

The Effectiveness of Monetary Policy in Responding to Oil Shocks in China

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Abstract

Oil shocks have demonstrated to have major effects on a nation's economic activities over the past decades, as rising oil prices have preceded almost all of the post-WWII recessions. Monetary authority might tend to tighten the liquidity in response to the current oil shock because of the potential inflation. When an oil price shock occurs, will and by how much will tight monetary policies aggravate the output reduction? A financial computable general equilibrium (CGE) model for China is constructed to answer these questions. The CGE model incorporates a financial side, which depicts the role of financial intermediates (commercial bank), the monetary authority (central bank), and financial markets (loanable fund market, enterprise bond market, government bond market, foreign borrowing market) in the economy. The linkages between the real and financial sides of the model are price index, interest rates of deposit, loan and other financial assets. Financial flows are distributed and allocated according to relative interest rates or to the monetary policies in the model. The benchmark data of the financial CGE model are obtained from a Chinese social accounting matrix of 2007 for the real side, and the flow of fund table and balance sheet of 2007 from the Central Bank of China for the financial side, along with a balance of payment table. Results show that tightening policies might contribute much less to the output reduction than the oil shock itself does.

Keywords: Financial computable general equilibrium, oil price shock, monetary policy

1 Introduction

Hamilton(1983) found that the correlation between oil shock and U.S. recessions was statistically significant and nonspurious over the period 1948-72. A considerable body of economic research suggests that oil price fluctuations have figured prominently in national economic activity in developed countries since then. However, few studied the case of developing countries like China at first.

China reformed the oil pricing system to set domestic oil price in accordance with the global oil price in 1998. In 2000, the pricing mechanism of the petroleum products of China was further deregulated. Under the new pricing mechanism, the monthly prices of the petroleum products were determined on the basis of the average closing prices of Singapore futures market of last month. In October 2001, the prices were gain revised to be the combination of the average prices of New York, Rotterdam and Singapore futures markets of last month.

As the second largest world oil consumer only after the US, the total amount of oil consumed in China reached 366 million tons in 2007. With the progress of industrialization and urbanization, especially the increase of privately owned cars, China's oil demand will keep increasing for the foreseeable future (IEA, 2006). On the other hand, the domestic oil production of China has slowed down since 1997, and almost half of the oil consumed in China was imported from outside markets in 2007.

With its larger amount of oil consumption, higher dependence on imported oil supply and more market-oriented domestic oil pricing mechanism, the interactions between the world oil price and China's macro economy should have been more significant than ever.

Tang(2010) demonstrated that an oil-price increase negatively affects output and investment, but positively affects inflation rate and interest. Wu(2013) conducted a simulation showing that under an ideal scenario China will experience a 4.91% increase in general price level when oil price doubles; the inflation rate will drop significantly to 1.39%.

Evidence shows that the rising of the oil price bring the monetary authority a lot of pressure on the possibility of severe inflation. Thus monetary authority might tend to tighten the liquidity in response to the current oil shock. And the monetary policies would add complexity to the oil shock impacts on an economy. We find it necessary to distinguish the monetary policy effect on the macro economy from the oil shock impact itself in order to give policy advices. How much do the monetary policies triggered by oil shock contribute to the change of economy performance other than oil shock itself?

There have been two seemingly conflicting beliefs in this issue. Hamilton(1983,2001,2004) suggested the major downturns in U.S economy are associated by the exogenous oil price shocks. While another set of researches held a different idea. Bernanke(1997,2004) stipulated that tightening monetary policies reacting to the potential or actual inflation triggered by a positive oil shock amplify the decline in real output associated with oil shocks. And it motivated a theoretical

literature that examines the potential macroeconomic impact of monetary policy responses to oil price shocks using DSGE models. Leduc(2004) concluded that monetary policy contributes about 40 percent to the drop in real output following a rise in the price of oil with a DSGE model.

Those studies are based on econometric methods or DSGE models. Today we propose a financial CGE model to estimate monetary policies effects responding to an external oil price shock on Chinese economy, contrasting with counterfactual scenarios where the central bank does not respond to the oil shock and holds the nominal interest rate constant. Specifically we introduce deposit rate and loan rate as depicting the relative tightness of monetary policies.

A financial CGE model comprises financial intermediate institutions and financial assets, while other CGE models only have the real side of economy. Financial CGE models can simulate the linkage and interaction between the financial side and production procedure by including agents' asset allocation behavior, the relationship between the asset demand and output, price level or other real side variables.

Lewis(1985) had a stylized model of Turkey that includes money and bonds, and a segmented loanable funds market that can capture elements of financial repression. Rosenweig and Taylor(1990) presented a macro-structuralist CGE model of Thailand which incorporates asset markets. Ulussever(2010) built a CGE model with a financial market. Xiao(2010) present a theoretical structure of FAGE model based on Monash style.

Many of the financial CGE models are exploited to study the income distribution effects of financial reform or stabilization procedures supported by World Bank and other institutions. There are few researches concerning monetary policies responding to oil shocks using financial CGE models. This paper is planning to fill the gap and employs a financial CGE model to assess those additional effects.

The structure of this paper is as follows. Section 2 briefly describes the model. Section 3 analyses the simulation results. Concluding remarks are provided in section 4.

2 Methodology and data description

The model has 42 production sectors, 1 household, 3 enterprises, commercial bank, central bank, government and rest of world. It concerns several financial markets and assets, such as loanable fund market, enterprise bond market and government bond market.

1) Real side

The real side of the model is following a Standard CGE model developed by IFPRI in 2002.

2) Financial side

A Institution financial account

The private institution, household and enterprises, allocate their asset flow among

different financial product and real invest. They also finance in different ways. And they make their financial decisions according to the relative interest rate of different ways of investing or financing.

Equation 1 states the flow balance of household account. Household saving plus household loan equals household total investment, which includes real investment and financial investment on money, deposit and bond.

$$Save_h + FFLOWC_h = \sum_a ZH_{a,h} + FFLOWM_h + FFLOWD_h + FFLOWBH_h, h \in H \quad (1)$$

Equation 2 states the flow balance of enterprise account. Enterprise saving plus enterprise loan, foreign borrowing, enterprise bond, and FDI equals to enterprise total investment, which includes real investment and financial investment on deposit.

$$Save_e + FFLOWC_e + FFLOWFB_e + FFLOWB_e + FFLOWFDI_e = FFLOWD_e + ZE_e, e \in E \quad (2)$$

B Real investment and financial asset demand

Equation 3 states the desired capital stock. When the marginal capital output equals to capital financing cost per unit, we get to the desired capital stock.

$$KSTAR_a = \left[\frac{QVA_a \cdot PVA_a \cdot \delta_{cap,a}^{va} \cdot \left(\sum_{f \in F} \delta_{f,a}^{va} \cdot QF_{f,a}^{-\rho_a^{va}} \right)^{-1}}{PK_a \cdot \left(\sum_{e \in E} INTRST_e^c \cdot \varpi_{e,a} - pinf + dep_a \right)} \right]^{\frac{1}{\rho_a^{va} + 1}}, \quad a \in A \quad (3)$$

Equation 4 states that we cannot reach the desired capital stock right away, thus we use a parameter λ_a to describe the speed of filling the gap between the present capital stock and desired capital stock, which is actually the function of real investment.

$$ZD_a = \lambda_a \cdot (KSTAR_a - QF_{cap,a}), \quad a \in A \quad (4)$$

As for the financial asset demand, we take the money demand for an example. Equation 5 calculates the money demand. It depends on the nominal GDP, household deposit rate and price level.

$$FSTOCKM = \frac{YGDP}{V_\gamma + V_R \cdot [intrstD_h + (\Delta PLEV_t / PLEV_{t-1})]} \quad (5)$$

3) Data description

Standard CGE models use SAM as their database. We build a China financial SAM of 2007 for this financial CGE model. The benchmark data of the financial CGE model are obtained from a Chinese social accounting matrix of 2007 for the real side, and the flow of fund table and balance sheet of 2007 from the Central Bank of China

for the financial side, along with a balance of payment table.

3 Empirical Results

In baseline scenario, we double the world oil price, while we postulate the interest rate to maintain constant. In scenario 1, we double the world oil price, while we shock the interest rate by raising 1 percent. In scenario 2, we double the world oil price, while we shock the interest rate by raising 2 percent.

In this section, the main results from the policy shocks are presented in terms of impacts on GDP, employment, general price level, household marginal propensity of saving and other macro economic variables.

1) baseline simulation

In the baseline scenario, the world oil price increases by 100%, and the interest rate remains constant. Price level goes up by 1.81%. Nominal GDP decreases by 4.74%. Real GDP decreases by 3.50%. And employment decreases by 5.95%.

Household marginal propensity of saving declines 0.61%. As the oil price goes up, people will have to pay more for the same quantity of commodities. Household would have to smooth their consumption by saving less and spending more. And because of the inflation and unchanged nominal interest rate, the real interest rate is actually negative. Thus household tend to save less.

As for the money demand, M0 increases 515 billion, for people need more cash or demand deposit for transaction purpose as the price level goes up generally. M1 decreases 978 billion, for people would not be willing to put their money into the bank when the real interest rate is still negative.

Total fixed invest falls by 6.89%. As the oil price goes up, the marginal cost increases, and the output goes down, so does the profit. Total quantity of exports falls by 3.49% for the domestic production price goes up. And total quantity imports falls by 7.50%. Since household income decreases 641 billion Yuan, and value of household consumption decreases 322 billion Yuan. Several kinds of final demand decline at the same time. Thus the imports go down as well. Still the decline of imports value exceeds that of exports value. Then the foreign exchange reserve decreases 196 billion. Since the model simplify the foreign investment in domestic financial market and set it proportional, the change in foreign exchange reserve largely reflects the change trade surplus.

2) monetary policy scenarios

In scenario 1, if the world oil price goes up by 100% and monetary authority let the interest rate increase 1%, it is seen that the inflation rate would lower 0.013% comparing to the baseline scenario. The nominal GDP would go down by 0.052% additionally. And the real GDP would go down by 0.04% additionally. The employment rate would go down by 0.092%.

In scenario 2, if the world oil price goes up by 100% and monetary authority let the interest rate increase 2%, it is seen that the inflation rate would lower 0.026% comparing to the baseline scenario. The nominal GDP would go down by 0.103%

additionally. And the real GDP would go down by 0.079% additionally. The employment rate would go down by 0.184%.

As far as we can see, implementing the monetary policy in response to the oil shock does not seem to have very much effect on the total output, nor on the inflation control. The inflation caused by the world oil price shock is primarily cost-push inflation. As the substitution elasticity of the oil is quite limited, we can hardly prevent price level from boosting for the first round. When the official interest rate is rising, people tend to find alternative ways for saving or financing, enterprise bond, foreign borrowing, which to certain extent slows the economic decline. The average financing cost increases 0.71% in scenario1, 1.35% in scenario 2, both smaller than the change of official rate.

4 Conclusion

Oil-price change affects the performances of macroeconomic variables through several channels. On the supply side, due to the rising cost of raw material and intermediate input, the marginal cost of production raises, which directly reduces the output and cause the cost-push inflation. On the demand side, due to the stickiness of labor wage and the reduction of output, household's real disposable income decreases. And expense on oil products expands. Thus the household's consumption on other commodities declines. Export demand declines because that the general price level goes up. In the meantime, central bank would raise the interest rate due to the inflation pressure, which affects the investment demand negatively. Three carriages slow down at the same time and the macro economy suffers from a large impact.

Some literature suggests the central bank should keep the interest rate constant, which may put the economy in danger of suffering from severe inflation in the long run. The analysis would go beyond the scope of the paper because we are building a comparable static model here that can hardly shed light on the price level trend in the long run.

However, what we can see from the results still provides reliable guidance for monetary policies. The monetary policy effects upon the macro economy are not large in the short run in addition to the oil price shock. The tightening policy would not contribute much to the economy contraction when oil price shock occurs. Although raising the interest rate could rarely counteract the inflation pressure, it can help the authority to shape public expectation towards long term inflation and to avoid an inflationary spiral in the future.

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