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Oil price shocks and China's stock market

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ABSTRACT

Using monthly data from February of 1996 to October of 2015, this article studies the effects of oil price shocks on China's stock market. Following Kilian [1], three different types of oil shocks named as oil supply shocks, aggregate demand shocks and oil-specific demand shocks are identified. We find the relationship between oil price shocks and stock market is unstable in the full sample, and there is a structural break in December of 2006. Thus, the full sample is split into two sub-periods: 1996M2-2006M12 and 2007M1-2015M10. We reveal that, in the two sub-periods, the responses of stock return to oil shocks are different and crucially related to the causes of oil price changes, while the responses of stock volatility to oil shocks are almost negligible. Meanwhile, we prove that the monetary policy almost has no effects on the link between oil shocks and stock market. For the sub-index of the stock market, we show that the influences of oil shocks on their returns and volatilities vary greatly, which suggests that generalizing the corresponding findings based on the composite index to its sub-index may be inappropriate. Finally, our analysis implies that the recent oil price fluctuations are mainly driven by speculative demand.

1. Introduction

Since the oil shocks of the 1970s, an increasing number of studies have examined the relationship between oil prices and the real macroeconomic activities.[1] Among them, the linkage between oil price shocks and stock market returns draws a particular attention from the researchers. For instance, based on the quarterly data of the United States, Canada, United Kingdom and Japan, Jones and Kaul [2], show that stock market returns respond negatively to oil price shocks. Similarly Nandha and Faff [3], find a negative linkage between oil prices and global industry indices. On the contrary Huang et al. [4], illustrate that oil price fluctuations may have no obvious effects on the U.S. stock prices, and Arouri et al. [5] show that oil returns fail to affect stock market returns in Kuwait, Saudi Arabia, and the United Arab Emirates. Moreover Refs. Park and Ratti [6] and Bjørnland [7] reveal that oil price increase has positive effects on Norway's stock market. Thus, among the economists, there is no consensus on this topic. The more recent research further shows that the relationship between oil prices and stock market may depend on whether the country is a net oil importer or exporter in the world, and whether the oil price changes are driven by demand or supply shocks in the oil market. For example, based on the data corresponding to nine oil-importing countries (United States, Japan, Germany, France, United Kingdom, Italy, China, Korea and India) and seven oil-exporting countries (Saudi Arabia, Kuwait, Mexico, Norway, Russia, Venezuela and Canada) Wang et al. [8], find that the influences of oil demand shocks on stock markets in oil-exporting countries are much stronger and more persistent than in oil-importing countries. Meanwhile Kilian and Park [9], illustrate that oil supply shocks are less important than oil demand shocks for understanding the changes in the U.S. stock market.

In this article, we take a fresh look at the above relationship for China. According to the National Bureau of Statistics of China (NBS), China has become a net oil-importing country since 1993. The U.S. Energy Information Administration (EIA) indicates that the China's crude oil imports increased from 313 thousand barrels per day in 1993–5421 thousand barrels per day in 2012. The heavy dependence on oil imports makes oil price shocks affect China's macro-

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[1] See, for example Hamilton [33,34], Kilian [35–37], Gronwald [38], Herrera and Pesavento [39], Peersman and Van Robays [40,41], Arouri and Rault [42], Jouini [43], Naser [44], Wei [45], Ahmadi *et al.* [46] and Wei and Guo [10].

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economy significantly (e.g., Ref. [10]). These effects can probably be transmitted to the stock market. This is because the stock prices are mainly determined by the expected cash flows and discount rate, while the oil price changes can influence the expected cash flows of the oil-related companies and the inflation rate which is used for calculating the expected discount rate.[2]

There has already been a lot of research on the effects of oil price changes on China's stock market, with varying results. Generally, these studies can be classified into two categories. In the first category, researchers mainly concentrate on the responses of aggregate returns to oil price shocks (e.g., Refs. [8,11–15], among others). For instance Nguyen and Bhatti [11], illustrate that oil price fluctuations have no significant influences on Chinese stock market, while Kang and Ratti [14] find that shocks to oil market-specific demand can significantly reduce the Chinese real stock market returns. In the second category, however, researchers further investigate the impacts of oil price shocks on sectoral or firm stock returns (e.g., Refs. [16–18]; among others). For example Broadstock and Filis [16], show that the linkages between oil price shocks and stock returns are systematically time-varying, and the impacts of oil shocks on Chinese stock market differ widely across industrial sectors Broadstock et al. [18] further uncover that around 90% of Chinese firms are influenced by both oil and gasoline shocks in the long run, and these influences differ with respect to price rises and price falls.

In the present paper, similar to Wang et al. [8], Fang and You [13], Kang and Ratti [14] and among others, the structural vector autoregressive (VAR) models are employed to analyze the relationship between oil shocks introduced in Kilian [1] and stock returns in China. Meanwhile, as in Broadstock and Filis [16], both the aggregate and sectoral stock returns are considered. Nonetheless, there are several differences between the present research and the above mentioned works. First, we incorporate interest rate and money supply into the structural VAR models for capturing the potential influences of monetary policies on the relationship between oil shocks and the stock market performances. Second, we employ the Bayesian multivariate time series methods to estimate the VAR models and compute the impulse responses, and thus overcome the possibly inaccurate estimates of the increased coefficients owing to the high dimension and long lag length models. Third, we consider the structural changes of the relationship between oil shocks and stock market using formal statistical tests. Fourth, we further investigate the link between oil shocks and stock volatilities. To the best of our knowledge, this is the first study that analyzes the effects of oil shocks on the stock volatilities for China.

Several interesting results emerge from the present analysis. First, we notice that the effects of oil shocks on the monetary and stock variables depend on the underlying sources of oil price changes. Second, we find the relationship between oil shocks and stock market is unstable in our full sample dating from February of 1996 to October of 2015, and a structural break date is detected in December of 2006. Third, the counterfactual analysis indicates that monetary policy has limited influences on the effects of oil shocks on the stock market. Finally, we show that the responses of the volatilities and returns of the sub-index to oil shocks vary greatly.

The remainder of this paper is organized as follows. In Section 2, we present the data set. In Section 3, we briefly introduce the method utilized in this study. In Section 4, we document the empirical analysis results and Section 5 concludes the paper.

[2] According to our calculation, in the period between 1996 and 2015, the average share of the oil-related stocks in Shanghai and Shenzhen stock exchanges is around 13%. Here, the oil-related stocks refer to the stocks in the industries including oil and natural gas extraction, petroleum processing, raw chemical materials and chemical products, chemical fiber, and rubber and plastic products manufacturing.

2. Data

Three groups of variables are employed in this research. The first group includes the percent change in the world oil production (Q), the world economic activity approximated by the global real economic activity index in industrial commodity markets (GREA) and the percent change in the spot price of Brent crude oil (P). The second group includes the one month interbank offered interest rate for Shanghai (R) and the percent change of the broad money supply M2 (M). The third group includes the volatility of the Shanghai composite index (VOLSH) and the return on the Shanghai composite index (RSH) measured as the percent change in the value of the index. Here, similar to Beetsma and Giuliodori [19], Degiannakis et al. [20], the VOLSH is computed as the sample standard deviation of the daily returns over the month. The frequency of the data is monthly and the period covered is between February 1996 and October 2015. The world oil production as well as the Brent crude oil price are obtained from the U.S. Energy Information Administration (EIA). The global real economic activity index in industrial commodity markets is constructed by Kilian [1].[3] The other variables that refer to the China are collected from the CEInet Statistic Database. A plot of these variables is presented in Fig. 1.

3. The statistical method

3.1. The specification of the structural VAR model

In this article, we employ the structural VAR model to study the effects of oil price shocks on China's stock market in order to allow for feedbacks among the variables and to control for monetary policy. Accordingly, the baseline monthly VAR-specification is given by

$$\boldsymbol{B}\boldsymbol{y}_t = \boldsymbol{\nu} + \boldsymbol{\Gamma}_1\boldsymbol{y}_{t-1} + \boldsymbol{\Gamma}_2\boldsymbol{y}_{t-2} + \ldots + \boldsymbol{\Gamma}_p\boldsymbol{y}_{t-p} + \boldsymbol{\eta}_t, \tag{1}$$

where $\boldsymbol{y}_t = [\boldsymbol{y}_t^{Oilmarket'}, \boldsymbol{y}_t^{Macro'}, \boldsymbol{y}_t^{Stockmarket'}]'$, $\boldsymbol{y}_t^{Oilmarket} = [Q_t, GREA_t, P_t]'$ is a block of global oil market variables, $\boldsymbol{y}_t^{Macro} = [R_t, M_t]'$ is a block of macroeconomic variables and $\boldsymbol{y}_t^{Stockmarket} = [VOLSH_t, RSH_t]'$ is a block of stock market variables, for $t = 1, \ldots, T$. $\boldsymbol{\nu}$ is the constant term, $\boldsymbol{B}$ and $\boldsymbol{\Gamma}_1, \boldsymbol{\Gamma}_2, \ldots, \boldsymbol{\Gamma}_p$ are the coefficient matrix, p is the lag length, and the error vector $\boldsymbol{\eta}_t \sim (\boldsymbol{0}, \boldsymbol{I})$. In much of the VAR literature, $\boldsymbol{\eta}_t$ are regarded as structural innovations. Similar to Kilian [1], Wei and Guo [10], Beetsma and Giuliodori [19], Christiano et al. [21], the Choleski decomposition is employed to identify the above VAR system. Thus, we assume that, in $\boldsymbol{y}_t$ within a given period, each variable does not react to the following ones, while a given variable is permitted to react to all these that precede it. Based on the widely accepted assumption that oil prices are predetermined with respect to the domestic macroeconomic variables (e.g. Ref. [22]), the oil market block is positioned before the macroeconomic block. Meanwhile, since the stock market variables can react instantaneously to the changes in the macro-economy, the macroeconomic block is ordered before the stock market block. The identifying assumptions corresponding to the three blocks themselves are explained below.

Oil Market Block. The order of the variables in oil market block is motivated by Kilian [1]. First, subjecting to the high costs of adjusting oil production and the uncertainty about the future state of crude oil market, the supply of crude oil does not respond to the innovations of oil demand (measured by real economic activity) within the same month, so we position Q_t before $GREA_t$. Second, the oil price increases caused by innovations that are specific to the oil

[3] The index is available at http://www-personal.umich.edu/~lkilian/paperlinks.html.