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The impact of global oil price shocks on China's bulk commodity markets and fundamental industries

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HIGHLIGHTS

- We investigated the impact of global oil price shocks on China's bulk commodity markets and fundamental industries.
- The aggregate commodity market was affected by both expected and unexpected oil price volatilities.
- The impact of unexpected oil price volatilities became more complex after 2007.
- The metals and grains indices did not significantly respond to the expected volatility in oil prices.

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ABSTRACT

This paper investigated the reaction of aggregate commodity market to oil price shocks and also explored the effects of oil price shocks on China's fundamental industries: metals, petrochemicals, grains and oilfats. We separated the volatilities of oil price into expected, unexpected and negatively expected categories to identify how oil prices influence bulk commodity markets. We contrasted the results between different periods and among classified indices, in order to discover the significant changes in recent years and the differences at an industry level. Our results indicate that the aggregate commodity market was affected by both expected and unexpected oil price volatilities in China. The impact of unexpected oil price volatilities became more complex after 2007. The metals and grains indices did not significantly respond to the expected volatility in oil prices, in contrast to the petrochemicals and oilfats indices. These results not only contribute to advancing the existing literature, but also merit particular attention from policy makers and market investors in China.

1. Introduction

Over the past few years, a rising demand from emerging economies and limited supplies from oil producing countries due to political tensions have frequently pushed oil prices to dramatically high levels. However, China, whose economic growth increasingly depends upon energy consumption, was the second largest consumer of oil in the world after the United States from 2002 to 2011 and is now the largest energy consumer in the world. The Chinese government is now facing severe challenges from an energy supply gap. China's dependence on imported oil has increased to over 53.9%. With high oil prices and high energy consumption, the energy issue has become critical and strategic to long-term development in China.

Crude oil is the most influential resource of raw materials and primary energies. It has been deemed the life blood of industrial economics. China is playing a more important role in the world economy and is becoming more heavily dependent on imported oil. The volatility of crude oil prices will undoubtedly affect China's economy. Moreover, this volatility could be transferred to the bulk commodity markets through various transmission mechanisms and further impact relevant industries through the chains of manufacturing, transportation and maintenance closely linked with the global oil markets. Furthermore, the present development of the commodity future market in China is rapid. Not only its effectiveness and functionality is evident, but also its global position and influence has greatly advanced. Therefore, it is necessary to recognize the volatility spillover effects of oil price shocks on the bulk commodity markets and relevant industries in China.

This paper investigated the reaction of aggregate commodity market to oil price shocks and the effects of oil price shocks on China's fundamental industries. We employed the ARJI and its extended model (ARJI-h_t), incorporating with the EGARCH method, to interpret the jump behaviors and volatility processes of various commodity indices. Moreover, we separated the volatilities of oil price into expected, unexpected and negatively expected categories

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to identify how oil prices influence bulk commodity markets. We contrasted the results between different periods and among classified indices, in order to discover the significant changes in recent years and the differences at an industry level. Our results indicate that the aggregate commodity market was affected by both expected and unexpected oil price volatilities in China. The impact of unexpected oil price volatilities became more complex after 2007. The metals and grains index did not significantly respond to the expected volatility in oil prices, in contrast to the petrochemicals and oilfats index.

This research not only contributes to knowledge about the jump behaviors of China's commodity markets and the different effects of oil price shocks at an industry level, but also is conducive to analyzing the problems existing in the markets of China's petroleum and commodity futures. Our results merit particular attention from policy makers and market investors in China.

2. Literature review

The comprehensive influence of oil price shocks on economies is not only an important issue among various regulatory agencies, enterprise managers and market participants, but also under scrutiny by many economists. Early empirical studies have revealed a significant negative relationship between oil price volatilities and the state of the macroeconomy, evidence that shocks from the crude oil market were a contributing factor in economic recessions (Hamilton, 1983; Mork, 1989). Later research on transmission mechanisms from crude oil shocks to economic growth indicated similar conclusions based on various statistical techniques and data sources (Baláž and Londarev, 2006; Cunado and Perezdegracia, 2005; Gronwald, 2008; Miller and Ni, 2011).

Besides close connections between crude oil prices and the macroeconomy, shocks from global oil markets were also a contributing factor to volatilities at an industry level. For example, Jones et al. (2004) found that sensitivities of Australian industry returns to an oil price factor were significantly different. Fan and Jahan-Parvar (2012) revealed that the impacts of changes in oil prices were concentrated in a relatively small number of U.S. industries. By extending the number of industries to 38 in the Euro area for the period 1983–2007, Scholtens and Yurtsever (2012) verified that the response to oil price shocks differed among different industries, in spite of all industries presenting asymmetric reactions regarding oil price increases and decreases. Jiménez-Rodríguez (2008) examined the dynamic effect of oil price shocks on the output of main manufacturing industries in six OECD countries and reported that there was cross-industrial heterogeneity of oil shock effects within the EMU countries.

Due to properties similar to crude oil, energy commodities, such as natural gas, electric power, coal, and fuel, have also attracted the attention of researchers. Many have investigated the relationship between crude oil and energy commodities. Lescaroux (2009) examined the co-movements of prices between oil and energy commodities and reported that the relationship between oil and natural gas prices was the strongest. Ewing et al. (2002) studied the link between crude oil and natural gas prices and revealed that there is a clear diffusion effect of natural gas prices on crude oil prices. Moutinho et al. (2011) found an analogous link between fuel and crude oil prices. However, Mohammadi (2009) argued that there was no long-term correlation between electric power and crude oil.

In terms of non-energy commodities, agricultural materials were the most popular subjects of study. For example, Sari et al. (2012) examined the roles of futures prices of crude oil, gasoline, ethanol, corn, soybeans and sugar in the energy–grain nexus. Chang et al. (2012) examined asymmetric adjustments for ethanol and agricultural products. They found that the skyrocketing price of crude oil was a major force driving the rising prices of corn, soybeans, maize and other foods. Their explanation was traditional that high oil prices would push up the costs of fertilizers, chemicals and transportation. Currently, the cause of this transmission is often the substitution of oil by bio-energy derived from maize, wheat and soybeans, increasing the need for agricultural commodities and their prices (Chen et al., 2010). However, conclusions varied from country to country. One study from Turkey supported the neutrality of agricultural commodity markets to both direct and indirect effects of oil price changes (Nazlioglu and Soytas, 2011). Furthermore, some results have also yielded apparently contradictory results from different times, as in the research of Du et al. (2011), who showed that from November 1998 to January 2009, there was only evidence of spillover after 2006.

As for correlations between crude oil and precious metals, most studies reported that they tended to move together (Lescaroux, 2009), owing to the factors of investment portfolios and hedging effects (Hammoudeh and Yuan, 2008; Lee et al., 2012; Narayan et al., 2010). Narayan et al. (2010) tested the cointegration relationship between gold and crude oil and found that crude oil prices can be used to forecast those of gold. Hammoudeh and Yuan (2008) found that oil shocks had calming effects on precious metals but not on copper by examining the volatility behavior of three metals: gold, silver and copper. However, Soytas et al. (2009) found no predictive power of oil prices on precious metals prices in Turkey.

In terms of analytical methodologies and econometric models, a framework covering several models or methods has recently become popular in the literature. A two regime Markov-switching method was connected with an EGARCH process to examine the relationship between oil price shocks and stock markets (Aloui and Jammazi, 2009). Wavelet decomposition and regime shifts were linked to VAR to explore the impacts of oil price shocks on stock returns (Jammazi and Aloui, 2010). By combining GARCH process to VAR model, Arouri et al. (2012) and Hanabusa (2012) investigated the effects of oil price shocks in Europe and Japan, respectively. Zhang and Chen (2011) applied the EGARCH process to China's stock returns, combined with the Autoregressive Conditional Jump Intensity (ARJI) method.

To sum up the extensive body of the literature on oil price shocks: most focus on U.S. or European economies, and only a few on developing countries. In contrast to the considerable numbers of papers concentrating on the relationship between crude oil and raw commodities in developed countries, we find there is little attention given to China. In particular, investigations at the industry level in China are still rare. Further work is needed in this area.

In this paper, we considered expected, unexpected and negatively unexpected components of global oil price volatility, using a theoretical technique based on Lee and Chiou (2009, 2011). We applied the EGARCH process to the returns of China's Commodity Index, combined with the Autoregressive Conditional Jump Intensity (ARJI) (Chan and Maheu, 2002) method to examine the influence of oil price shocks on China's bulk commodity markets during the period of October 10, 2001–September 30, 2006 and also the separate phases before and after 2007. In addition, to compare the different effects of oil price shocks at an industry level, we investigated their effects on China's fundamental industries: metals, petrochemicals, grains and oilfats.

3. Methodology

3.1. The ARMA–GARCH model

The traditional ARMA model is a good prediction method of time series, but the oil price time series has a feature of volatility

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