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The macroeconomic determinants of commodity futures volatility: Evidence from Chinese and Indian markets

Di Mo*, Rakesh Gupta, Bin Li, Tarlok Singh

Department of Accounting, Finance and Economics, Griffith Business School, Griffith University, 170 Kessels Road, Nathan, QLD 4111, Australia

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ABSTRACT

We examine the macroeconomic determinants of the volatility of commodity futures (including agricultural commodity futures, metal futures and oil futures) in two emerging commodity markets – China and India. The macroeconomic variables used include both domestic and international macroeconomic variables that gauge economic environment, monetary policy and financial market information. We use a recently proposed GARCH-MIDAS model which jointly incorporates the daily price volatility and low-frequency macroeconomic variables. The model decomposes the volatility series into short- and long-run components, thereby enabling us to test whether the macroeconomic variables can determine the long-run variance. We find that there exists a long-run volatility component in the commodity futures, and most of the tested low-frequency macroeconomic variables are positively related to the long-run variance of commodity futures. Our results suggest that both domestic and international macroeconomic information plays an important role in determining the price volatility of the emerging commodity futures.

1. Introduction

Commodity futures have exhibited significant price volatility in recent decades. Beginning in 2002, the commodity markets entered a strong and upward trend and prices reached a peak in mid-2008. During the second half of 2008, commodity prices experienced a significant drop with the advent of the Global Financial Crisis. Although the commodity prices have recovered since March 2009 and are close to their mid-2008 peaks, they are still very volatile.

Fluctuations in prices tend to have an impact on the viability of both existing and future production and on investment decisions made by governments and corporations. Producers and consumers may suffer higher borrowing costs and higher volatility in their cash flows with the increased uncertainty in prices. The challenges associated with high price volatility warrants the necessity of identifying its determinants for producers, processors and policy makers. Understanding the volatility dynamics becomes a key consideration in the strategy formation for hedging, derivatives trading and portfolio optimization. Producers and consumers can make their investment choices more wisely by understanding the true dynamics of volatility.

Emerging markets have started to play an important role in terms

of commodity prices and volatility. Many scholars argue that one of the most important drivers of the substantial increase in commodity prices is the rapidly raising demand of emerging countries for commodities. These emerging countries are at the commodity intensive stage of development. Though the trading activity (including trading volume and open interest) in these countries is thin, the price volatility is quite high. As a result, the impact of volatile commodity futures prices is more significant in emerging countries than in well-developed countries. Moreover, commodity exchanges in China and India, two largest emerging economies, are ranked as top commodity exchanges in the world. For instance, according to the Futures Industry Association (FIA) and the China Futures Association (CFA), the Dalian Commodity Exchange (DCE), Zhengzhou Commodity Exchange (ZCE) and Shanghai Futures Exchange (SFE) in China are ranked No.1, 2, and 3, respectively in 2015 in terms of trading volume of commodity futures and options.¹ The Multi Commodity Exchange (MCX) in India is also ranked No.6. Additionally, a number of futures contracts in China and India are ranked as top contracts, based on their trading volumes.² Therefore, given the significant role that emerging commodity markets play in the world, it is worth investigating the determinants of the volatility of commodity futures in these markets.

* Corresponding author.

E-mail address: di.mo@griffithuni.edu.au (D. Mo).¹ The information provided by FIA and CFA is the total trading volume of commodity futures and options. However, no commodity options are traded in either China or India during our sample period.² The information was collected from the 2015 survey of Global Derivative Volume. http://marketvoicemag.org/sites/default/files/pdf/March2016_TopStoryupd.pdf

Most previous research investigates the impact of microeconomics; however, we cannot ignore macroeconomic fundamentals when discussing the microeconomic variables in the context of commodity prices, especially during the period of significant price movements. Few studies have examined the relationship between macroeconomic variables and the volatility of commodity futures. One reason for the exclusion of the economic environment may be the low-frequency of data for macroeconomic factors. The analyses of time-varying volatility are mostly based on variables with availability of high-frequency data and the estimated variables are limited to short-term interest rates and premiums, which have high frequencies. Low-frequency variables such as those measuring the business cycle, monetary policies and the broad economic environment have not been sufficiently explored.

The primary goal of our study is thus to examine the macroeconomic determinants of the volatility of commodity futures. Further, we hypothesize that the volatility of commodity futures is affected not only by short-term information such as daily price information, but also by the information contained in the broad economic environment. Current research on the determinants of commodity volatility has failed to explicitly test the effects of macroeconomic variables on the daily price changes in commodities.³ Therefore, when estimating the impact of macroeconomic variables on the volatility of commodity futures, we decompose the volatility into short-run and long-run components. The short-run component is the one caused by news that affects the prices on a daily basis such as cash rate and stock market returns, while the long-run component is affected by macroeconomic variables. This long-run component is of particular interest to our study as this has not been appropriately tested in the past.

Previous studies suffer from two noticeable flaws. The first flaw is the proxy for volatility. Most studies treat long-run volatility as a low-frequency volatility, which is assumed to be determined by slowly evolving macroeconomic variables. To obtain long-run volatility, many studies use traditional GARCH-type models (Liu et al., 2015), which set unconditional volatility as a constant. This constant volatility is unlikely to capture the true dynamics of long-run market volatility. The second problem is the non-synchronized frequency between macroeconomic variables and commodity futures. Macroeconomic variables generally occur on a monthly or quarterly basis, while the commodity futures prices have relatively higher data frequency, i.e., daily or intra-daily. Incorporating variables with different frequencies in the same model creates econometric modelling difficulties.

Daily price changes in the commodities are caused by two groups of factors: the first group of factors relate to information that emerges in the market, such as the stock market index, short-term interest rate; the second group of factors relate to the macro news that is available on a monthly/quarterly/semi-annual basis. Our study aims to dissect the daily price volatility into two components that are caused by each of the two factor groups. The volatility component that is caused by macroeconomic variables is of interest for our study. To fill this research gap, we employ Mixed Data Sampling (MIDAS) model, which allows data of different frequencies to be included into the same model. The MIDAS type of regressions, introduced by Ghysels et al. (2007), involves time-series data sampled at different frequencies, which makes the analysis between high- frequency and low-frequency macroeconomic variables possible. Following this, Engle et al. (2013) further propose a GARCH-MIDAS model within the MIDAS framework to analyze the time-varying volatility. Under this framework, the conditional variance has been decomposed into two components – long-run and short-run variances. The major advantage of this model is that it allows the link between the daily observation on return series and the sampling of

macroeconomic variables, which occurs at relatively low frequencies. In this way, the impact of macroeconomic variables on the commodity futures volatility can be examined directly.

We thus have two research objectives in line with the main purpose of our study. The first objective is to examine the predictive power of changes in macroeconomic variables for the volatility of commodity futures. The second objective is to further test the impact of uncertainty in macroeconomic variables on the volatility of commodity futures. In accordance with these two research objectives, we propose the following two research questions:

Q1: Does change in macroeconomic variables determine the long-run volatility of commodity futures?

Q2: Does uncertainty in macroeconomic variables determine the long-run volatility of commodity futures?

The macroeconomic determinants of the volatility of commodity futures are important to study for several reasons. First, understanding the volatility dynamics is critical for producers, consumers and policy makers. Previous studies focus only on determinants of short-term volatility; however, the volatility of commodity futures is influenced by short-term daily information as well as information contained on the long-term horizon. Our study differs from previous studies in that it decomposes the commodity futures volatility into short-run and long-run components, thus enabling us to investigate whether the information content in macroeconomic variables is valuable for the long-term volatility of commodity futures. Second, the emerging commodity futures markets have started to play a significant role in the global commodity futures market; however, few studies focus on these emerging commodity markets. Our study covers a wide range of commodity futures from emerging markets and examines the linkage between macroeconomic variables and emerging commodity futures.

Our study contributes to the existing literature in several ways. Firstly, we examine the determinants of volatility more accurately by combining the high-frequency return data with the low-frequency macroeconomic variables into one model. In this case, it separates the impacts of daily information and the low-frequency macroeconomic conditions on the volatility of commodity futures. The investigation of the influence of the low-frequency macroeconomic variables on the volatility of commodity futures is straightforward. Thus, the causal relationship between price volatility and its determinants can be more accurately analyzed and the long-run variance forecasting is improved by including macroeconomic information. Secondly, our study focuses on a wide range of commodities in two largest emerging markets. This allows us to investigate nature of the arbitrage and price relationships between commodity futures and macroeconomic determinants in some unexplored emerging countries. To the best of our knowledge, this is the first paper to focus on the impact of macroeconomic variables with respect to the volatilities of a wide range of commodity futures in the emerging markets. The results may have important implications to other emerging markets. Thirdly, findings suggest that the volatility of commodity futures are not only affected by domestic macroeconomic variables but also influenced by international macroeconomic environment. Therefore, our study contributes to the volatility literature by providing additional volatility determinants.

Our study has several important economic implications. Investors can adjust their investment portfolio in response to macroeconomic conditions such as consumer confidence, money supply and industrial production. Moreover, the findings of our study have important implications for economic policies, towards minimizing speculations and achieving financial stability, especially for the policy makers in emerging markets. According to International Monetary Fund (2016), the Global Financial Stability Report, the world economy is gaining speed, boosting the appetite for risk, reinforcing the recovery in commodity prices and supporting the rebound in asset prices in emerging market economies. Therefore, the impact of international

³ Studies that test determinants of daily (or weekly) volatility using variables with daily frequency implicitly (or explicitly) assume that the impact of macroeconomic variables are incorporated into daily prices of the commodity through market variables via expectations, their expectations are always accurate, and there is no impact on the prices when the actual data for the variables are released or this impact is not significant.

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