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The effect of global oil price shocks on China's precious metals market: A comparative analysis of gold and platinum

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ABSTRACT

This paper investigated the impacts of global crude oil price shocks on China's precious metals market using the meliorated autoregressive conditional jump intensity (ARJI) model (Chan and Maheu, 2002) and the extended autoregressive moving average-generalized autoregressive conditional heteroscedasticity (ARMA-GARCH) (Gronwald, 2012), based on the comparative analysis of gold and platinum markets. The results showed that discrete jumps existed in the crude oil market. Considering the volatility clustering of oil returns, the effect of oil price expected shocks on precious metals market was negative (−0.7025,-1.3341), due to the profitability of capital; While that of unexpected shocks was positive (0.0211,0.0645), which can be explained by the adaptive expectation theory. In terms of discrete jumps, the impact of current jumps on precious metals market was significantly negative (−1.4810,-2.6775), according to the risk transmission theory, and the responses tended to be characterized by "overreactions". In addition, some evidence also suggested permanent volatility effects in China's precious metals market.

1. Introduction

With dual economic and political attributes, crude oil, as a basic raw material and important strategic resource, occupies a pivotal position in the international political, economic and financial fields. Moreover, due to the impacts of various economic and political events, crude oil price has gone through a roller coaster fluctuation in recent years. For example, in July 2008, the Brent crude oil price reached a peak of $146.08 per barrel. Afterwards, due to the global economic crisis, oil price fell to the lowest level of $36.61 per barrel. With the global economy recovering, oil price also began to bottom out at $80 per barrel. Moreover, the European debt crisis, Iran's nuclear issue and other major economic and political events also made oil price change dramatically. Undoubtedly, crude oil price is closely related to the global economy (Karaki, 2017). Along with oil price fluctuations, the global economy has also experienced expansions and recessions. In terms of China, thanks to the acceleration of industrialization and the urbanization process, the amount of oil imports and consumption has increased significantly. In 2008, China became the world's second largest oil importer, and the dependency rate on imported crude oil reached 49.8%. Meanwhile, it has been the largest crude oil consumption country since 2012. In addition, in 2015, China's annual oil net imports reached 328 million tons, but also its dependency on imported oil exceeded 60% for the first time. According to the International Energy Agency's (IEA) predictions, China's oil import dependency will reach 80% in 2040. Therefore, China's sustainable development of the economy and society will still depend on traditional fossil fuels for a long time in the future.

In view of the high external dependency on oil, global oil price fluctuations will undoubtedly be transferred to other related industries through a variety of price transmission mechanisms, further bringing risks and challenges to China. Therefore, it is necessary to explore the effects of oil price shocks and to hedge the risks of oil price volatility. The early literature mostly focused on the effects of oil price shocks from a macroeconomic perspective (Hamilton, 1983). Later, researchers began to turn to specific markets and investigated the effects of oil price shocks on different markets, such as the energy market (Sari et al., 2011), metals market (Scholtens and Yurtsever, 2012) and agricultural market (Wang et al., 2014). However, less research has concerned China's precious metals market. Moreover, compared to other markets, the

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precious metals market is characterized by stronger financial attributes (Solt and Swanson, 1981). Therefore, the precious metals market may be more sensitive to oil price shocks, which would be affected by oil price shocks through the two paths of the commodity market and financial market (Sari et al., 2010). Thus, to resist oil price volatility risks and safeguard economic stability, it is necessary and urgent to investigate the impacts of oil price shocks on China's precious metals market.

In this paper, we applied the meliorated autoregressive conditional jump intensity (ARJI) model, which was proposed by Chan and Maheu (2002) and was a good method to research the extreme movements of assets price, to describe the characteristics of oil price shocks. Moreover, we decomposed the oil returns volatility process into two parts: the continuous volatility clustering process and the discrete jump process. In addition, we separated oil price shocks into two categories: expected shocks and unexpected shocks. In the process of discrete jump, we extracted the current and lagged-one jump. Additionally, in the precious metals market, we constructed autoregressive moving average-component generalized autoregressive conditional heteroscedasticity (ARMA-CSGARCH) model with exogenous factors. ARMA model was proposed by Box and Jenkins (1976), which is a good prediction method for most time series, while Engle and Lee (1993) proposed CSGARCH model to investigate the long- and short-run movements of volatility. By integrating the exogenous factors, that is, expected shocks, unexpected shocks, current and lagged-one jump, into conditional mean equation of the precious metals market, we explored the spillover effects of crude oil market on China's precious metals market. When the changes in the market itself may affect the changes in other markets, this change is called a spillover effect (Cheng et al., 2017). In particular, we selected two precious metals, namely gold and platinum, and mainly focused on their comparative analysis. Meanwhile, we also verified the permanent volatility effects of returns in China's precious metals market.

This work is different from previous studies as follows: First, this paper analyzed the impacts of oil price shocks on China's precious metals market, particularly focusing on the comparative analysis of two specific precious metals markets, that is, the gold and platinum markets, rather than from the perspective of the macro-economy or fundamental industries. Second, we investigated the effects of different categories of oil price shocks on China's precious metals market. By separating oil price shocks into the expected and unexpected parts and extracting current and lagged-one jump, we examined the spillover effects of diverse oil price shocks on China's precious metals market.

2. Literature review

Oil is viewed as the “blood” of modern industry. As an important energy resource and basic production material, the relationship between crude oil and the economy is getting closer. Undoubtedly, the impact of oil price fluctuations on social and economic activities is also growing. The existing literature shows that global crude oil price fluctuations will have profound impacts on different markets.

Due to the similar properties of crude oil and energy commodities, the energy market has naturally attracted the attention of researchers. Many studies have verified the relationship between oil and energy commodities. In light of co-movements of prices, Scholtens and Yurtsever (2012) noted that the mining, oil and gas industries would benefit from oil price hikes and suffer losses from the declines. Meanwhile, Broadstock and Filis (2014) verified specific demand shocks of oil market were more strongly correlated with the oil & gas sector. As for transmission mechanism of price volatility, Ewing et al. (2002) took the oil and gas markets as an example and concluded that there existed a direct and indirect transmission mechanism from the natural gas sector to the oil sector, of which the volatility of the natural gas sector was directly affected by the events of its own department and indirectly affected by the oil sector. However, in contrast to the above views, Mohammadi (2009) found that there was no long-term relationship between electricity and crude oil.

Thanks to extensive energy inputs for agriculture, the agricultural market has been the subject of most of the literature that investigated the relationship between crude oil and agricultural commodities. Most papers believe that oil price shocks have significant effects on the agricultural market. For example, Taheripour et al. (2010) revealed that since 2006, the price volatility of energy market has had a significant spillover effect on agricultural products market. According to Nazlioglu and Soytas (2011), there was an indirect nonlinear causality between oil and agricultural products. However, some think that the impact of oil price shocks on agricultural commodities prices depends on the time periods (Wang et al., 2014) and the specific agricultural commodities (Dong et al., 2014). In addition, a few even argue the neutrality hypothesis (Qiu et al., 2012).

As for the metals market, there is a close relationship between the crude oil market and metals market because metals manufacturing, such as aluminum and steel, etc., is a highly oil-intensive industry (Hammoudeh et al., 2004). Some research has mainly focused on the correlation and transmission mechanism. For example, in terms of relevance, Baffes (2007) noted that the coefficient of oil price changes to the metals index was 0.11. Regarding the transmission mechanism whereby the oil price affects metals prices, Hammoudeh and Yuan (2008) believed that the ups in oil price would raise metals prices by increasing the cost of transportation and production. Moreover, some have also investigated the spillover effects and further explored asymmetric effects (Wang and Zhang, 2014). Furthermore, others have begun to conduct research on the spillover effects of jumps (Zhang and Tu, 2016). As a part of the metals market, the precious metals market has strong responses to oil price volatility (Baffes, 2007). In terms of relevance, Sari et al. (2010) found that oil price was positively related to gold, silver and platinum during the period 1999–2007. Similarly, Le and Chang (2012) also came to a similar conclusion. In addition, in light of the causality and long-term relationship, Zhang and Wei (2010) argued that the change in oil price during the 2000–2008 periods was a one-way linear Granger reason related to gold price changes. Moreover, Zhu et al. (2015) verified that global oil price played an important role in precious metals price changes in the long and short term.

In terms of research methods, most studies used traditional methods, such as vector auto-regression (VAR) (Sims, 1980) and error correction model (VECM) (Davidson and Mackinnon, 1993), to study the impact of oil price shocks on other economic variables (Chen and Chen, 2016). Others further examined the impacts of global oil price shocks on other economic variables in linear and nonlinear models (Sek, 2017). Considering the characteristics of volatility clustering, some began to use the generalized autoregressive conditional heteroscedasticity (GARCH) (Bollerslev, 1986) model and asymmetric extension models, such as Threshold-GARCH (TGARCH) (Glosten et al., 1993) and Exponential-GARCH (EGARCH) (Nelson, 1991), to analyze the spillover effects of crude oil market. For example, Wu et al. (2011) used the TGARCH model to analyze the impacts of external crude oil futures market on corn futures market. Wang and Dong (2011) applied the EGARCH model to study the impacts of external oil price volatility on the concentration of petrochemical industry. With the gradual deepening of research, jumps in crude oil price exist (Baum and Zerilli, 2016). However, GARCH family models cannot portray price jump