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Dynamic jumps in global oil price and its impacts on China's bulk commodities

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ABSTRACT

This paper investigated the impacts of oil price shocks, especially dynamic jumps in its returns on China's bulk commodity markets at both the aggregate and industry levels. After setting a zero lower bound to the jump intensity of the ARJI model, we found that dynamic jumps exist in oil price movements. Moreover, under shocks of oil price jumps, not only the returns but also the risks of China's bulk commodity markets are affected significantly, and the reactions of risks are characterized by "overreactions". Meanwhile, by decomposing oil price shocks into expected positive (negative), and unexpected positive (negative) components, we discovered that the impacts of unexpected shocks are positive and significantly asymmetric at both levels, while those of the expected shocks are negative and insignificantly asymmetric at the industry level. In addition, the volatility clustering of all price movements and the permanent volatility effects on China's bulk commodities are also authenticated by applying the GARCH family models.

1. Introduction

As the most influential raw material, crude oil is of vital importance to the stability and development of modern industrial societies. However, due to the impacts of the global economy and political events, its market price is always characterized by dramatic fluctuations. For instance, the Brent spot oil price was $40.37 per barrel on January 3, 2005. From that day on, it maintained an upward trend and hit an all-time highest record of $146.08 on July 3, 2008. Then, however, it continued oscillating down until hitting a bottom of $35.4 on January 15, 2009, a decrease of 75% in about half a year. As for daily movements, oscillations above 5% were not uncommon during our sample period, whilst fluctuations greater than 10% would also appear occasionally. For example, from October 9 to 10, 2008, the Brent crude oil price dropped sharply from $82.66 to $74.09 per barrel and declined by nearly 11% within a single day, and from December 30 to 31 in the same year, it soared from $40.15 to $45.59, an increase of as much as 12.70%.

In terms of China, the second largest economy worldwide, crude oil consumption increased from 325.354 million tons to 577.80 million tons during the period of 2005–2016. Actually, it has been the largest crude oil consumption country since 2012. Moreover, its external dependent rate of crude oil has also climbed from 44.26% to 65.40%, while its imports have surged from 171.632 million tons to 381.011 million tons during the same time interval. In fact, in September 2013, the U.S. Energy Information Administration (EIA) announced that China had already become the largest net-importer of crude oil among all the world's economies.

Therefore, global oil price shocks would undoubtedly have profound impacts on the Chinese economy, given that it is now the largest crude oil consumer and net-importer. As a matter of fact, several studies have been conducted on this issue in recent years: such as Zhang and Chen (2011), who have investigated the influence of oil price shocks on China's stock returns, as well as Wang and Zhang (2014), whose attention mainly focused on the fundamental industries. Nevertheless, the impacts of oil price jumps, especially its implications for the risks of China's bulk commodities, have not received adequate attention, although the reactions of its returns to different categories of crude oil price shocks have been carefully discussed by Zhang and Chen (2014). Nowadays there are three bourses in China. Metals and energy commodities are traded

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in Shanghai are, while agricultural commodities are traded in Dalian and Zhengzhou. China's bulk commodity markets are usually characterized by dramatical price fluctuations as well as national unified price limitations. Considering the apparent financial attributes of bulk commodity markets, impacts of oil price jumps should not only rest in its market returns, but also manifest in its risk movements. Moreover, there is one weak point in the Autoregressive Jump Intensity (ARJI) model, which has not been revealed and improved by the follow-up scholars.

In this paper, we investigated the characteristics of global oil price shocks and its impacts on China's bulk commodity markets. Our work is different from previous studies in three aspects. First, we fixed a zero lower bond to the jump intensity series of the ARJI model before applying it to capture the dynamic jumps of global oil returns. Second, by checking the correlations between extreme movements of oil price volatility and market risks of the bulk commodities, we verified reactions of heteroscedasticity on China's bulk commodities when investigating the impacts of oil price jumps. Finally, we adopted a CSGARCH model to analyze the long-and short-run volatility effects on the bulk commodity markets.

2. Literature review

Over the past few decades, characteristics of oil price shocks and its comprehensive impacts on economies are not only an important issue among regulatory agencies and market participants but also a popular topic to research. In terms of the global oil price behavior, early studies paid a great deal of attention to the volatility clustering of its price movements (Sadorsky, 1999; Hamilton, 2003). The focus of later studies penetrated into the asymmetric effects (Huang and Guo, 2007; Lorde et al., 2009), as well as the transitory and permanent effects of its clustering process (Lee et al., 2010). By applying the GARCH family models, all of these features have been strictly evidenced. Recently, along with the emergence and progress of GARCH-Jump models, studies about the jump behavior of oil price fluctuation have also proliferated. For example, by employing the GARCH-ARJI model introduced by Maheu and Mccurdy (2004), Gronwald (2012) have not only verified that discrete jump is a component of crude oil price volatility but also authenticated that its jump intensity series is characterized by a time varying tendency. From then on, the main topic about oil price fluctuation has gradually diverted from volatility clustering effects to dynamic jumps, while the impacts of its abnormal volatility movements have eventually become a new focus among researchers.

In terms of spillover effects, a great deal of studies have investigated the impacts of crude oil shocks on the macro-economy and evidenced the negative correlation between oil price hikes and economic growth rates. In the U. S., 9 out of 10 recessions may have been induced by the rise in crude oil price since world war II (Hamilton, 2005), while studies about Turkey (Aydın and Acar, 2011), Thailand (Rafiq et al., 2009), and Nigeria (Iwayemi and Fowowe, 2011) have all indicated similar conclusions. As for inflation, crude oil price shocks could affect the inflation rates of G7 countries (Cologni and Manera, 2008), and a large fraction of inflation volatility in the U. S. is caused by oil price shocks (Cavalcanti and Jalles, 2013). As for unemployment, there is a positive relationship between oil price and unemployment in Central and Eastern Europe (Cuestas and Gil-Alana, 2016), although the conclusion in Sudan may be the converse (Rahma et al., 2016). In terms of the Chinese economy, fluctuations in crude oil price would have significant impacts on inflation and economic growth (Du et al., 2010), investment (Tang et al., 2009), and the exchange rate (Ju et al., 2016).

In addition to the close connection between crude oil shocks and the macro-economy, the reaction of stock markets to oil price shocks is another hot issue in the recent years. Empirical results have proved that high fluctuations in oil price would have asymmetrically unexpected impacts on S&P 500 returns (Chiou and Lee, 2009) and negative but insignificant impacts on the stock returns of Nigeria (Fowowe, 2013), as well as most European countries (Cunado and Perez De Gracia, 2014). However, oil price hikes are not always bad news for the stock markets in Japan (Abhyankar et al., 2013) and India (Kumar, 2014) because hikes driven by aggregate global demand may be positively correlated to the stock returns of these two countries. Actually, the reactions of stock markets to oil price shocks would be time varying (Le and Chang, 2015), and different between oil-import and oil-export economies (Wang et al., 2013). In terms of the stock markets in China, although Zhang and Chen (2011) reported that its returns are correlated only with expected oil price shocks, bidirectional Granger causality relationship between most of the sector stock indices and crude oil price does exist in the short-, medium- and long-term (Huang et al., 2015). However, according to the empirical results of (Zhu et al., 2016), the Chinese industry stocks and the global oil market may only have contagion in rare situations.

Except for the macro-economy and the stock markets, impacts of oil price shocks on the bulk commodities and specific products have also attracted the attention of scholars. Generally, recent studies mainly concentrate on three kinds of commodities: energy industry, metal markets, and agricultural products. In terms of the energy industry, although the long-term connection between electricity and crude oil prices is insignificant (Mohammadi, 2009), the co-movements of oil and natural gas prices is indeed significant ((Lescaroux, 2009). According to Scholtens and Yurtsever (2012), mining, oil, and gas industries would be positively affected by oil price hikes and negatively affected by its declines. Moreover, an analogous link between fuel and crude oil price has also been evidenced (Moutinho et al., 2011). As for metals, most empirical results suggested that the prices would move with oil price fluctuations (Lescaroux, 2009), owing to the factors of investment portfolios and hedging effects (Lee et al., 2012). Recently, Reboredo and Ugolini (2016) also discovered that spillover effects of oil price shocks on metal returns are not only significant but also asymmetric, although some studies may deny its predictive power on the movements of metal returns (Chang et al., 2013). As for agricultural products, the impacts of oil price shocks on its commodities are significant (Nazlioglu and Soytas, 2012) and nonlinear (Nazlioglu, 2011), while the results may tend to be neutral in Turkey (Nazlioglu and Soytas, 2011). Actually, bidirectional panel causality does exist between the prices of global oil and international agricultural products (Rezitis, 2015), but the responses of agricultural markets would vary with the causes behind oil price hikes (Wang et al., 2014). Recently, Dillion and Barrent (2016) reported that fluctuations on the crude oil market do affect food price but primarily through transport costs rather than biofuels or production cost channels.

In terms of bulk commodities in China, the impacts of oil price shocks have been repeatedly evidenced in recent years. According to Zhang and Chen (2014), both expected and unexpected oil price changes would affect the market returns of China's bulk commodities. As for fundamental industries, unidirectional spillover effects from the global oil market to the corn and fuel ethanol markets are also significant (Haixia and Shiping, 2013), while petrochemicals (grains) suffered most (least) from oil price shocks, and the impacts of negative shocks may be stronger (Wang and Zhang, 2014). Later on, the asymmetric influences of oil price shocks on agricultural markets (Zhang and Qu, 2015) and metals (Zhang and Tu, 2016) were both verified by applying the log-likelihood ratio test, while the effects of oil price jumps on agricultures are not significant except for the case of natural rubber. Moreover, the long-run and short-run influences of crude oil price changes on agricultural markets (Ma et al., 2016) and the common movements across bulk commodity sectors (Chen, 2015) have also been authenticated by empirical studies.

In summary, the relationships between oil price shocks and socio-economic activities have become a hot issue among scholars, while studies concerning the Chinese economy have also surged, especially in recent years. Nevertheless, the impacts of oil price jumps have rarely been investigated by existing studies. However, for those who have addressed this issue, such as (Zhang and Chen, 2011; Zhang and Qu, 2015), the reaction of market returns seems to be their main subject, while its implication on the risks of China's bulk commodities has unfortunately been ignored. In terms of analytical