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The Impact of Openness of Trade and Terms of Trade Volatility on the Exchange Rate Regime Transition——Based on the Multi-state Markov Model

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Abstract

In this paper, we use the Multi-state Markov model to explore the impact of trade openness and terms of trade volatility on exchange rate regime transition through sample data from 93 countries between 1970 and 2010. In addition, we show the probability of exchange rate regime transition path. The empirical result shows that under the control of macro-politics and other economic conditions, the openness of trade and the terms of trade volatility have no significant effect on the transition of the exchange rate regime, that is, a higher degree of trade openness has not prompted the economy exit from a status to a fixed regime, and the terms of trade volatility did not turn the economy into a floating exchange rate system. And in the long run, we find the economy prefers an intermediate exchange rate regime not the "intermediate system disappearing theory".

Keywords

Exchange rate regime, Multi-state Markov Model, Openness of trade, Terms of trade volatility.

1. Introduction

Since the 1970s, the international financial crises happened frequently. It then has made the adjustment and conversion of the exchange rate regimes of related countries to intensify. Between 1970 and 2010, the transition of exchange rate regime occurred 251 times, and the average duration of each exchange rate system varies from 9 to 32 years. The phenomenon of the exchange rate system changing from one state to another has made the research of exchange rate regime from static to dynamic. Meanwhile, scholars pay close attention to the theory of exchange rate system transition.

The phenomenon of exchange rate regime has also caused scholars to think about the factors that promote the conversion of the exchange rate system. Observation the world data of exchange rate system transition found that the transition in emerging market countries' or regions' is more frequent than developed countries, and it tends to the manage floating exchange rate systems. The adjustment of the exchange rate system in developed countries or regions is relatively stable, and they prefer a free-floating system (the United States, Japan, etc.) or seek monetary integration (such as the EU region). At the same time, the world's economy is continuing open and the countries becoming more interdependence, the domestic economy is inevitably subject to external shocks, and the problems of economic stability and growth have become inevitable problems in various countries. Especially after the 1970s, countries' trade dependence has continued to increase and become the main part supporting for a national. Inevitably, the volatility of the world economic and financial markets has further increased, and the volatility among various economies has become more and more synchronized. The situation of coexistence in the trade openness actual economic shocks and exchange rate regimes transition have introduced scholars and policy makers to focus on the impact of trade openness and

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trading conditions fluctuations on exchange rate regime conversion, and There is a fierce debate about whether the impact of trade openness and terms of trade volatility are causing countries of different development to switch to different exchange rate regimes.

In this paper we based on the Multi-state Markov model and use the data of 93 countries from 1970 to 2010 as a sample to explore the impact of trade openness and the terms of trade volatility on the exchange rate regime transition. Further we want to explore which is the suitable regime for a country in an open world economy.

2. Literature Review

The exchange rate regime transition theory is a brand-new research field. It is developed on the basis of the exchange rate system selection theory. The exchange rate system selection theory shows that the choice of a country's exchange rate regime will be affected by its economic fundamentals and the national expectations. From the time series, the choice of exchange rate system is a dynamic process. As Frankel pointed out, no exchange rate system is suitable for all countries at all times. The factors related to the conversion of the exchange rate system can be divided into active conversion and passive conversion [1]. For example, Mckinnon and Pill ,Domac and Peria take the view from the banking crisis, moral crisis, and banking system vulnerability and policy or original sin theory to analyze the relationship between crisis and exchange rate regime transition[2,3]. Agenor and Masson and Fabrizio Carmignani demonstrated the motivation of the exchange rate regime transition from the perspective of political variables[4,5]. In general, there are common conclusions in the theoretical literature about the passive factors of exchange rate regime transition, but when based on the economic environment of a country, the research conclusions on the active transition of the exchange rate regime are quite different, especially in empirical research, and even have many opposite conclusions.

In an open market, the economy actively adjusts its exchange rate regime according to its own economic structural characteristics and development. For example, economists generally believe that countries with greater trade openness are more inclined to choose a fixed exchange rate regime, McKinnon believes that in an economy, the greater proportion of traded departments, or the higher degree of economic openness, it is more beneficial to choose a fixed exchange rate regime[6]. However, on the empirical side, there are diametrically opposite conclusions about the impact of trade openness on exchange rate regime transition. For example, Bosco analyzed the determinants of exchange rate system choices in developing countries by the orderly logit and multiple logit models, he found that when a country with a higher trade openness and a close to world inflation, then it is more likely to choose a fixed exchange rate system[7]. Javier and Carlos analyzed the time series data of the exchange rate regime in Chile from 1974 to 1993, found that the degree of openness was inversely related to the choice of flexible exchange rate regime[8]. When Poirson used the data of 93 developing countries from 1990 to 1998 as a sample, it was found that the influence of variables such as trade openness on the conversion of exchange rate system was not significant[9]. Adrian and Gros analyzed from the perspective of costs and benefits, found that the more open the economy, the more susceptible to external shocks, and the cost of maintaining a fixed exchange rate system will increase as the degree of openness increases[10]. Yao Bin analyzed the relationship between openness, exchange rate regime and welfare through mathematics, he pointed out that the higher the relative openness index of a country, the more inclined to floating exchange rate regime. Sanbao Zhang and Zhou Yu found that large countries with high trade openness tend to choose floating exchange rate systems, while small countries with high trade development tend to a fixed exchange rate regime, through the statistical analysis[11].

Facing the inconsistently conclusion of trade openness affects the exchange rate regime, this paper proposes hypothesis 1: Higher trade openness will prompt a country to turn to a fixed exchange rate.

At the same time, in a globalized market, fluctuations in terms of trade are the most important practical shocks of affecting exchange rate regime transition. When economies face actual shocks,

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Meade thought that actual shocks will lead to changes in the equilibrium real exchange rate [12]. For example, if the nominal exchange rate is fixed, the equilibrium of the real exchange rate will be adjusted by the domestic nominal prices and wages. In countries with a fixed exchange rate regime, wages are sticky, and real exchange rate balance adjustment is more difficult than under the floating exchange rate regime. Mundell and Boyer believe that when subjected to the actual shocks, economies can adjust their relative prices quickly and have smoother adjustments in output, therefore, floating exchange rate system can adjust the relative price immediately through the nominal exchange rate, it resists the adverse impact of fluctuations on output, so in the face of the actual impact of fluctuations in trade conditions, the economy prefers to choose a floating exchange rate system[13].

But in empirical research, positive and negative conclusions have emerged on the impact about the terms of trade volatility on the exchange rate regime transition. As estimated by Edwards and Yetati through the coefficients of the output growth rate equation, found that the impact of terms of trade volatility will be amplified under the fixed exchange rate regime[14]. Broda observed the data of 75 developing countries and found that when the terms of trade volatility was 10%, the real GDP of the economy fluctuated by 2% under a fixed exchange rate regime, and only fluctuated by 0.2% with floating exchange rate regime [15]. Wang Bo and Lanbiao Liu analyze the choice of exchange rate system by introduced the growth account ,they found that the floating exchange rate system performed better when facing actual shocks[16].

It is worth noting that Eichengreen and Haussman and Calvo proposed that the exchange rate adjustment becomes invalid, for it may amplify the negative effects by the terms of trade when the private and public sectors contain large amounts of foreign debt with denominated in foreign currencies[17,18]. Mishkin also pointed out that when the terms of trade volatility increase, excessive responses to exchange rate fluctuations may make the output change more unstable[19].

In light of the existing literature on the effects of terms of trade volatility on exchange rate regime transition, the second hypothesis is proposed: terms of trade volatility have an impact on the exchange rate regime conversion of a country, that is, when the economy faces a high level of terms of trade volatility, the risk rate of turn to a floating exchange rate system increases.

3. Multi-state Markov Model of Exchange Rate Regime Transition

In this paper, we applied the multi-state Markov model to the exchange rate regime transition, and selected the data of 93 countries from 1970 to 2010 as the sample for our analysis. Because the conversion of exchange rate regime between different types is only related to the current system and has nothing to do with the previously implemented system, the calculation of its risk rate meets the Cox-Markov model. The conversion risk rate expression is as follow:

$$q_{rs}\left(t,Z\left(t\right)\right)=q_{rs}^{0}\left(t\right)exp\left(\beta_{rs}Z\left(t\right)\right) \tag{1}$$

Where $q_{rs}\left(t,Z\left(t\right)\right)$ is the instantaneous risk rate of transition from state r to state s at time t, $q_{rs}^{0}\left(t\right)$ is the baseline risk rate, β_{rs} is the regression parameter of covariate $Z\left(t\right)$. Regarding the classification of the exchange rate regime, this paper adopts the de facto exchange rate system classification method which proposed by Ilzetzki et al. (2011; IRR for short), which divides the exchange rate regime into peg and crawling peg, managed floating and freely floating[20]. the path of exchange rate regime transition is shown in figure 1, and the arrow represents the transition direction of the exchange rate regime. Thus, an exchange rate regime transition risk matrix $Q\left(4\times4\right)$ is obtained. The expression is as follows. For ease of presentation, the number 1 is used to denote the peg exchange rate regime, 2 is the crawling peg, 3 is the management floating, and 4 is the freely floating exchange rate regime.

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$$Q = \begin{pmatrix} q_{11} & q_{12} & q_{13} & q_{14} \\ q_{21} & q_{22} & q_{23} & q_{24} \\ q_{31} & q_{32} & q_{33} & q_{34} \\ q_{41} & q_{42} & q_{43} & q_{44} \end{pmatrix}$$

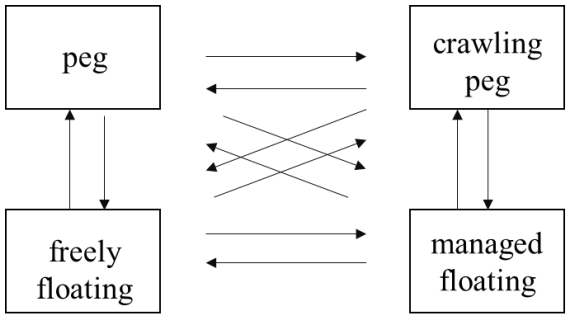

Figure 1. Exchange rate regime transition path

Therefore, the risk rate function of the impact of trade openness and terms of trade volatility on the exchange rate regime transition can be expressed as:

$$q_{irs}(t) = q_{rs}^{0} \, exp\left(\beta_{rs,1} CTS_{it} + \beta_{rs,2} VTOT_{it} + \gamma' Z_{it}\right) \tag{2}$$

Where $q_{irs}(t)$ represents the risk rate of a country's exchange rate regime changing from state r to state s at time t, and CTS_{it}, $VTOT_{it}$ represent the country's trade openness and terms of trade volatility at time t, respectively. In addition, the traditional trade dependence measured by the ratio of total import and export to GDP is affected by economic scale, market size and domestic, etc., it cannot fully express the changes in trade openness, so in this paper we adopted the Squalli and Wilson's (2011) new result-oriented measurement standard, and used the trade openness to replace the trade dependence, while the terms of trade volatility use the three-year moving average of terms of trade. $\beta_{rs,1}$, $\beta_{rs,2}$ are the corresponding parameters, Z_{it} represents the control variables, including inflation rates, foreign exchange reserve rates, GDP per capita, capital account opening degree, globalization index, financial development degree, economic scale and political factors, including whether it is left-wing, or it was elected in that year , the degree of democracy, and the number of years that the authorities have been in power.

However, due to the limitations of the Multi-state Markov model, too many variables will make the model complex and the log-likelihood function Heiser matrix non-positive definite, which will make the function unable to converge. Therefore, in order to simplify the model, reduce the control variables that affect the conversion of the exchange rate regime, thereby reduce the excessive parameters of the model, this paper divides the two major categories of economic structural factors and political factors that affect the exchange rate regime transition, and uses the principal component analysis method to combine the control variables into two comprehensive variables, and take their principal components as indicators of our economic structure and political factors. Similarly, due to the limitation of data dimension, the first principal component is taken as the control variable in this paper. Therefore, the expression of the conversion risk rate of trade openness and terms of trade volatility to the exchange rate regime transition is as follows:

$$q_{irs}(t) = q_{rs}^{0} \, exp\left(\beta_{rs,1} CTS_{it} + \beta_{rs,2} VTOT_{it} + \beta_{rs,3} economics_{it} + \beta_{rs,4} political_{it}\right) \tag{3}$$

4. Empirical Results Using Multi-state Markov Model

In order to test the two hypotheses proposed in this paper, a regression analysis of the conversion of trade openness and terms of trade volatility to the exchange rate regime is performed. The results are

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shown in Table 1, and the corresponding parameter in the table is $exp\left(\beta_{rs,j}\right)$, That is, the risk rate of the exchange rate regime transfer from regime r to s. It can be seen from the results that the impact of trade openness and terms of trade volatility on the exchange rate regime transition is not significant, that is, when the trade openness of a country or a region increases, it may not prompt the country to switch to a fixed exchange rate system. Also,when the volatility of a country's terms of trade increases, it is not the motive for the country to shift to a floating exchange rate system. Therefore, neither Hypothesis 1 nor Hypothesis 2 proposed in Chapter 2 is valid. In the results, we can also see that the factors that motivate the economy to actively convert its regime can be explored from other economic structures.

Table 1. Empirical results of the impact of trade openness and terms of trade volatility on the exchange rate regime transition risk rate

Q	*Baseline*	*CTS*	*VTOT*	*Economics*	*Political*
q_{11}	-0.031				
peg⟶peg					
q_{12}	0.018	1.115	1.666	0.954***	1.474***
peg→crawling peg		(0.119)	(0.216)	(25.581)	(12.222)
q_{13}	0.008	0.877	1.943	0.916***	0.503
peg→managed floating		(0.092)	(0.268)	(18.777)	(1.576)
q_{14}	0.005	0.853	0.931	0.990***	0.546
peg→freely floating		(0.177)	(0.041)	(22.225)	(0.883)
q_{21}	0.031	0.906	1.128	0.990***	0.999***
crawling peg→peg		(0.107)	(0.341)	(35.710)	(9.766)
q_{22}	-0.071				
crawling peg→crawling peg					
q_{23}	0.039	1.202	0.869	1.004***	1.063***
crawling peg→managed floating		(0.153)	(0.275)	(33.713)	(195.544)
q_{24}	0.001	1.167	1.131	1.248***	0.565
crawling peg→freely floating		(0.088)	(0.035)	(11.728)	(0.801)
q_{31}	0.001	1.106	0.732	0.872***	1.082***
managed floating →peg		(0.040)	(0.146)	(11.080)	(7.669)
q_{32}	0.019	1.018	5.583***	0.950***	0.911***
managed floating →crawling peg		(0.137)	(2.659)	(29.751)	(7.500)
q_{33}	-0.039				
managed floating →managed floating					
q_{34}	0.019	1.087	0.932	0.981***	1.101***
managed floating→freely floating		(0.173)	(0.256)	(34.881)	(6.698)

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q_{41}	0.005	0.792	0.974	0.994***	0.694
freely floating →peg		(0.056)	(0.041)	(41.709)	(0.656)
q_{42}	0.034	0.639	1.543	0.999***	0.556
freely floating →crawling peg		(0.035)	(0.128)	(45.997)	(1.171)
q_{43}	0.069	1.151	0.578	1.001***	1.457***
freely floating →managed floating		(0.136)	(0.064)	(56.084)	(6.003)
q_{44}	-0.108				
freely floating →freely floating					
-2 * Log Likelihood:	636.9093				

Note: The value in brackets is the corresponding variable parameter t value, *, **, *** indicate significant at the level of 10%, 5%, 1% respectively

5. Conclusion

This article takes the background of the frequent transitions of exchange rate regime in various countries as the entry point since the 1970s, and on the basis of combing the literature on exchange rate regime conversion, we put forward the assumption that trade openness and terms of trade volatility urge economies to convert exchange rate regimes, use the Multi-state Markov model to empirically test the hypothesis and explore the path of the exchange rate system conversion. We get the main conclusions as follows:

First, the impact of trade openness and terms of trade volatility on the exchange rate regime transition is not obvious. That is, a higher degree of openness to trade may not prompt a country or region to withdraw from the current exchange rate system and turn to a pegged exchange rate regime; also a higher fluctuations in terms of trade are not the reason for the economy to change to a floating exchange rate system.

Second, in the long run, the path of exchange rate system conversion is the intermediate state of the exchange rate system. This result strongly opposed the "space disappearance theory", that is, in the long run, the intermediate exchange rate system will not only disappear, but on the contrary, it will occupy a large proportion.

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