Energy Economics 62 (2017) 61–69

Contents lists available at ScienceDirect

Energy Economics

journal homepage: www.elsevier.com/locate/eneeco

Oil price shocks and China's economy: Reactions of the monetary policy to oil price shocks

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ARTICLE INFO

Article history:
Received 30 March 2015
Received in revised form 19 September 2016
Accepted 9 December 2016
Available online 26 December 2016

JEL classification:
C32
E52
O13
O53
Q43

Keywords:
Oil price shock
China's monetary policy
TVP SVAR
SVAR
Generalized impulse response

ABSTRACT

The paper empirically analyzes the effect of positive oil price shocks on China's economy, having special interest in the response of the Chinese interest rate to those shocks. Using different econometric models, i) a time-varying parameter structural vector autoregression (TVP SVAR) model with short-run identifying restrictions, ii) a structural VAR (SVAR) model with the short-run identifying restrictions, and iii) a VAR model with ordering-free generalized impulse response VAR (GIR VAR), we find that the response of the Chinese interest rate to the oil price shocks is not only time-varying but also showing quite different signs of responses. Specifically, in the earlier sample period (1992:4–2001:10), the interest rate shows a negative response to the oil price shock, while in the latter period (2001:11–2014:5) it shows a positive response to the shock. Given the negative response of the world oil production to an oil price shock in the earlier period, the shock is identified as a negative supply shock or a precautionary demand shock as suggested by Kilian (2009), thereby the negative response of the interest rate to the oil price shock is deemed as economy-boosting. The positive response of the interest rate to the oil price shock in the later period, given that this shock is identified as a positive world oil demand shock, gives evidence that stabilization of inflation is one of the main objectives of China's monetary authority, even though the current main objective of the monetary policy is characterized as "maintaining the stability of the value of the currency and thereby promoting economic growth." Finally, the variance decomposition results reveal that the oil price shock becomes an increasingly important source in the volatility of China's interest rate.

1. Introduction

According to BP (2014), China is the second largest oil consumer in the world, consuming 10.77 million barrels per day or about 12% of the world oil demand in 2013. This puts China second to the United States which consumes 18.89 million barrels per day or 19.9% of the world demand. By consuming an estimated amount of 18.72 million barrels per day by 2035 as forecasted by the U.S. Energy Information Administration (EIA, 2014), China would surpass the U.S. which is forecast to consume 18.46 billion barrels per day by that year. Given China's increasing future consumption of oil, it would be interesting and useful to see how China's economy responds to changes in the oil market. There are several studies that examine the relationship between changes in oil prices and the responses of the Chinese economy but there seems to be no clear explanations of why the signs of the responses of China's macroeconomic variables to an oil price shock should be that way. For example, the result in some studies of having a positive response of industrial production to a positive oil price shock seems puzzling, particularly when the source of the positive oil price shock is not specified.

Ou et al. (2012) analyze how China's macroeconomy responds to the world oil price shocks, using a structural dynamic factor model. They find that various price indices, industrial production, investment and interest rate rise, while stock prices fall in response to a positive oil price shock. These authors however do not specify whether the positive oil price shock is demand shock or not.

Qianqian (2011), on the other hand, finds that positive oil price shocks cause China's real output to fall but the interest rate and CPI to rise. Tang et al. (2010) also find that a positive oil price shock has a negative impact on output and investment but positive effects on inflation and interest rate. Du et al. (2010) note that there is a structural break in the model because of recurrent reforms in China's oil pricing mechanism, and find that the effects of the oil price shock on China's macroeconomic variables are non-linear. However, those asymmetric responses are found to be statistically insignificant. Wu and Ni (2011) test a Granger causality between the oil price and China's inflation,

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http://dx.doi.org/10.1016/j.eneco.2016.12.007
0140-9883/

interest rate and money supply and find that the oil price affects inflation contemporaneously and also with lags.

China's price regulations of oil prices are well documented in Du et al. (2010). In 1981, the State Council of China introduced a dual-track pricing system through which the Ministry of Petroleum was required to sell the first 100 million tons at a regulated low price, while the production that exceeds more than 100 million tons was allowed to be sold at higher market prices. However, the government deregulated its domestic pricing mechanism in 1998. The dual-track pricing system was abolished and the current month's price of crude oil was determined on the basis of the average world price of similar quality of the last month. Still the petroleum products were still required to follow the government's guideline price and the retail prices were allowed to fluctuate within 5% from the guideline. In 2000, the pricing mechanism of the petroleum products of China was further deregulated and the monthly prices of the petroleum products were determined on the basis of the average closing prices of the Singapore futures market of the last month. Finally, in October 2001, the prices were revised to combine the futures prices of New York, Rotterdam and Singapore of the last month. Those price regulation events would be useful in identifying structural breaks in the relationship between the Chinese economy and oil prices.

Therefore, what is an oil price shock? Archanskaïa et al. (2012) identify the main driving force behind oil price shocks in the period 1970–2006. Their identification strategy relies on a simple premise: supply-driven oil price shocks negatively impact global economic activity, while demand-driven oil price shocks do not have negative effects. They find that the oil price shocks between 1970 and 1992 were adverse supply-driven shocks, while between 1992 and 2006 those shocks were favorable global oil demand shocks. The former is also confirmed by Hamilton (1983, 1996, and 2009) and the latter is confirmed by Hamilton (2009), Kilian (2008a, 2008b) and Kilian (2009).

We basically are interested in addressing three questions. The first question is: How do China's industrial production and interest rate respond to positive oil price shocks? The second question is: Are the positive oil price shocks always the same, thereby they can be characterized as positive demand shocks. The third question is: How important is the oil price shock in the volatility of China's interest rate in two different sub-periods, which are separated by the last oil price regulations near the end of 2001.

Therefore, we attempt to invoke several explanations of why the literature comes up with different and sometimes contradicting signs of China's macroeconomic responses to a positive oil price shock, particularly the role played by the Chinese monetary policy and the conduct of the interest rate in response to the shock. Our explanations depend partially on the degree the various types of models capture the time variations in response to the positive oil price shock. They also relate to the regulatory state of the Chinese crude oil and refined products markets, thereby structural breaks and sub-period separations matter in those explanations. The type of the positive oil price shock whether it is a negative supply shock or a positive demand shock matters in governing the responses.

The results also cooperate with our research scheme well. They show that the responses of the macroeconomic variables including the interest rate are not only time-varying but also different in different sub-periods. Before the regulatory structural break, the responses are negative in response to the positive oil price shock, while the interest rate drops, indicating that the shock is negatively supply-driven. However, in the sub-period following the structural break the responses are positive, underscoring that the shocks are demand-driven. These findings have important implications for the conduct of China's monetary policy and the response trajectory of its interest rate once the type of the oil price is identified.

The remainder of the paper is organized as follows. Section 2 presents the empirical methods that will be used. Section 3 discusses the results produced by the various models employed in this study. Section 4 concludes.

2. Empirical methods

To analyze the effect of positive oil price shocks on China's macroeconomy and monetary policy (i.e., interest rate), we consider a six-variable VAR model for $\Delta z_t = (\Delta oy, \Delta op, \Delta y, \Delta p, \Delta q, \Delta i)'$, where Δoy is the log-differenced global crude oil production, Δop is the log-differenced real oil price where it is defined as the US refiner acquisition cost of imported crude oil deflated by U.S. CPI, Δy is the log-difference of China's industrial production, Δp is the log-difference of China's CPI, Δq is the log-difference of China's real exchange rate, defined as $q = \frac{S(\frac{CN}{US}) \times CPI(US)}{CPI(CN)}$, Δi is the difference of China's interest rate. The structural VAR representation is

$$A_0 \Delta z_t = \alpha + \sum_{i=1}^{p} A_i \Delta z_{t-i} + u_t, \tag{1}$$

where u_t is the vector of serially and mutually uncorrelated structural innovations and $Eu_t u_t' = I$. Assume that A_0^{-1} has a following structure such that the reduced-form errors ε_t, where $E\varepsilon_t \varepsilon_t' = \Sigma$ can be decomposed according to $\varepsilon_t = A_0^{-1} u_t$:

$$\varepsilon_t \equiv \begin{pmatrix} \varepsilon_t^{\Delta oy} \\ \varepsilon_t^{\Delta op} \\ \varepsilon_t^{\Delta y} \\ \varepsilon_t^{\Delta p} \\ \varepsilon_t^{\Delta q} \\ \varepsilon_t^{\Delta i} \end{pmatrix} = \begin{pmatrix} a_{11} & 0 & 0 & 0 & 0 & 0 \\ a_{21} & a_{22} & 0 & 0 & 0 & 0 \\ a_{31} & a_{32} & a_{33} & a_{34} & a_{35} & a_{36} \\ a_{41} & a_{42} & a_{43} & a_{44} & a_{45} & a_{46} \\ a_{51} & a_{52} & a_{53} & a_{54} & a_{55} & a_{56} \\ a_{61} & a_{62} & a_{63} & a_{64} & a_{65} & a_{66} \end{pmatrix} \begin{pmatrix} u_t^{\text{oil production shock}} \\ u_t^{\text{oil price shock}} \\ u_t^{\Delta y} \\ u_t^{\Delta p} \\ u_t^{\Delta q} \\ u_t^{\Delta i} \end{pmatrix}. \tag{2}$$

Our objective is to identify a structural oil price shock, and therefore we adopt a partial identification strategy. It is well-known that a unique oil price shock (and an oil production shock) can be identified as long as the oil production and the oil price have a recursive structure as above. None of the results (responses of macroeconomic variables to an oil price shock) is sensitive to altering the ordering of China's industrial production, CPI, real exchange rate and interest rate while keeping the oil production and the oil price ordered first and second, respectively. The recursive ordering between oil production and oil price is consistent with the VAR-based empirical literature on analyzing oil price shocks.

Kilian (2009) defined a positive oil price shock as the oil-specific demand shock which is generated from a precautionary demand that is driven by uncertainty about future oil supply shortfalls. Given that the positive oil price shocks may be time-varying, alternative explanations of determining the cause of the oil price shock may be useful, as we will suggest below.

Our identification strategy of finding the driving source of the oil price shock is based on how the world oil production responds to a positive oil price shock in a VAR framework. If the world oil production falls in response to a positive oil price shock, the oil price shock is referred to as a negative supply shock or a precautionary demand shock according to Kilian (2009). If, however, the world oil production rises in response to a positive oil price shock, the oil price shock is referred to as a positive demand shock. Our identification strategy of the driving forces of the oil price shock is summarized in Fig. 1.

3. Empirical results

3.1. Data

Based on data availability, the monthly sample period is January 1992–May 2014. Following the recent trend in the oil-price literature