The effect of financial openness on international financial risk contagion based on DSGE model

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ABSTRACT

Since entered WTO, China's financial market has opened up gradually. However, faced with the sub-prime crisis in 2008, China suffered destruction ,especially for financial institutions that are exposed directly to international environment. Consequently, China stopped its preparations for financial liberalization. To solve the issue that whether should China keep opening up or strengthen capital control, this article chooses New Keynesian dynamic statistic general model to investigate relationships between financial openness and risks transmitted by international output shocks. Besides, this article assigns variables through calibration and appraisement, then adopts commen monte carlo random simulation method .It is suggested that when international output shocks occur, with the increase of financial openness, the volatility of domestic macroeconomic variables decrease. That is, financial openness can effectively decrease risks from international output shocks and improve stability of China's macro economy.

Key words: Financial Openness, International Financial Risk, DSGE Model
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INTRODUCTION

Since implementation of reform and opening up, China's economy has witnessed rapid development as trade openness creates a broad market for cheap Chinese goods, thus driving the increase of domestic production constantly. Fortunately, in the 30 years of reform and opening up, China's economy has achieved great success. Gross Domestic Product (GDP) has maintained an average growth rate of nearly 10 points, and the income level has improved tremendously as well. Along with trade liberalization, globalization has also become one of the big themes of Chinese financial market, leading to the introduction of foreign capital, especially, foreign direct investment, which boosted significant upgrade of production technology and production capacity in China. Meanwhile, China's domestic capital began to enter the international market, and looks for investment opportunities within a global scale. In the presence of financial openness, Southeastern Asia has already become an important capital-importing region for China. In order to meet the need of deepening market economy reform, and promoting marketization of interest rates, formation of exchange rate mechanism and internationalization of RMB, partial domestic and foreign scholars advocate to accelerate China's financial openness.

Back in 1961, Mundell-Fleming Model has discussed monetary policy and fiscal policy issues in an open economy. This seminal work points out that under the free flow of international capital, that is to say a completely open financial market, once a country adopts floating exchange rate, monetary policy will be fully effective, while fiscal policy has no effect; on the contrary, if a country adopts a fixed exchange rate regime, fiscal policy is fully effective with monetary policy not valid . Subsequently, Dornbusch (1976) adds expectations and price stickiness to the conditions of financial liberalization and further analyzes the effectiveness of monetary policy. As far as he is concerned, if changes in monetary policy can't induce an increase in output, the exchange rate will overshoot. On this occasion, even for the floating exchange rate regime, monetary policy is not effective. Lucas believes that traditional research methods are lack of microscopic basis, and the corresponding results therefore are difficult to

be convincing. Obstfeld (1995) discoveres via analysis of Redux model that, in conditions of financial liberalization, residents of a country can purchase foreign bonds to bring about the intertemporal allocation and inter-regional configuration of consumption, and thus global sharing of consumption risk [1]. A similar approach is taken by Devereux and Sutherland (2008) .They also analyzed the issue of financial liberalization under the framework of Redux model. Similarly, their study also point out that with financial globalization, the economic impacts get scattered in the international market, helping stabilize the domestic macro-economy and finally improve its own benefits [2]. However, Gavin and Haussmann (1996) do not adopt a purely theoretical analysis, but implemented an empirical research for more than 100 developing countries. They find that the increase of financial liberalization will exacerbate the spread of financial risks, inducing macroeconomic instability of developing countries [3]. Pancaro (2010) also investigates financial liberalization and international financial risk transfer under the framework of Redux model, except that he adds the real estate wealth effect. Because of this factor, the consumption has undergone a fundamental change. Under the real estate wealth effect, financial liberalization will induce the hot money to transfer international financial risks into various countries and increase the volatility, as well as macroeconomic instability. Evans and Hnatkovska (2007) simplify the Redux model and point out that the effect of financial liberalization on international financial risk transfer is related to time[4]. Financial liberalization in the short term will result in a vicious pass of international financial risks, while in the long run; financial liberalization can effectively disperse international financial risk and increase the stability of the global economy [5].

This paper regards China's financial liberalization as a foothold, and conducts the dynamic stochastic general equilibrium method, which combines theoretical model and actual data analysis together, as well as Monte Carlo random numerical simulation method to investigate Chinese financial liberalization and issues on transmission of international financial risks to China.

CHINA'S FINANCIAL OPENNESS AND PARAMETER ASSIGNMENT
From mid-1980s, China began to implement market-oriented reform of financial regime that includes both internal bank reform and external international financial market reform. Twenty years later, China's domestic financial market is gradually moving towards a market-oriented one, and provides strong financial support for China's economic development. While on account of ongoing international financial crisis, which delays opening up of external financial, the reform of international financial markets struggles.

As several methods of financial liberalization measure have already been introduced before, we choose quantitative measure to analyze financial liberalization in China. The expression of this measure can be written as: FOP=100× (GFA+GFL)/GDP. Where the FOP denotes financial openness, the GFA is total external debt, the GFL is total external assets, and the GDP refers to gross domestic product (GDP).

Table 1. Trend of China's financial openness

Time	FOP	GFA/100Miliion	GFL/100Miliion	GDP/100Miliion
1991	3.66%	497	300.24	21781.5
1992	4.16%	691.4	428.03	26923.48
1993	11.43%	3430.8	606.9	35333.92
1994	9.51%	3935.7	649.43	48197.86
1995	3.37%	1186.1	863.73	60793.73
1996	4.40%	2285.4	843.35	71176.59
1997	10.53%	7477.4	840.58	78973.03
1998	5.87%	4193.8	759.97	84402.28
1999	12.64%	10440.1	898.49	89677.05
2000	5.57%	4566.3	961.86	99214.55
2001	19.28%	20159	981.72	109655.17
2002	17.71%	20340	973.11	120332.69
2003	15.87%	20511.55	1044.4	135822.76
2004	13.15%	19827.98	1202.72	159878.34
2005	3.83%	5807.261	1280.05	184937.37
2006	13.98%	28653.76	1597.06	216314.43
2007	8.09%	19771.51	1730.39	265810.31
2008	6.94%	20106.91	1685.53	314045.43
2009	6.66%	21023.53	1680.04	340902.81
2010	5.70%	21064.81	1808.21	401202.03

Note: Data from the China Economic Information Network and China Statistics

 Table 1 shows the measurement conditions of China's financial openness from 1991 to 2010. In 1991 China's gross domestic product (GDP) is only 2.17815 trillion RMB. While in 2010, this data increases to more than 40 trillion, which indicates that in the past two decades, China's economy has achieved rapid growth. China's total

external assets are 49.7 billion RMB in 1991, and the total external liabilities are 30.024 billion RMB. As we can see, assets are in excess of liabilities, which is opposite to situations of early periods of reform and opening up. Financial openness of China in 1991 is 3.66%, followed by a substantial rise then. But after 1993 there was a decrease. In order to carry out a more careful evaluation, we use the following figure to represent the trend of financial openness.
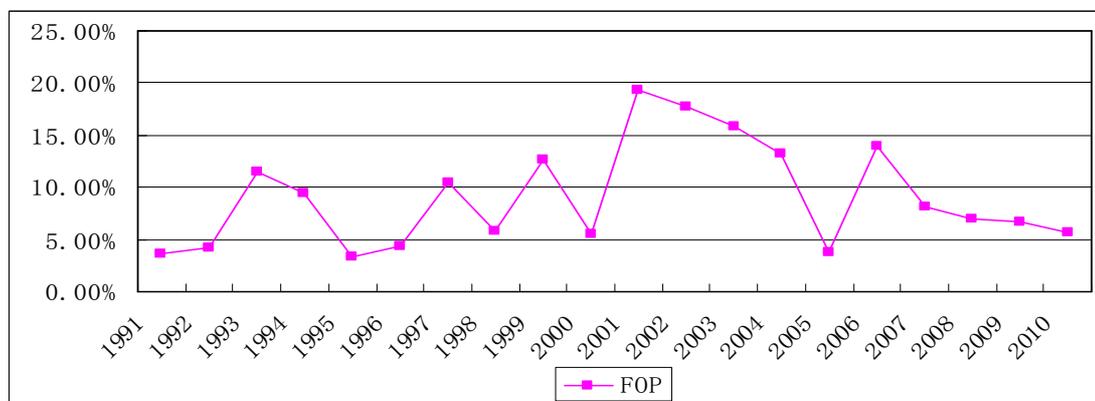
Figure 1. Financial Openness of China From 1991 to 2010

Figure 1 shows the trend of financial openness in 1991 - 2010. As we can see from the figure, movements of China's financial openness exhibits a volatile form, other than continuously rising tread as of GDP. All too often, there occurs a reverse every 2-3 years. Apparently there is a substantial rise in 2001, owing to China's accession to WTO, and there is also a significant increase in 2006, which is related to China's commitment about opening up domestic financial markets. In addition, we can see that China's financial openness has a downward trend after each financial crisis. For instance, after the Southeast Asian financial crisis of 1997, the level of financial openness has a decline, and after the 2007 subprime crisis, its financial liberalization also has a significant decrease. Based on actual data, the change of financial openness values in the range of 0.01-0.2, and later this feature will provide references for the assignment of financial openness in China.

In addition to financial openness, there are many other underlying parameters that may be of interest and need to be assigned in this paper. Calibration and valuation are commonly used parameter assignment methods both at home and aboard. The calibration method means giving appropriate values to parameters combined with characteristics of our model in reference to previous studies. The valuation method is to make use of existing data to measure the value of parameter based on the objective of economic research. As to principle of parameter assignment in this paper, we choose valuation method for parameters which can be assigned according to actual data, and for parameters that are difficult to rely on actual data, we use calibration method.

The parameter that is evaluated through valuation method is trade openness. Trade openness in this article is measured by the proportion that foreign goods account for the national index of consumer goods. Via data of China's consumption and imports in 2009 we can estimate that China's trade openness in recent years is 0.41. By comparison between values of trade openness and financial openness, we can draw that China's degree of trade openness is much higher than that of financial openness, which is consistent with the actual situation. In order to stimulate economy through exports, current account obtained free conversion since 1992 but long-term financial services accounts are restricted to mandatory foreign exchange settlement regime.

The other parameters are calibrated for assignment. In addition to the impact of foreign output, this paper also assumes the impact of domestic output, $y_t=\rho_3 y_{t-1}+e_m$.where ρ_3 represents domestic technological advances. This paper regards the total factor productivity as a reference for assignment. We follow other works, e.g. in Hong and Chang Xianyu (2011) .They employ C-D functions based on the 1978-2008 GDP datas in China, to estimate that China's total factor productivity is approximately 0.83, hence we make the assignment of ρ_3 0.83. Huang Minghao (2010) implemented inspections of domestic goods, and indicates that the substitution elasticity of domestic and foreign goods δ is appropriate by value of 2.η's value is 3,θ's value is 0.75, ρ's value is 1, and ρ_2's values is 0.86 as found by Gali and Monacelli (2005). Referring to the parameter assignment of Parrado (2004), the value of ρ_1，β, κ_x, κ_π, κ_e is 0.8、0.99、0.5、1.5 and 3.34, respectively. At the same time, the value of domestic real interest rate $\bar{r}$ is 0.02. Particularly, the reason why the value of κ_x is 0.5, the value of κ_π is 1.5, the value of κ_e is 3.34, is that China is still adopting a fixed exchange rate regime, and the weight of the exchange rate in monetary policy is still heavy [7-9].

THE EFFECT OF FINANCIAL OPENNESS ON INTERNATIONAL FINANCIAL RISK CONTAGION
For a country, only stable development of macro economy can bring about continued increase of benefit for residents. Extremely large volatility of macroeconomic variables will put a negative impact on economic development. The economic shocks from foreign countries are sources of international financial risks. Whether these risks will be conducted to China as well as the degree of conduction, and its impact on macroeconomic instability constitute important contents of researches about international financial risk transfer.

In the management of macro economy, output, inflation, exchange rates and interest rates are the four most important macroeconomic variables. The steady growth of output will lead to increased employment and increased income level, and thereby improves the welfare of the residents. However, if the increase of output is accompanied by a high inflation rate at the same time, then the increase of residents' income is likely to be eroded by inflation and the residents will experience less economic growth as well as welfare enhancing effect. As exchange rate is the price variable that reflects the intrinsic value of two currencies, with the movements of exchange rate, prices of import and export commodities between the two countries will change with it, thus affect bilateral trade eventually. Furthermore, ups and downs of foreign economy will also urge domestic production and consumption volatility and makes adverse effect on macroeconomic stability. Interest rate is the time value of domestic currency, which has an important impact on investment. It will affect macroeconomic stability through output and price changes created by movements of investment.
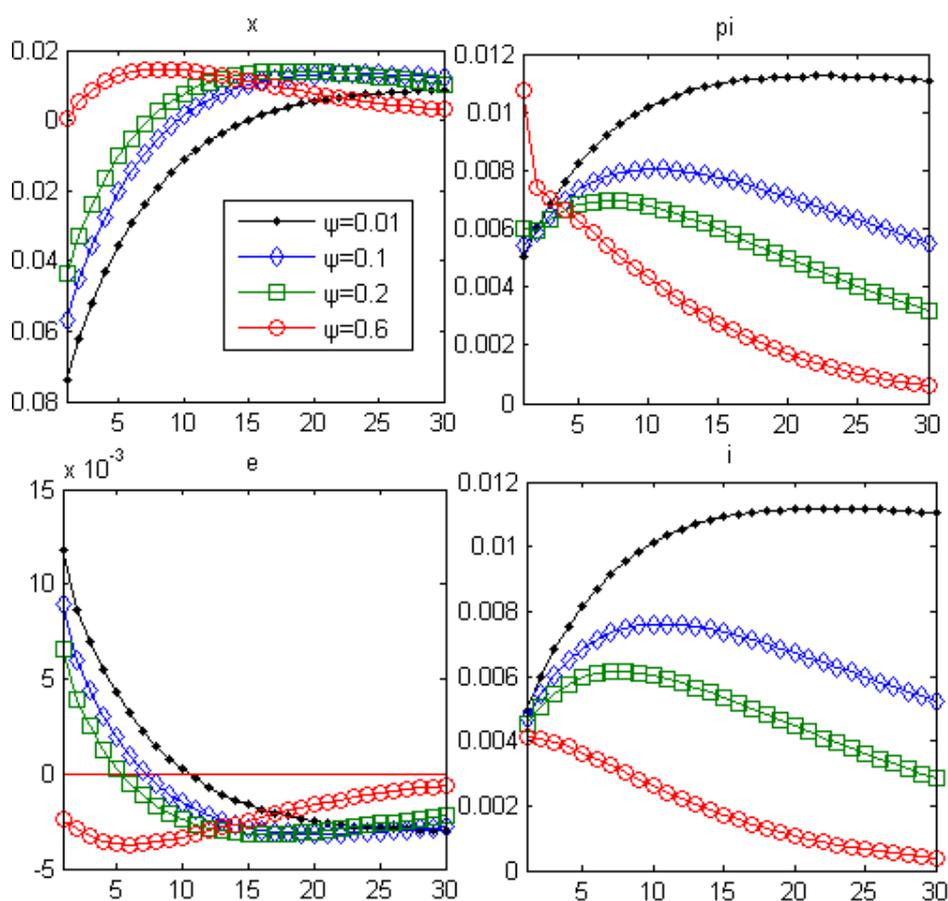
Figure 2. the Effect of Financial Openness on International Financial Risk Expansion

As is learned before, output, inflation, exchange rates and interest rates are the most important variables that affect macroeconomic stability. Estimating the impact of foreign output on the contagion of international financial risks to China's macro economy can be broken down into four research approaches: the impact of foreign output shock on China's output fluctuations, the impact of foreign output shock on China's inflation, the impact of foreign output shock on China's exchange rate fluctuations and the impact of foreign output shock on China's interest rate fluctuations. These effects may be in the same direction, or in the opposite direction. Comprehensively taken into consideration, some effects could be offset, which makes the conclusion deviated. Therefore, we adopt problem split analysis to make more accurate and in-depth study on this article.

After assignment of variables in the New Keynesian dynamic stochastic general equilibrium model which is

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combined with the introduction of financial openness, we will resort to the Matlab software. We take advantage of Monte Carlo random numerical simulation method to observe the impact of financial openness on the contagion of international financial risks by international output. In order to acquire stable simulation results, we carry out several experiments and finally find the stabilized results of 3000 tests, of which the simulation time period is 30.In Figure 2, x is the output gap, pi denotes inflation, e is the nominal exchange rate, i is the interest rate, and ψ refers to financial openness.

From previous section of research on financial openness, we see that the degree of financial liberalization in China is generally between 0.01-0.2, accordingly the values of financial openness in this section are 0.01, 0.1 and 0.2.At the same time, in order to assess the impact of continued expansion of financial liberalization in China on the international financial risk propagation, we also simulate the case when financial openness is 0.6. Figure 2 shows the impact of financial openness changes on the risk transfer of international output shock. Afterwards, we will discuss the impact of financial openness changes on risk transfer of international output shocks to output, inflation, exchange rates and interest rates.

(1)When international output shocks occur, with the increase of financial openness, the volatility of the domestic output gap will reduce. If the value of financial openness is 0.01, positive international output shocks will decrease the country's output with the magnitude of 0.08. Suppose the degree of financial openness is 0.2, a unit of positive international output shocks will make the country's output decrease by about 0.04. Surprisingly, when financial liberalization is further increased to 0.6, positive international output shocks will increase domestic output instead of reducing. From the historical point of view of China's economic growth, this phenomenon is more obvious. Early in the reform and opening up, owing to low level of financial openness, China imports exceed exports, which makes domestic output decline. While with the increasing degree of openness, China has gradually integrated into the international trade and financial markets and has fully expressed its comparative advantages, resulting in continued increase of exports and rapid development of domestic output.

(2)Suppose the overall level of China's financial openness is low, with the increase of financial openness, the volatility of domestic inflation will decrease in the face of international output shocks. If the financial openness is 0.01, a unit of positive international output shocks will make the country's inflation increase at the beginning by 0.005, later there accompanies a continuously increasing process. If the financial openness is 0.2, a unit of positive international output shocks will make the country's inflation rise slightly in the short term, and then converge to a stable value. When the financial openness is 0.6, a unit of positive international output shocks will urge the country's inflation to shoot up in the rate of about 0.01, and then a rapid decline will occur with violent fluctuations. As we can see from the simulation, at the time when the degree of financial openness is quite low, with the increase of financial openness, output shocks will reduce domestic inflation volatility. Nevertheless, if the degree of financial openness is high, with the increase of financial openness, output shocks will aggregate the extent of fluctuations in domestic inflation. Currently, ups and downs of inflation in China is related to financial openness. The gradual opening up of China's financial markets provides opportunities for foreign investors to flow into domestic market through QFII, underground banking, false foreign direct investment and currency speculation, resulting in continually uplifting domestic price level and making the high level of domestic inflation lasts long period of time.

(3)When international output shocks occur, with the increase of financial openness, the volatility of nominal exchange rate decreases. If financial openness is 0.01, a unit of positive international output shocks will cause an increase of about 0.012 in the nominal exchange rate at the beginning, that is, RMB would be devalued, and keeps the tendency of declining. Finally it stabilizes after 20 periods, and exhibits appreciation indication in the long run. If the financial openness increases to 0.6, the exchange rate of RMB declines at the beginning, which means RMB appreciates. This conclusion has a strong similarity with the history of China's current exchange rate changes: at the beginning of the reform and opening up in China, RMB exchange rate devaluates, with the rising.

(4)When international output shocks occur, with the increase of financial openness, the volatility of domestic interest rates increases. If the financial openness is 0.01, a unit of positive output shocks will raise the country's inflation to 0.004 in the short term and continues to rise in the long run. If the financial openness is 0.6, confronted with output shocks, domestic interest rate will swiftly converge to equilibrium. Although China's current interest rates are still subject to government control, the interest rate market shows a long-term trend, and the increase of financial openness influences the stability of interest rates to a certain extent.

In general, when international output shocks occur, that is, international entity economic shocks dominate, the improvement of financial openness would be of interest to China's output, inflation, the stability of exchange rates and interest rates. However, it is not suggested that China should continue expanding the degree of financial

openness. From the inflation point of view, when financial liberalization rise to a certain degree, domestic inflation will generates more violent fluctuations in the face of international output shocks, which has an extremely negative impact on China's economic development.

CONCLUSION

Faced up with international financial risks, which financial opening-up strategy should China take to minimize adverse impact? Besides, in addition to the financial liberalization strategy, is there any other economic measures which can assist China in coping with adverse effects of international financial risks? Suggestions are as follows:

(1)Adhere to discretionary financial opening-up strategy. In case that the world economic development is fine, that is, international output impact dominates, China should actively expand the opening up of financial markets to disperse domestic macroeconomic risks within global scales, and maintain steady and rapid growth of domestic economy; but if the world economic development is poor and there is a financial turmoil, that is, the international interest rate shock is dominant, China should strengthen the control of the international financial markets, especially the monitoring of hot money.

(2)Developing international financial markets. Market is the most important place to spread risks. A well-developed financial market can help resolve a variety of risks. Therefore it is an important long-term measure to vigorously develop China's international financial market to prevent and resolve adverse impact of international financial risk on China's financial market. Specifically, in the first place, to further promote the market-oriented reform of interest rates. Secondly, to vigorously develop the onshore financial market.

(3)Implementing the internationalization of RMB. As is known to us all, U.S. dollar occupies a very large proportion in the international price, international settlement and international reserves, once U.S. real economy or financial markets fluctuate, the risk will soon affect other countries through the exchange rates movement of U.S. dollar, and the international financial risks that economic impact of the United States brings to other countries are greater. Therefore, to promote the internationalization of RMB can largely reduce the adverse effects of Dollar Standard and also effectively prevent the conduction of the financial risks from the United States to China. China's monetary authorities must strive to promote the process of internationalization of RMB. Three important steps are as follows: the first step is to improve the proportion that RMB marks the price and settles in cross-border trades; the second step is to improve the proportion of RMB in overseas direct investment and settlement; the third step is to promote RMB to be the international reserve currency.

(4)Strengthening international cooperation in monetary policy. In the backdrop of financial globalization, effective control of international financial risk and international financial crisis has been already beyond the scope of a country's capacity. The complexity of international financial risks and the extensive subjects involved raise a claim for states to establish effective cooperation.

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