The empirical characteristics of domestic and foreign interest rate shocks are obtained by using VAR method: the domestic interest rate regulation is counter-cyclical, and the increase of foreign interest rate leads to the increase of domestic output and inflation. On this basis, we construct a small open dynamic stochastic general equilibrium theory framework which reflects the empirical characteristics, including exchange rate control, to analyze the macroeconomic effects of exchange rate liberalization reform. By volatility simulation, impulse response and social welfare loss function analysis, the empirical results show that: firstly, exchange rate reform would increase volatility of output and exchange rate, but reduce volatility of inflation and interest rate. Secondly, exchange rate reform enhances the impact of domestic interest rate shocks on output and inflation. Which means the reform would improve the control ability of interest rate as a monetary policy tool. Moreover, the reform increases loss of social welfare. The conclusion shows that the exchange rate liberalization should be implemented step by step. The government should accelerate the reform when the external macro economy is stable. Otherwise it will cause a larger economic volatility.

Keywords: exchange rate liberalization, a small open DSGE model, macroeconomic effects

1. Introduction

Currently, the reform of Chinese exchange rate liberalization is in progress at an accelerating pace. China’s managed floating exchange rate is based on market supply and demand and with reference to a basket of currencies for adjusting. On April 16, 2012, the daily volatility range of RMB against the US dollar expanded from ±0.5% to ±1%. On March 17, 2014, the range expanded to ±2% further. One of the important questions is to discuss macroeconomic effects of the exchange rate liberalization reform. Whether the increase in exchange rate volatility will bring a larger fluctuation for macroeconomic variables.

The relationship between exchange rate regulation and the stability of macroeconomic is an important economic research topic. In academia, there is no unanimous conclusion that whether floating exchange system is better than fixed exchange rate system. After the collapse of the Bretton Woods system in 1973, countries replaced fixed exchange rate system by floating exchange system. The relationship between exchange system and macroeconomic fluctuations has begun to be studied. The conclusions are different or even opposite. In sum, there are four viewpoints. Firstly, “exchange system irrelevance theory,” scholars who hold this view believe exchange rate system has little influence with microeconomic fluctuation, such as Baxter et al. [1], Ghosh [2]. Secondly, “fixed exchange rate advantage theory,” which means under a fixed exchange rate system the macroeconomic fluctuations are smaller than under a floating exchange rate system. For example, Eichengreen et al. [3] found that fixed exchange rate system is better than floating exchange rate system. Calvo [4] found that fixed exchange rate is more suitable for developing countries. Thirdly, “fixed exchange rate advantage theory,” which shows that can effectively absorb foreign shocks, reduce economic fluctuations, Prasard et al. [5], Edwards et al. [6] hold this view. Fourthly, “exchange rate system uncertain theory,” scholars who hold this view believe exchange rate system according to economic conditions and needs, instead of a single exchange rate system.

The existing research above is analyzed qualitatively. In recent years, a small open macroeconomics dynamic stochastic general equilibrium (DSGE) model is becoming a mainstream analysis method to study the international macroeconomics. Many scholar have constructed the model to study exchange rate-related issues, such as Guillermo J. Escudé [7]. We build a small, open new Keynesian dynamic stochastic general equilibrium model based on Gali and Monacelli [8] and Justiniano and Preston [9], the monetary policy reaction function in RMB, Chen and Liu [10] for reflecting the choosing of exchange rate regime. By volatility simulation, impulse response and social welfare loss function analysis, we analyzed the macroeconomic effects of exchange rate reform. Taking into account the exchange rate market reform will lead to...
changes of environment, policy system, expectation, using ordinary linear model may lead to Lucas Critique. The vector auto regression model can’t incarnate the micromechanism. We choose to construct a small, open DSGE model which can avoid Lucas Critique because of the following reasons: firstly, from the perspective of foreign trade, the subentry statistic of expenditure-based GDP shows that the share of imports and exports in GDP averaged 46% in recent 5 years, which indicate the strong reliability between Chinese economy and the globe economy as well as the strong open characteristic of our country; secondly, from the perspective of finance. Taking into account the fact that RMB is not a reserve currency and China’s financial market size is still smaller than developed countries, China does not yet have the pricing power that can affect the world interest rate. In the meantime, the flow of international capital does not have a major impact on our economic fluctuation yet. It must be said that “small” indicate the share in global capital market and foreign product market is small instead of the output share in the global market.

The paper is organized as follows. Section 2 is empirical characteristics of domestic and international interest rates shock. We construct a small open economy dynamic stochastic general equilibrium model which meets the empirical characteristics in Section 3. Section 4 describes parameters calibration and estimation in the model. Section 5 is the simulation analysis, from the economic variables fluctuations by external economic shock, impulse response simulation and the social welfare loss we analyze the macroeconomic effect of exchange rate liberalization reform. Section 6 is the conclusion.

2. The Empirical Characteristics of Domestic and International Interest Rates Shock

We select domestic and foreign output as constant GDP data, the 7 days interbank interest rates as the domestic interest rate, the US federal benchmark interest rate as foreign interest rates, the dollar against the RMB exchange rate as exchange rate. Domestic output and inflation data are from the National Bureau of Statistics website, the exchange rate data from the People’s Bank of China website, foreign output and inflation data from the US Bureau of Labor statistics website. The sample period is 1996Q1-2015Q4. First of all, the unit root test of each variable shows that the data is not smooth, but after the first order difference, all variables are stationary. Further, the optimal lag order is determined according to the AIC and SICS minimization criteria. Finally, the impulse response method is used to obtain impulse diagram of domestic and international interest rate shocks as shown in Fig. 1.

Figure 1 shows the impact of domestic and international interest rates on domestic and international output, inflation and exchange rate. Where the variables Y, PAI, R represent the domestic output, inflation and interest rates respectively, the corresponding YF, PAIF, RF that foreign output, inflation and interest rates respectively, E represents the RMB exchange rate. It shows that the rise in domestic interest rates will lead to domestic output, inflation and exchange rate decline; the rise of foreign interest
rates would decline the foreign output, inflation and exchange rate decline.

The impact of foreign interest rates on domestic output and inflation is positive. The main reason is that the rise of foreign interest rates led to the outflow of currencies, domestic demand for funds decreased, the domestic interest rate declined, and stimulated investment and consumption, then output and inflation increased. Based on the above analysis we found that the following empirical characteristics of domestic and international interest rates shock: (1) the domestic interest rate control policy is counter-cyclical; (2) the impact of foreign interest rates on domestic output and inflation is positive.

3. The Basic Framework

The macro economy contains three economic subjects, households, firms and the central bank. We construct a model to reflect the behavior characteristics of these three economic subjects. To optimize the expected utility function, households choose the quantity of consumption, labor supply and assets of the end period under budget constraints. The products are divided into two categories: the final product and the intermediate product. Assuming that the final product market is in a perfectly competitive state and the intermediate product market is in a state of monopolistic competition. And further assumes that the firm’s pricing for intermediate products adopt the pricing method by Calvo [11], which means that firms choose the quantity and price of products to achieve the maximum profit. Monetary policy is formulated and implemented by the central bank. Monetary policy objectives include price, economic growth and exchange rate stability at a reasonable level of equilibrium.

Assuming that domestic and foreign residents have similar utility functions and budget constraints, Domestic economic variables are expressed with subscripts H and foreign economic variables with subscript F. We also assume the alternative elasticity of domestic and foreign products is $\eta$.

3.1. Household

We assume that domestic residents and foreign residents have similar utility functions and budget constraints. The representative household in the economy are countless and homogeneous and have an infinite life. The decision problems are concentrated in choosing consumption, labor supply and the quantity of real currency holdings.

Under budget constraints, domestic residents maximize their utility function:

$$
\max_{\bar{c}_t, \bar{y}_t, \bar{c}_t^1} \sum_{t=0}^{\infty} \beta^t \left[ c_t^{1-\sigma} + \left( \frac{M_t}{P_t} \right)^{1-\sigma} + \left( \frac{1}{1-\sigma} + \frac{N_t^{1+\psi}}{1+\psi} \right) \right]
$$

With $\beta$ is discount factor and $c_t, M_t/P_t, \psi$ are separately household consumption of native and foreign products, the real balance and laboratory time of residents. $\sigma, v, \phi > 0$ is the reciprocal of the intertemporal elasticity of substitution, the reciprocal of the elasticity of monetary supply to interest rates and the reciprocal of labor supply to real wages, respectively. The consumer goods basket of the national and foreign goods is defined by the CES function:

$$
C_t = \left[ \alpha \left( \frac{1}{1-\sigma} \right) + (1-\alpha) \left( \frac{1}{1-\sigma} \right) \right] \left( \frac{C_{CH}^{1-\sigma}}{C_t^{1-\sigma}} + \left( \frac{C_{CF}^{1-\sigma}}{C_t^{1-\sigma}} \right)^{1-\sigma} \right)^{\frac{\sigma}{\eta}}
$$

Where $1-\alpha$ is the weight of foreign goods in the basket and $C_{CH}$ is the quantity of the social consumption of native products, $C_{CF}$ is the quantity of the social consumption of foreign products. The parameter $\eta > 0$ is the elasticity of substitution between home- and foreign-country goods.

Total consumption expenditures by domestic households are given by:

$$
P_tC_t = P_{tH}C_{tH} + P_{tF}C_{tF}
$$

Where $P_t, P_{tH}, P_{tF}$ is consumer price index, the price index of the domestic goods and the price index for import goods.

Thus, the equation of domestic price index is given by

$$
P_t = \left[ \alpha + (1-\alpha)s_t \right] \frac{1}{\eta} g(t) \ldots \ldots . (4)
$$

Domestic residents can choose among consumption, national currency and bond hold. The budget constraint can be written as

$$
P_tC_t + B_t + M_t = R_tB_{t-1} + W_tN_t + M_{t-1} + T_t \ldots \ldots (5)
$$

The notation is residents bond ($B_t$); the nominal wages ($W_t$); one-time transfers from the government ($T_t$); nominal interest rates ($R_t$).

The equations of utility maximization after first derivation is

$$
C_t^{\sigma} N_t^{\sigma} = \frac{W_t}{P_t} \ldots \ldots \ldots \ldots \ldots \ldots \ldots . (6)
$$

$$
\left( \frac{M_t}{P_t} \right)^{1-\sigma} C_t^{\sigma} = \frac{R_{t-1}}{R_t} \ldots \ldots \ldots \ldots \ldots \ldots \ldots . (7)
$$

$$
\beta R_t E_t \left\{ \left( \frac{C_{t+1}}{C_t} \right)^{-\sigma} \frac{P_t}{P_{t+1}} \right\} = 1 \ldots \ldots \ldots \ldots . (8)
$$

$$
\beta E_t \left\{ \left( \frac{C_{t+1}}{C_t} \right)^{-\sigma} \frac{P_t^*}{P_{t+1}} \right\} = \frac{Q_t}{Q_{t+1}R_t} \ldots \ldots \ldots . (9)
$$

After maximizing these equations, we can get the optimal risk allocation condition:

$$
\frac{Q_{t+1}P_{t+1}^*}{P_{t+1}(C_{t+1})^{-\sigma}} = \frac{Q_tP_t^*C_t^{-\sigma}}{P_t(C_t^{-\sigma})^{-\sigma}} \ldots \ldots \ldots . (10)
$$

where $Q_t$ represents nominal exchange rate.

The formula above means that 1 unit currency (whether local currency or foreign currency) is used to purchase...
foreign goods basket and for purchase. The ratio of the marginal utility of the domestic commodity basket is a constant that does not change over time. When the country and the foreign are symmetrical, the ratio is 1. We obtain:

$$\frac{C_i}{C^*_i} = q_i^\frac{1}{\eta} \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdot
The parameter in the first-order auto regression equation of foreign technology shock is the same as domestic. In order to eliminate the influence of inflation, nominal GDP should be transferred into real GDP (Real GDP = Nominal GDP / fixed inflation, benchmark quarter is chosen as 1995Q4). The output gap is dealt with by HP filtering method which is widely and easily used. Inflation is reflected by CPI. The economic activity of residents and firms are greatly affected by the regulated interest rate and the main instrument for the central bank to adjust price is the benchmark one-year deposit and lending rates. So the benchmark one-year deposit rates are chosen in this paper and real interest rate adopt nominal rate minus inflation. Real exchange rate adopts $q = S \cdot CPI^* / CPI$, in which $q$ and $S$ are real exchange rate and nominal exchange rate respectively, $CPI^*$ represents fixed benchmark index of America consumer price, $CPI$ represents the index of China. The data of America inflation are taken from the Statistical Review of the U.S. Department of Labor. Inflation data both go through fixed benchmark treatment, where the base period is December, 1995. The data of nominal RMB exchange rate are taken from monetary policy department of the People’s Bank of China. Taking the end of the month data for the nominal exchange rate data and the quarterly data is got through averaging monthly data.

### 4.2. Parameters Calibration

Most of the values of parameters are taken from Liu [13]. We set steady-state value of exogenous technology shocks as 1. In Table 1, $\pi = P_t / P_{t-1}$ is set as 1 for the steady-state. $R$ and $R^*$ are replaced by mean value respectively. $\beta$ equals $1 / R$ in a steady state, so do the foreign parameter $\beta^*$. $\rho = 0.75$ reference Parrado [12]. $\rho^*_x$, $\rho^*_y$ followed standard Taylor rule are taken from Taylor [14].

### 4.3. Parameters Estimation

For GMM requiring less limiting condition, the generalized method of moment estimation is widely used. GMM is a parameter estimation method based on the actual parameters which satisfy certain moment conditions. In the random sampling, the sample statistics converge to some constant with probability one. This constant is a function of some unknown parameters. If a right model was set, we could found some moment conditions that the parameters in the model satisfy, so that unknown parameters can be estimated. The lag period variables of inflation, real interest rate, exchange rate and output gap can be used as the instrumental variables in the estimation. The results are shown in Table 2.

The DW value and $t$ statistics values show that the estimation results are significant (Fig. 2).

In the following, three kinds of scenarios are simulated to analyze the policy effect of exchange rate liberalization reform by three methods: economic volatility, impulse response and social welfare loss. It is suggested from the monetary policy Eq. (20) that if the parameter $\phi_q$ equals 0, domestic policy is a fixed exchange rate regime and if the parameter $\phi_q$ does not equal 0, domestic policy is managed floating exchange rate regime. The larger $\phi_q$ is, which means the stricter controls are. With the processing of the exchange rate liberalization, the parameter $\phi_q = 0.2$ will decrease gradually. $\phi_q$ is assumed to be reduced to 0.1 for scenario 2, and $\phi_q = 1$ represents that the exchange rate liberalization reform is implemented completely. To measure the gradual reform process of exchange rate liberalization, we set following three scenes: managed floating exchange rate regime 1(MRF1): $\phi_q = 0.2$, managed floating exchange rate regime 2(MRF2): $\phi_q = 0.1$, free floating exchange rate regime: $\phi_q = 0$.

### 5. Model Simulation

#### 5.1. Volatility Simulation

Table 3 shows the volatility (standard deviation) of the macroeconomic variables by all shocks in the three following scenes.

The current exchange rate system in China is MRF1 in Table 3. Comparing analysis, we can find that the reaction coefficients of monetary policy to exchange rate decreased and the fluctuation of output and exchange rate become larger while inflation and the fluctuation of interest rate are smaller.
Table 3. The fluctuation (standard deviation) of variables in different equilibrium interest rate under impacts (unit: \(10^{-2}\)).

<table>
<thead>
<tr>
<th>MRF1</th>
<th>Output</th>
<th>2.00</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inflation</td>
<td>1.02</td>
<td></td>
</tr>
<tr>
<td>Interest rate</td>
<td>1.06</td>
<td></td>
</tr>
<tr>
<td>Exchange rate</td>
<td>1.07</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>MFR2</th>
<th>Output</th>
<th>2.13</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inflation</td>
<td>0.97</td>
<td></td>
</tr>
<tr>
<td>Interest rate</td>
<td>1.03</td>
<td></td>
</tr>
<tr>
<td>Exchange rate</td>
<td>1.12</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Free floating exchange rate regime</th>
<th>Output</th>
<th>2.27</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inflation</td>
<td>0.91</td>
<td></td>
</tr>
<tr>
<td>Interest rate</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>Exchange rate</td>
<td>1.18</td>
<td></td>
</tr>
</tbody>
</table>

Note: The interest rate above equals the nominal interest rate in Table 1 minus 1, Interest rate = 3.50.

Chinese policy objectives of economic growth and inflation decreased to 7% and 3% respectively in 2015. In the first quarter of 2015, the growth rate of GDP was 7% and rose 1.2%. In such a macroeconomic environment, it is the right time to promote exchange rate liberalization. It can be seen that promoting liberalization should follow the principles of promoting step by step in current circumstances to avoid excessive volatility.

5.2. Impulse-Response Analysis

In this section, we simulate and analyze the macroeconomic effects of implementing exchange rate liberalization. Domestic technology and interest rate have a significant influence on domestic economy.

Figure 3 exhibits that technology advancements make output increasing and inflation decreasing. The main reason is that technology advancements decrease marginal businesses costs of production which will reduce inflation and inflation reduction will stimulate aggregate demand growth which will increase the output in the short run. By comparing, we found that as the exchange rate liberalization reform goes on, the output fluctuation caused by technologic impact will increase and inflation fluctuation will decrease gradually.

Figure 4 exhibits that the rise of interest rate by 1 percent can curb inflation effectively and also decrease investment so that decrease output. The effectiveness of monetary policy consists of two important factors: the degree of influence and the time of action. A satisfactory situation is that interest rate obtains the best affection in minimal time under the certain situation. By comparing, we can see that the different on regulation effects under different exchange rate regime is expressed in the initial effect degree. As the exchange rate liberalization reform goes on, the ability of monetary policy to regulate output and inflation will gradually be further strengthened.

Although RMB exchange rate is floating rate in China, the floating bands are too narrow according to analysis of years of data. Furthermore, most of the fluctuations are one-sided appreciation instead of bilateral fluctuation in a real sense. With the increase of China’s foreign trade amount, the absolute value of favorable balance of trade was increasing, which means the foreign-exchange reserves will be more and more through capital account and current account. In order to handle up to the huge foreign-
exchange reserves, the center bank had to issue excess currency and release liquidity. It led to the cost of hedging through monetary tools used by center bank increasing. There are conflicts between the goals of monetary policies and exchange rate policies and the independence of monetary policies are also suffered by the influence. The impulse-response analysis of the results above show that the ability of interest rate adjusting inflation and output is enhanced as the exchange rate liberalization reform goes on. Combining with our country’s actual situation, we should advance interest rate liberalization step by step and increase the bilateral floating range of exchange rate.

5.3. Social Welfare Loss Function Analysis

Different from the closed economy, we need to consider exchange rate fluctuation in social welfare loss function analysis under an open economy. Following Woodford [15], welfare standards is based on the cross-period loss function below:

\[ L = E_0 \sum_{t=1}^{\infty} \theta^t \left[ \hat{\pi}^2_t + \lambda_p \hat{y}^2_t + \lambda_q q^2_t \right] \]  

(21)

where \( \theta \) is discount factor; \( \lambda > 0 \), depict the relative attention degree of central bank on output; \( n \) is the time horizon (equals 0 in most case); \( \hat{\pi}, \hat{y}, \hat{q} \) is the fluctuation of inflation, output and exchange rate separately. Policy objectives of central bank are to minimize the difference between output gap, inflation, exchange rate and their target. So the loss function of central bank can be shown as the quadratic all three above. Woodford [15] proved the consistency between multi-period expression of central bank loss function and social welfare objective function, namely under second-order perturbation approximation minimizing the loss function is the same as maximizing social welfare objective function. According to the common practice, we set maximum size value as \( 40 \), that is, considering ten-year policy effectiveness at most. Assume central bank and the household has the same preferences, namely \( \theta = \beta = 1/R \). For the reliability of conclusions, analysis under the situation of \( \lambda_p = \lambda_q = 0.5 \) and \( \hat{\pi} = 0.5, \lambda_q = 0 \).

From the impulse response analysis we know that the impact on the economy by technology shock is greatest among all shocks in the model. We analyze the influence of the economy variables by technology shock. The influence can be measured by social welfare loss, the computation results shown in Table 4.

Table 4 shows that in the three floating exchange rate regimes, promoting exchange rate liberalization is in favor of stabilizing economic fluctuations for the social welfare loss caused by exchange rate liberalization; on the other hand, it will contribute to reduce the welfare loss caused by exchange rate liberalization and mitigate the economic fluctuation if promoting exchange rate liberalization. Therefore, in order to avoid excessive fluctuations of the economy, we should advance the reform of exchange rate step by step.

All this time, the government was afraid that over-rapid financial reform would lead to the macroeconomic instability. Recently interest rate liberalization has been gradually advancing, interest rate and exchange rate liberalization was both advancing in a coordinated way, such as the RMB exchange rate liberalization reform starting in July 2005. The volatility range of RMB against the US dollar was 0.3% in 2005, and the range expanded to 0.5% in May 2007, 1% in April 2012, and 2% in March 2014. The impact of the external economic shocks is great and capital outflow is serious in 2015, China’s exchange rate market reform has slowed. So China’s exchange rate liberalization reform is step by step.

6. Conclusion

A small, open new Keynesian dynamic stochastic general equilibrium model is constructed to analyze the macroeconomic effects of exchange rate liberalization reform from three aspects: volatility simulation, impulse response and social welfare function. The empirical results show that: Firstly, in current circumstances, promoting exchange rate liberalization will increase the fluctuation of output and exchange rate and decrease the fluctuation of inflation and interest rate. Secondly, impulse-response analyses show that the reform of exchange rate can enhance the effectiveness of interest rate. Therefore, the government should regulate macroeconomics by price-based monetary policy instruments. Thirdly, the social welfare loss caused by exchange rate liberalization has something to do with the stage of the exchange rate liberalization reform. If equilibrium exchange rate rose too fast, the social welfare loss caused by exchange rate liberalization reform is bigger that it caused by exchange rate liberalization reform. So we should advance the reform of exchange rate step by step, increasing the floating range of interest rate accompanying with the floating range of exchange rate increasing. The conflicts between the goals of monetary policies and exchange rate policies also need to be reduced gradually.

Recently, Chinese government is being faced with a pressure of outflow as RMB suffering the devalue pres-

| Table 4. The value of loss function by the technology shock (unit: \( 10^{-4} \)). |
|-----------------|-----------------|-----------------|-----------------|
| \( \lambda_p = 0.5 \) | \( \lambda_q = 0.5 \) | \( \lambda_p = 0.5 \) | \( \lambda_q = 0.5 \) |
| \( \lambda_p = 0.5 \) | \( \lambda_q = 0.5 \) | \( \lambda_p = 0.5 \) | \( \lambda_q = 0.5 \) |
| 1.68 | 1.51 | 1.70 | 1.53 | 1.74 | 1.56 |
sure. Internationally, the US economic recovery and the rate hike expectation of the Federal Reserve pushed the dollar up, which bring international capital back to American. This would lead to further outflow of Chinese capital. With the opening of financial market of China, the opening of capital account and a faster pace of RMB internationalization, capital flow bidirectional frequently and the range of exchange rate fluctuation keep increasing, which also means that the risk of domestic financial instability caused by international capital flow is growing. It is suggested that as we promoting exchange rate liberalization reform, perfect regulatory tools and requisite capital controls are both needed. Bidirectional monitoring and warning of cross-border funding flows should be strengthen. We should prevent two-way impact of cross-border capital flow and be more valiant against cross-border capital flows and the risk of the instability of Chinese financial market caused by RMB depreciation.

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