A Study on Asymmetric Preference in Foreign Exchange Market Intervention in Emerging Asia

Yanzhen Wang [1,a], Xiumin Li [1], Yutan Li [1], Mingming Liu [1]

[1]School of Economics, Northeast Normal University, Changchun, Jilin, China

[a]suifeng19890903@126.com

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Abstract: Using asymmetric loss function, this paper estimates asymmetric preference in central bank foreign exchange market intervention in seven emerging Asian economies between January 1999 and December 2014 and its three sub-sample periods. The estimation results indicate that all the seven countries have "fear of appreciation" asymmetric intervention preference in the entire sample period. While, in three sub-sample periods, Philippines has "fear of depreciation" asymmetric intervention preference in the first sub-sample period, but it has "fear of appreciation" asymmetric intervention preference in the later two sub-sample periods and so do all the other six countries in all sub-sample periods. Besides, the estimation results also reveal that there is big difference in degree and evolution trend of asymmetric intervention in different countries and each country has different degree of asymmetric intervention against nominal exchange rate and nominal effective exchange rate.

Introduction

After the Asian financial crisis of 1997-1998, the amount of foreign exchange reserves in some emerging Asian economies are increasingly high. However, scholars gradually recognize that no matter which model of reserve adequacy is used, these economies hold more than enough reserves as a financial safeguard, (Bird and Rajan, 2003; Aizenman and Marion, 2003) [1][2]. Based on this, some scholars have inferred that emerging Asian economies conduct asymmetric intervention in foreign exchange market, which means that these countries prevent domestic currencies appreciation by purchasing foreign exchange reserves continuously. This kind of exchange rate policy was initially described by Levy-Yeyati and Sturzenegger (2007) as "fear of appreciation"[5].

Since the concept "fear of appreciation" was put forward, a great deal of research has empirically tested asymmetric preference in foreign exchange market intervention of emerging Asian economies. Ramachandran and Srinivasan (2007) proved that India's central bank conducted strong asymmetric intervention against rupee appreciation in foreign exchange market using dummy variable method. After this research[10], Srinivasan et al. (2008) examined foreign exchange market intervention of India's central bank using central bank asymmetric loss function, which further confirmed that India's central bank had "fear of appreciation" asymmetric intervention preference. Thereafter, using this method, scholars tested asymmetric preference in foreign exchange market intervention in more emerging Asian economies, mainly including India, South Korea, Philippines, Singapore, Thailand, Indonesia and Taiwan China (Srinivasan et al., 2008[11]; Pontines and Rajan, 2011[6]; Rajan, 2010[8], 2011[9]; Cavoli et al., 2008[3]). Results of all above research showed that sample countries conducted asymmetric foreign exchange market intervention against domestic currencies appreciation. Most current research used central bank asymmetric loss function, but there were also some scholars studied this problem in other ways. Stigler et al. (2009) used momentum threshold autoregressive model (MTAR) to study structural change of exchange rate regime and evolution of asymmetric behavior in central bank foreign exchange market intervention in India[12]. Pontines and Siregar (2012) used smooth transition auto-regression (STAR) model and Markov-regime switching method to study central bank asymmetric foreign exchange market

intervention in Indonesia, Philippines, South Korea and Thailand[7]. Although these studies used different methods, the conclusion had not been changed.

Chinese scholars have conducted a great deal of research on this issue, but most of them focused on whether China's central bank conducts asymmetric intervention against RMB appreciation. Du et al. (2010) confirmed that China's central bank conducted one-direction asymmetric intervention to prevent RMB appreciation through dummy variables method[4]. Adopting exponential linear asymmetric loss function method, Wang and Li (2014) proved that central bank of China conducted muted asymmetric intervention in foreign exchange market against RMB appreciation, which was defined defensive orientation of exchange rate policy[13].

In conclusion, empirical research on asymmetric preference in central bank foreign exchange market intervention starts from the end of Asian financial crisis. Most related research regards emerging Asian economies as objects and most of the research adopts asymmetric loss function method. This paper also adopts this method to test asymmetric intervention in foreign exchange market in seven emerging Asian economies. The difference with existing research is as follows. Apart from testing asymmetric intervention preference in foreign exchange market in each country from January 1999 to December 2014, this paper divides the entire sample period into three sub-sample periods according to the demarcation points of the reform of RMB exchange rate regime in July 2005 and the outbreak of the global financial crisis with the symbol of Lehman Brothers bankruptcy in September 2008, then tests asymmetric preference in each sub-sample period and reveals its evolution process and reasons.

The remaining part of this paper is organized as follows. On the basis of central bank asymmetric loss function, section 2 derives central bank foreign exchange market intervention reaction function, which is also the estimating equation of this paper. Section 3 estimates central bank foreign exchange market intervention reaction equation of the seven emerging Asian economies for the data January 1999 to December 2014 and its three sub-sample periods and analyses the empirical results. Section 4 concludes the paper.

Central bank foreign exchange market intervention reaction function

This paper follows Pontines and Rajan (2011) in specifying central bank foreign exchange market intervention target and asymmetric loss function. Supposing the central bank can directly control the scale of the foreign exchange market intervention, its target is to select an appropriate intervention scale to minimize its losses:

$$\min_{(I_t)} E_{t-1} \sum_{\tau=0}^{\infty} \delta^{\tau} L_{t+\tau} \tag{1}$$

Where, δ is discount factor and L_t is the loss function in period t.

$$L_t = \frac{1}{2}(I_t - I^*)^2 + \frac{\lambda}{2}\left\{(\tilde{e}_t - e^*)^2 + \frac{\gamma}{3}(\tilde{e}_t - e^*)^3\right\} \tag{2}$$

Where, $\lambda > 0$ is the relative weight and γ is the asymmetric preference parameter. $\tilde{e}_t$ denotes the percent change in the exchange rate e_t, and e_t is domestic currency nominal exchange rate against the USD (domestic currency price of one unit of USD) and RMB nominal effective exchange rate, respectively. e^* is the central bank's target value of percent change in the exchange rate, which is always assumed to be 0. I_t is the scale of central bank foreign exchange market intervention and I^* is optimal scale intervention, which is always assumed to be constant.

If $\gamma = 0$, loss function listed above collapses to the traditional symmetrical loss function. If $\gamma \neq 0$, deviation of the same size but opposite sign of $\tilde{e}_t$ from e^* will generate different losses. Specifically, if $\gamma > 0$, $\tilde{e}_t - e^* > 0$ (depreciation of domestic currencies' nominal exchange rate against the USD or appreciation of domestic currencies' nominal effective exchange rate) will yield greater losses. On the contrary, if $\gamma < 0$, $\tilde{e}_t - e^* < 0$ (appreciation of domestic currencies' nominal exchange rate against the USD or depreciation of domestic currencies' nominal effective exchange rate) will yield greater losses.

It is assumed that intervention can reduce the rate of change in the exchange rate:

$$\tilde{e}_t - e^* = a_0 + a_1 I_t + \varepsilon_t \quad (3)$$

Where, a_0 and a_1 are parameters, ε_t is the error term with zero mean and variance σ_ε^2. Minimizing Equation (1) by choosing I_t subject to the constraint (3) leads to the following intervention reaction function:

$$I_t = I^* - \lambda a_1 E_{t-1}\left\{\tilde{e}_t + \frac{\gamma}{2}(\tilde{e}_t)^2\right\} \quad (4)$$

Replacing the expected values with the actual values, the empirical version of the central bank foreign exchange market intervention reaction function can be simplified as follows:

$$I_t = c + \alpha\tilde{e}_t + \beta(\tilde{e}_t)^2 + v_t \quad (5)$$

Parameters in Equation (5) are defined as follows: $\alpha = -\lambda a_1$, $\beta = (-\lambda a_1 \gamma)/2$, and the asymmetric preference parameter is $\gamma = 2\beta/\alpha$. If γ is significantly different from 0, it can be concluded that the central bank has asymmetric intervention preference. Particularly, $\gamma > 0$ denotes that the central bank has "fear of depreciation" tendency for domestic currencies' nominal exchange rate or "fear of appreciation" tendency for domestic currencies' nominal effective exchange rate. While, $\gamma < 0$ denotes that central bank has "fear of appreciation" tendency for domestic currencies' nominal exchange rate or "fear of depreciation" tendency for domestic currencies' nominal effective exchange rate. Apart from that, the larger the absolute value of γ, the stronger asymmetric preference in central bank foreign exchange market intervention.

Because data of foreign exchange market intervention in most countries is unavailable. Similar to existing research, this paper substitutes the scale of foreign exchange market intervention with percent change in foreign exchange reserves. Variables in Equation (5) are adopted in the logarithmic differential form. $I_t = (\Delta\log(\text{Reserves}_t)) * 100$ with Reserves_t denotes foreign exchange reserves. And $\tilde{e}_t = (\Delta\log(e_t)) * 100$ with e_t denotes domestic currencies' nominal exchange rate NER or domestic currencies' nominal effective exchange rate NEER. Besides, the US federal funds rate is also used in this paper.

Empirical testing and results analysis

This paper studies asymmetric preference in the central bank foreign exchange market intervention using the monthly data from January 1999 to December 2014. Since China, Indonesia and some other countries conducted exchange rate regime reform in July 2005, and the global financial crisis broke out in 2008. According to the demarcation points of the reform of RMB exchange rate regime in July 2005[1] and the outbreak of the global financial crisis with the symbol of Lehman Brothers bankruptcy in September 2008, this paper divides the entire sample period into three sub-sample periods and tests asymmetric preference in each sub-sample period: January 1999 to June 2005, July 2005 to August 2008 and September 2008 to December 2014. The data is sourced from the IMF's International Financial Statistics (IFS) except for the NEER which is sourced from the Bank for International Settlements (BIS).

To solve heteroscedasticity and serial correlation of the random error term in this model, similar to existing studies, this paper adopts Generalized Moment Method (GMM) to estimate equation (5). Instrumental variables in this paper are adjusted on the basis of a constant, lagged values (1 to 15 months) of R_t, $\tilde{e}_t$ and $(\tilde{e}_t)^2$, as well as current and lagged values (1 to 15 months) of r_t.

Table 1 reports the estimation results of the central bank foreign exchange market intervention reaction equation and asymmetric preference parameters for seven emerging Asian economies in the entire sample period and three sub-sample periods. For each period we present two sets of results—the upper results using the nominal exchange rate against the USD (NER) and the lower results using the nominal effective exchange rate (NEER). The J test indicates that the hypothesis of valid over-identifying restrictions is never rejected, which means the instrumental variables specified in this paper are all valid.

[1] Henning (2012) pointed out that large emerging Asian economies follow the trend of RMB exchange rate after the reform of China's exchange rate regime, so this paper selects July 2005 as a demarcation point for all sample countries in this paper.

Table 1. Asymmetric preference parameters for the entire sample period

Country	1999.1-2014.12	1999.1-2005.6	2005.7-2008.8	2008.9-2014.12
China				
NER	-3.183	-1103.336***	-0.464	-0.309
NEER	0.464**	0.655***	0.461*	0.328**
India				
NER	-0.234**	-0.236**	-0.196***	-0.119**
NEER	0.690*	1.643**	1.120***	0.294***
Indonesia				
NER	-0.272*	-0.098**	-0.294**	-0.333***
NEER	0.389*	0.152**	0.727*	0.816***
Korea				
NER	-0.350*	-0.468***	-0.299***	-0.336***
NEER	0.316*	0.341***	0.289***	0.324
Philippines				
NER	-0.443***	0.363***	-0.595**	-0.650***
NEER	0.282*	-0.261***	0.281***	0.300**
Singapore				
NER	-0.395*	-0.479***	-0.314***	-0.349*
NEER	0.468*	0.519**	0.455***	0.395
Thailand				
NER	-0.359*	-0.440***	-0.286***	-0.349***
NEER	0.815*	1.273***	0.735**	0.673*

Notes: (1) Newey-West method is adopted to estimate the covariance matrix, so as to control heteroscedasticity and serial correlation in error terms. (2) Hansen's J-test is a Hansen's over identifying restrictions, which is distributed as a $\chi^2(L-K)$ under the null hypothesis of valid over-identifying restrictions, in which L and K are the number of instrumental variables and parameters to be estimated, respectively. (3) The standard deviation of parameter γ is calculated using the Delta method.

As can be seen from estimation results for the entire sample period, asymmetric preference parameters γ for all the seven countries are negative when nominal exchange rate against the USD is used, while they are positive when nominal effective exchange rate is used, which implies that the central banks in these countries react more strongly to appreciation than depreciation pressures. Specifically, the absolute value of asymmetric preference parameters of nominal exchange rate of these countries range from 0.234 to 3.183, and asymmetric intervention degree from small to large order is India, Indonesia, South Korea, Thailand, Singapore, the Philippines and China. The absolute value of China's asymmetric preference parameter of nominal exchange rate is way greater than the other six countries, but fails to pass the significance test. Except China, asymmetric preference parameters of all other countries are significant. The asymmetric preference parameters of nominal effective exchange rate of these countries range from 0.282 to 0.815, and asymmetric intervention degree from small to large order is Philippines, South Korea, Indonesia, China, Singapore, India and Thailand, and all countries are significant.

From above analysis, the results of some countries are not significant, which affect the comparison of asymmetric preference in foreign exchange market intervention among these countries. In addition, results above cannot present evolution of asymmetric preference of central bank foreign exchange market intervention. Thus, this paper will further analyze asymmetric preference of central bank foreign exchange market intervention in three sub-sample periods.

From January 1999 to June 2005, except that Philippines has significant "fear of depreciation" inclination against both the nominal exchange rate and nominal effective exchange rate, all the other six countries have significant "fear of appreciation" inclination. Among them, China's asymmetric preference parameters of RMB nominal exchange rate is -1103.336, the absolute value of which is much higher than the other five countries (range from -0.1 to -0.48). The fact that China's asymmetric preference parameter of nominal exchange rate is so high during this period

coincides with its pegging to the dollar exchange rate regime.

From July 2005 to August 2008 and from September 2008 to December 2014, central Banks in all countries have "fear of appreciation" asymmetric foreign exchange market intervention inclination. But during these two sub-sample periods, asymmetric preference parameters of China's RMB nominal exchange rate against the dollar fail to pass the significance test. In addition, in the last sub-sample period, asymmetric preference parameters of nominal effective exchange rate in South Korea and Singapore fail to pass the significance test.

Observing the evolution of asymmetric preference of central bank foreign exchange market intervention in these countries, no matter against nominal exchange rate or nominal effective exchange rate, the degree of asymmetric intervention in China and India is gradually reduced, while Indonesia is in the contrary, and Korea falls before rise. The asymmetric intervention preference of Philippines' nominal exchange rate and the nominal effective exchange rate convert from "fear of depreciation" inclination in first sub-sample period to "fear of appreciation" inclination in last two sub-sample periods and the degree of "fear of appreciation" rises gradually. The degree of asymmetric intervention of Singapore and Thailand against nominal exchange rate appreciation falls before rise, while the degree of asymmetric intervention against nominal effective exchange rate decreases gradually.

As can be seen from the degree of asymmetric intervention against nominal exchange rate and nominal effective exchange rate in each country, India, Indonesia, Singapore and Thailand's degree of asymmetric intervention is stronger against nominal effective exchange rate than nominal exchange rate, which indicates that these four countries are more inclined to intervene asymmetrically against nominal effective exchange rate appreciation in comparison with the nominal exchange rate. In contrast, Korea is more inclined to intervene asymmetrically against nominal exchange rate. Although Philippines present significant "fear of depreciation" asymmetric intervention inclination in the first sub-sample period, generally, no matter its domestic currency appreciates or depreciates, it concerns more about its nominal exchange rate change against the USD rather than its nominal effective exchange rate. Before the reform of exchange rate regime in July 2005, since China implements the peg to the dollar exchange rate regime, China's asymmetric intervention against nominal exchange rate appreciation is far higher than that against nominal effective exchange rate. But after the reform of exchange rate regime, the RMB exchange rate no longer pegs to the dollar, but refers to a basket of currencies. Thus, compared with the RMB nominal exchange rate against the dollar, the central bank is more inclined to intervene asymmetrically against RMB nominal effective exchange rate appreciation.

Conclusion

Following the model and method of Pontines and Rajan (2011), this paper estimates asymmetric preference of central bank foreign exchange market intervention in seven emerging Asian economies for the period between January 1994 and December 2014 and its three sub-sample periods. All of the seven countries have "fear of appreciation" asymmetric intervention preference during the whole sample. Except that Philippines have significant "fear of depreciation" asymmetric intervention preference in the first sub-sample period, it has "fear of appreciation" asymmetric intervention preference in the later two sub-sample periods and so do all the other six countries in all sub-sample periods. These estimation results are similar to many scholars, which supports the conclusion that many emerging Asian economies conduct asymmetric intervention in foreign exchange market against appreciation of their domestic currencies.

Although all countries conduct "fear of appreciation" asymmetric intervention in foreign exchange market (except the Philippines's exchange rate policy in the first sub-sample period), the degree of asymmetric intervention in different countries varies. All in all, in order of ascending asymmetric intervention degree, the asymmetric preference parameters of nominal exchange rate of these countries are India, Indonesia, South Korea, Thailand, Singapore, the Philippines and China. While in order of ascending asymmetric intervention degree, the asymmetric preference parameters

of nominal effective exchange rate of these countries are Philippines, South Korea, Indonesia, China, Singapore, India and Thailand.

Besides that, the estimation results also reveal that the evolution trend of asymmetric preference of foreign exchange market intervention varies in different countries. The degree of "fear of appreciation" asymmetric intervention in China and India reduces gradually, and Indonesia is just the opposite, while the asymmetric intervention in Korea rises before fall. Philippines converts from "fear of depreciation" asymmetric intervention preference to "fear of appreciation" asymmetric intervention preference after the reform of exchange rate regime, and the degree of "fear of appreciation" increases gradually. The degree of asymmetric intervention in Singapore and Thailand increases before decreases against nominal exchange rate, while the degree of asymmetric intervention decreases gradually against nominal effective exchange rate.

Each country has different degree of asymmetric intervention against nominal exchange rate and nominal effective exchange rate. The degree of asymmetric intervention in India, Indonesia, Singapore and Thailand is stronger against nominal effective exchange rate than nominal exchange rate, while Korea and Philippines are just the opposite. The degree of asymmetric intervention in China is stronger against nominal exchange rate than nominal effective exchange rate before the reform of exchange rate regime, but this situation is reversed after the reform of RMB exchange rate regime in July 2005.

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