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The effect of global oil price shocks on China's metal markets

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HIGHLIGHTS

- We investigated the effect of oil price shocks on China's metal markets.
- The oil price shocks had significant impacts on China's metal markets
- The oil price shocks on China's metal markets were symmetric.
- Copper is more easily affected by oil price shocks than aluminum.

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ABSTRACT

This paper investigated the impacts of global oil price shocks on the whole metal market and two typical metal markets: copper and aluminum. We applied the autoregressive conditional jump intensity (ARJI) model, combining with the generalized conditional heteroscedasticity (GRACH) method, to describe the volatility process and jump behavior in the global oil market. We separated the oil price shocks into positive and negative parts, to analyze whether oil price volatility had symmetric impacts on China's metal markets. We further used the likelihood ratio test to examine the symmetric effect of oil price shocks. In addition, we considered the jump behavior in oil prices as an input factor to investigate how China's metal markets are affected when jumps occur in the global oil market, in contrast to the existing research paying little attention to this issue. Our results indicate that crude oil price shocks have significant impacts on China's metal markets and the impacts are symmetric. When compared with aluminum, copper is more easily affected by oil price shocks.

1. Introduction

Since the completion of the transformation from coal to oil in 1860s, oil has become the important strategic material relating to national economic development, national politics and military and diplomatic security. As "black gold" and "blood of industry", oil not only provides the direct energy for industry, agriculture, transportation industry and commerce, but also has significant influence to the upstream and downstream firms of all the relevant industry chain. Besides, due to its special property and application as well as its characteristic of non-renewability, it becomes the focus of world competition and its realistic significance is far beyond its influence in economy and society.

In addition, China is a large consumer of crude oil in the world. In 2013, China's consumption of crude oil reached 487.01 million tons. However, the domestic supply of oil struggled to keep pace with demand following growing energy demand/supply imbalances (Crompton and Wu, 2005). China's dependence on imported crude oil increased to 58.1%, with 282.95 million tons of oil imports. In September 2013, the Energy Information Administration (EIA) announced that China had already become the world's largest net importer of crude oil. At the same time, metals such as copper and aluminum, as important strategic resources, are widely used in various fields of national economy and national security. The price fluctuation of metals not only has great influence on the price advantage of China's manufacturing products in international trade, but also affects the steady and healthy development of China's economy. In 2013, the industrial output value of China's equipment manufacturing industry ranked the first in the world, reaching 3.229 trillion dollars, more than a third of the global equipment manufacturing industry. As important raw materials in equipment manufacturing industry, production and consumption of the metals in China remains at high level. For example, the production of refined copper was 4.58 million tons and apparent consumption was 7.53 million tons in 2010, while the annual growth rate reached 12% and 15% from 2006 to 2010 (Wang et al., 2013).

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Due to high external dependency on oil, global oil price fluctuations will affect relevant industries and further affect China's economic development. Meanwhile, metal manufacturing industries are highly oil-intensive (Hammoudeh et al., 2004; Ray, 2011). In addition, metals are widely used in various fields of national economy; through various transmission mechanisms, global oil volatility will inevitably affect metal markets, and then bring challenges for China's economic development. Therefore, it is necessary to research the influences of global oil price shocks on China's metal markets. However, the existing researches mainly focus on the effect of global oil price shocks on macroeconomy, industries and precious metals. Only Baffes (2007) and Wang and Zhang (2014) are concerned with the effect of oil prices on metal markets. The study of Baffes (2007) found that the pass-through of crude oil price changes to metals index is 0.11, and mentioned copper and aluminum, but failed to compare the different effects of oil price changes on them and didn't consider whether the asymmetric effects of oil price shocks existed or not. In addition, Wang and Zhang (2014) just concerned the metal market as one of a number of markets, without further study on copper and aluminum. Our research studied these issues further.

The existing research is extensively concerned with the relationship between crude oil prices and macroeconomy (Bashar et al., 2013; Brown and Yücel, 2002). Evidence suggests that shocks from the crude oil market were a contributing factor in economic recessions (Hamilton, 1983; Mork, 1989). Aydın and Acar (2011) also hold the opinion that high oil prices lead to the decline in output and consumption and arouse the deterioration of net foreign asset position. Iwayemi and Fowowe (2011) got the result that most macroeconomic variables were under weak influence of oil price shocks In Nigeria. According to the study of Cologni and Manera (2008), oil prices could affect the real economy by increasing interest rates using the structured co-integrated VAR model in G7 countries. Based on examining the relationship between crude oil prices and macroeconomy when oil prices decreased, Mork (1989) extended Hamilton's (1983) work and concluded that oil price changes had asymmetric impacts on the national economy.

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. Scholtens and Yurtsever (2012) verified that the response to oil price shocks differed among different industries. To analyze the reactions of different industries to oil price shocks, Wang and Zhang (2014) investigated the impacts of oil price shocks on China's fundamental industries. In more detail, Du et al. (2011) analyzed speculation and volatility spillover in the crude oil and agricultural commodity markets. In addition, manufacturing industry (Jiménez-Rodríguez, 2008) and oil and gas industries (Scholtens and Yurtsever, 2012) also were discussed.

As for the relationship between crude oil prices and metal markets, most studies concerned only precious metals. Further researches showed that the precious metal market is affected by the oil price fluctuations (Hammoudeh and Yuan, 2008). Lescaroux (2009) found that the prices of crude oil and precious metals tended to move together. Le and Chang (2012) investigated the impact of oil price fluctuations on gold market returns using monthly data from May 1994 to April 2011. They hold the opinion that oil price shocks appear to have a statistically significant and positive impact on real gold returns contemporaneously. According to the study of Jain and Ghosh (2013), there were transmission links between the global oil market and the Indian precious metals and foreign exchange markets. Furthermore, Sari et al. (2010) pointed out the existence of strong correlations among precious metal prices in the short run, but no cointegration in the long term. They also found that oil had a slight impact on precious metals. Oil and silver had a bidirectional relationship whereas the linkage between oil and gold was nearly unidirectional. The relationship between oil and platinum was weak in both directions. Zhang (2010) explored the more complex interaction between oil and gold markets from the three dimensions of cointegration, causality and price discovery, and found a significant positive correlation between oil prices and gold prices, and the correlation coefficient reached 0.9295. In addition, the two markets have a long-term equilibrium relationship, but there is only one-way granger causality from the oil market to the gold market.

Although changes of crude oil price are often considered an important factor for understanding fluctuations of precious metal prices, there is no consensus about the relationship between precious metal prices and the price of oil. Some scholars discovered that the metal market was not affected by oil price fluctuations significantly. More specifically, Soytas et al. (2009) examined the long- and short-run transmissions of information between world oil prices, Turkish interest rates, Turkish lira–US dollar exchange rates, and domestic spot gold and silver prices, and found that the world oil price has no predictive power of the precious metal prices in Turkey. Similarly, Chang et al. (2013) also got the result that oil price, gold price and exchange rate remain largely independent from one another in Taiwan, using Hansen co-integration test, VAR model, Granger causality test, impulse response analysis, and variance decomposition method.

In terms of methodologies and econometric models, many different models and methods were used. Le and Chang (2012) employed structural vector autoregressive approach to examine the dynamics between oil price shocks and gold returns. Soytas et al. (2009) used the Toda–Yamamoto (TY hereafter) procedure to run a VAR to assess the long-run relationship. Sari et al. (2010) used generalized forecast error variance decompositions and generalized impulse response functions to understand the impacts and responses to shocks. Besides, there is also much research using a framework covering several models or methods. Chang et al. (2013) used Johansen co-integration test, VAR model, Granger causality test, impulse response analysis, and variance decomposition method to discuss the interactive relationships between crude oil prices, gold prices, and the NT–US dollar exchange rate in Taiwan. Jain and Ghosh (2013) employed ARDL bounds tests of cointegration and Toda–Yamamoto version of Granger causality to study the dynamics of global oil prices, exchange rate and precious metal prices in India. In addition, GARCH family models have become popular in the literature. Arouri et al. (2012) combined GARCH process to VAR model in order to investigate the effects of oil price shocks in Europe and Japan. Gronwald (2012) used the GARCH method along with the conditional jump model to describe the price behavior of crude oil.

To sum up, the existing literature mainly focused on macroeconomy, industries and precious metals, and most focused on developed countries and regions. In this paper, we not only analyze the effect of the price fluctuations of crude oil on the whole metal market, but also analyze the influence of crude oil on typical metal markets: copper and aluminum in China. This paper differs from the previous research mainly in three aspects: first, we investigated the impacts of oil price shocks on China's metal market. Contrary to the existing studies concentrating on macroeconomy, industries and precious metals, we focus on the metal market, further analyzing how global oil price fluctuations affect typical metal markets: copper and aluminum. Second, we analyze whether oil price volatility had symmetric impacts on China's metal markets by separating the oil price shocks into positive and negative parts. We also use the likelihood ratio test to examine the symmetric effect of oil price shocks. Third, we consider the jump behavior in oil prices as an input factor to investigate how China's metal markets are affected when jumps occur in the global oil