The effect of global oil price shocks on China's agricultural commodities

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ABSTRACT

This paper studied the effect of global oil price shocks on agricultural commodities in China, including strong wheat, corn, soybean, bean pulp, cotton and natural rubber. We regarded oil price volatility process as a combination of continuous process and jump process. We not only separated oil price shocks into positive and negative categories to identify different effects on agricultural commodities in continuous process, but also investigated how jump behavior influenced these agricultural commodities. We found that the oil price was characterized by volatility clustering and jump behavior. At the same time, oil price shocks had different effects on agricultural commodities. In addition, the shocks on most agricultural commodities were asymmetric. Only natural rubber was under influence of the jump intensity of the oil price, in contrast to strong wheat, corn, soybean, bean pulp and cotton.

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1. Introduction

As the most important raw material and basic energy in the world, crude oil is of vital importance to socio-economic development and stability. China has been listed the second-largest oil-consumption country in the world, second only to the U.S. since 2003 and afterwards has become the world's largest net oil-importing country since September 2013. External dependency on oil has improved in line with the growth of economy, mirroring the growing interdependence between China and the international oil market. China's oil consumption was 272.74 million tons in 2003 and reached 507.40 million tons in 2013—an increase of 86.04%. Meanwhile, China's crude oil imports rose from 91.02 million tons in 2003 to 281.92 million tons in 2013, increasing by 209.73%. Accordingly, China's dependency on oil imports initially was 33.37% in 2003. This figure rapidly climbed to 55.58% in 2013. Due to high external dependency on oil, global oil price fluctuations will affect relevant industries through a variety of price transmission mechanisms and further bring risks and challenges for China's economic development.

Trading is brisk on the global oil market; the oil price is not only affected by the supply–demand relationship but also by other external market information. The global oil price has displayed violent fluctuations under the impact of Iraq war and the spreading subprime crisis during the 21st century. For example, the Brent crude oil spot price was $46.53 per barrel on September 23, 2004. Then from September 2004 to July 2008, the global oil price has been rising. On July 3, 2008, it even rose as high as $143.95 per barrel—up around 209.37%. However, shortly after the peak, due to disturbance of the exceptional information, the Brent crude oil spot price dropped sharply to $33.73 per barrel on December 26, 2008—down about 76.57%. Henceforth, it began to enter into a new motion cycle with relatively moderate volatilities. The Brent crude oil spot price mainly hovered at around $100 per barrel from February 2011 to August 2014. Yet, soon after, there has appeared another drastic plunge in the global oil price since October 2014.

As a cornerstone of economic development, oil has penetrated into all aspects of society (He et al., 2012). Oil price shocks will not only affect the macroeconomy, but also will bring risks for industrial development. Some people blame the rise in the oil price for the large increase in inflation. And as production input factors for most industries, the skyrocketing oil price will inevitably drive up the costs of production as well. For example, agricultural industry is gradually shifting from labor-intensive industry to energy-intensive industry in China, the changes in agricultural production patterns lead to the changes in global oil prices having greater impacts on agriculture production costs, specifically on the agricultural machinery, pesticides and chemical fertilizers and so on. According to the statistics from China's Statistical Bureau,

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from 2002 to 2013, the price indices of chemical fertilizers and oils for farm machinery rose more than 90%. In addition, the corn-based biofuel production also makes the corn price be more vulnerable to fluctuations in the oil price. According to the study of Ciaian and Kancs (2011), due to the expansion of biofuels from 2004 to 2008, the interdependencies between the fuel and agricultural prices was expected to be stronger. Vacha et al. (2013) also found that the connection between ethanol and corn was statistically significant. China is a large agricultural country and agriculture is regarded as the foundation of the national economy. Once agricultural development is at the mercy of oil price fluctuations, the whole national economy will be heading for serious trouble. Thus it is necessary to investigate how global oil price shocks affect China's agricultural commodities.

Currently, there exists a great deal of research investigating the spillover effect of the crude oil price. Some scholars are concerned about how oil price shocks affect the macroeconomy. In their opinion, there existed a negative correlation between the oil price and macroeconomy (Baláž and Londarev, 2006; Hamilton, 2005). Meanwhile, others launch a more detailed analysis about the effect of oil price fluctuations on industry, such as agricultural industry (Du et al., 2011), manufacturing industry (Jimenez-Rodriguez, 2008) and the stock market (Cunado and Perez De Gracia, 2014) and so on. However, most research is mainly conducted from the perspective of developed countries. Only a few scholars focus on China at the industry level. For example, Wang and Zhang (2014) researched the influence of oil price fluctuations on China's fundamental industries. Up to now, there are few studies involving the impact of oil price fluctuations on China's agricultural commodities.

This paper mainly discusses how oil price shocks impact China's agricultural commodities. On account of the availability of data, we choose six kinds of agricultural commodities: strong wheat, corn, soybean, bean pulp, cotton and natural rubber. We apply ARJI-GARCH model to investigate how oil price shocks, especially the jump behavior of the oil price, affect China's agricultural commodities. We divide oil price shocks into positive and negative categories to investigate the asymmetric effects of oil price shocks on the six kinds of agricultural commodities.

This work is different from previous research in three aspects: Firstly, the paper analyzes China's six kinds of specific agricultural commodities: strong wheat, corn, soybean, bean pulp, cotton and natural rubber, unlike previous studies focusing on macroeconomy or the whole fundamental industries. Secondly, we apply ARJI-GARCH model, rather than traditional VAR model or the impulse response function to investigate how oil price shocks, especially the jump behavior of the oil price, affect China's agricultural commodities. Finally, we investigate the asymmetric effects of oil price shocks on the six kinds of agricultural commodities.

2. Literature review

Oil price fluctuations are closely linked with socio-economic activities. Accompanied by severe oil price fluctuations in recent years, the influence of oil price shocks is being paid more attention and has gradually become a popular topic for study. The existing research mainly focuses on the effect of oil price shocks on macroeconomy, energy industry and non-energy industry.

A great deal of research investigates the effect of oil price shocks on macroeconomy. The macroeconomy responds differently to oil price shocks in different countries, perhaps due to various economic organizational forms and different development levels. In the U.S., 9 out of 10 recessions may have arisen from the rise in oil prices since World War II (Hamilton, 2005). In Turkey, high oil prices had very harmful effects on economy. It could not only lead to the decline in output and consumption but also arouse the deterioration of the net foreign asset position (Aydın and Acar, 2011). In Thailand, Rafiq et al. (2009) pointed out that there existed unidirectional causality between oil price volatility and some macro-economic variables from 1993 to 2006 in terms of

the Granger causality test. In China, according to Ou et al. (2012), China's macroeconomy was less independent on the WTI price shocks apart from China's foreign trade and stock market in the light of the price transmission mechanism. In Nigeria, most macroeconomic variables were under weak influence of oil price shocks (Iwayemi and Fowowe, 2011). In general, the effects of oil price shocks on the macroeconomy mainly involve three aspects. First, the potential effects of oil price fluctuations are on investment and output. An increase in the oil price would negatively affect the investment and output in China (Tang et al., 2010). Second, oil price shocks can result in changes in unemployment rates. From 1947 to 1995, Uri (1996) suggested that there existed unidirectional causality from a change in the oil price to agricultural employment in the United States. At last, oil price shocks keep in close touch with inflation. Cavalcanti and Jalles (2013) found that oil price shocks accounted for a larger fraction of inflation volatility in the United States.

As the connection between the international crude oil market and relevant industries is becoming closer, some scholars have begun to focus on this topic from the aspect of industry, and point out that oil price volatilities obviously have different effects on different industries. According to Scholtens and Yurtsever (2012), how industries responded to oil price shocks depended on certain industries and the mechanism by which oil price shocks impacted the industry.

Due to owning similar properties with crude oil, the relationship between energy commodities and crude oil has been paid more attention. Scholtens and Yurtsever (2012) found that mining, oil and gas industries were positively affected by oil price increases while negatively affected by falling oil prices. According to the study of Ewing et al. (2002), the oil sector was impacted by the natural gas sector by direct and indirect volatility transfer effect, while the natural gas sector was directly affected by events in its own sector and indirectly under influence of the oil sector. Panagiotidis and Rutledge (2007) suggested that there existed a cointegrating relationship between the gas and oil price in the UK during the sample period (1996–2003) in terms of a recursive methodology. However, in contrast to the above opinions, El-Sharif et al. (2005) found that the relationship between oil prices and equity values in the non-oil and gas sectors was weak. Mohammadi (2009) also found that the long-term connections between electricity and crude oil and/or natural gas prices were insignificant.

As for non-energy industries, the current work mainly concentrates on two industries. One is the metals industry. Hammoudeh and Yuan (2008) found that oil price volatilities negatively impacted gold and silver volatilities except copper volatility. According to Narayan et al. (2010), the price in the gold market was at the mercy of the price in the crude oil market and vice versa. Wang and Chueh (2013) also showed that in the short term both gold and crude oil prices positively influenced each other. However, Soytas et al. (2009) found that global oil price had no impact on precious metal prices in Turkey in the long run and vice versa, although there existed transitory positive initial impacts of innovations in oil prices on gold and silver markets in the short run.

The other is the agricultural industry. Some studies pointed out that there existed information transmission from the global oil price to several kinds of agricultural commodity prices by using panel causality analysis (Farzanegan and Markwardt, 2009; Nazlioglu and Soytas, 2012). Oil price shocks have different effects on agricultural commodity prices in different periods. Before the food crisis in 2006–2008, oil price shocks only accounted for a minor friction of variations in agricultural commodity prices. However after the crisis, oil price shocks contributed more on volatilities in agricultural commodity prices than aggregate demand shocks (Wang et al., 2014). As for the mechanism by which oil price shocks influence the agricultural commodity prices, there are also two opinions. On the one hand, the oil price changes affected agricultural commodity prices by means of increasing the costs of various energy-intensive inputs, such as chemical fertilizer, pesticide and