of research. The first line focuses on the macroeconomic determinants of precious metals. In this

[1] See among others, Conover, Jensen, Johnson, and Mercer (2009) and Jensen, Johnson, and Mercer (2002).

[2] To our knowledge, there is only two studies in the related field; Hammoudeh, Malik, and McAleer (2011) and Hammoudeh, Araújo Santos, and Al-Hassan (2013). However, they model the VaR of precious metals, using different risk management techniques, standard GARCH and asymmetric power GARCH (APARCH) models.