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Capital Control, Financial Depth and the Demand of Foreign Reserves: Evidence on 1994-2013 Data in China

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Abstract

We combined foreign reserves, capital control and financial depth with other economic variables in the same model and discussed the factors that affect the demand of China's foreign reserves. The results showed that 1) a considerable number of foreign reserves are passively accumulated, for instance, stronger capital controls deeper financial system will lower the demand of foreign reserves; 2) the ratio of Hot Money/GDP is more significant than the FDI/GDP as a proxy of foreign reserves' protective demand.

Keywords

Foreign Reserves, Capital Controls, Financial Depth

1. Introduction

At the end of 2013, China held a huge stock of international reserves at the amount of US$ 3821.3 billion foreign exchange reserves, which is far more enough to prevent financial risks. Most research about China's foreign exchange reserves are basically admitted that international capital could flow in and out of China with few restrictions. However, the capital controls are not under consideration, which probably cause miscalculation on the optimal quantity and the opportunity cost of foreign exchange reserves. Therefore, this paper will show significance theoretically and practically by integrating capital controls and other variables to re-estimate the foreign exchange reverses demand model.

2. Literature Review

The earlier empirical studies measured the demand of foreign exchange reserves through various ratios, such as reserves to import [1]; or the cost and return of reserves [2]. Frenkel (1980) [3] suggested that the model of monetary demand should be established to define the optimal foreign exchange reserves. There are also some recent researches that resubmit the motive of Mercantilism [4] and precaution [5].

Several Chinese studies investigated the China's demand of foreign exchange reserves on various periods and their conclusions are as follows: (1) believing that the demand had already exceeded the optimal quantity or

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zone [6] [7]; (2) that the quantity was still in the optimal zone [8]; (3) that China had insufficient quantity of foreign exchange reserves [9]. And there are some different points of this issue made by other researchers.

In spite of these fruitful studies, international and domestic, there are still some obvious shortcomings: (1) most studies presumed that the international capital can flow in and out of China freely, without consideration of the existence of capital controls, which, when works efficiently, can on some level could maintain the economy steadily and consequently reduce the actual demand of foreign exchange reserves. (2) During the period, substantially speculative capital, as known as Hot Money, flew in China and away after making a huge profit from the appreciation of RenMinBi, which will cause the economic turmoil. So the effect of Hot money should also be considered in the model of foreign exchange reserves.

3. Reserve Demand Function

Most researches divided the demand of foreign exchange reserves into three levels: transactional requirement (R_1), precautionary requirement (R_2) and speculative requirement (R_3). However, apart from these requirements, the effect of capital controls and hot money should also be under consideration. Therefore, we establish this model as follows:

$$RES = R_1 + R_2 + R_3 + \sum P \tag{1}$$

Firstly, to cover the transactional requirement, we use the proxy of average propensity to import (API). The more the average propensity to import is, the bigger the effect suffered from outer shocks, therefore the more reserve holdings will be needed. As the proxy of economic opening, the coefficient of API should be positive.

Secondly, with the prosperity of Chinese economy, numerous international capitals enter into China by all kinds of investment; some of these are speculative capitals, also as known as Hot Money, which could cause turmoil by sudden flew. Thus the sufficient reserve holdings should be kept for precautionary demand. Some studies calculated Hot Money by Balance of Payment (BOP), that Hot Money equals to the newly added foreign exchange reserves minus FDI and Trade Balance [10], yet this measurement not only ignored the effect caused by the change of exchange rate and returns of foreign exchange reserves, but also presumed that no Hot Money in FDI. This paper will use a new approach which can avoid those problems above. We estimate that Hot Money should equal to the Newly Added Funds outstanding for foreign exchange minus the actual utilization of foreign capital and trade balance. Hot Money/GDP should have a positive relation with foreign exchange reserve holding for precautionary reason. We also use FDI/GDP as an alternative variable. Because the large amount of FDI returns come back to the mother countries will reduce foreign exchange reserves.

Thirdly, many recent studies have blamed the short-term external debt (STED) as one of the reasons for financial crises (see [11] [12]). More importantly, the STED is considered to be an important indicator to measure the foreign exchange reserves by the People's Bank of India (PBC). At the end of 2013, the accumulative STED reached to more than $640 billion, as many as 7% of GDP or 70% of total external debt. A large of reserves will be used to pay back. Therefore, we include the relative size of STED (ratio of STED/GDP) in the reserve demand function.

Fourthly, most papers on reserves demand are presumed the free floating system (see [13]-[16]). However, China has restrictions about international capitals; therefore some proper variables should be adopted for describing this kind of effect, such as the differential between international and domestic interest rate (ΔR) and the expected volatility of RMB exchange rate (EXVOL). Wang & He (2007) [17] proved that there are long-term relations among short-term capital inflow and, EXVOL. Bai & Wang (2008) [18] also use the differential of interest rate to discuss the efficiency of capital controls under the framework of Interest Rate Parity Theory. The more effective the capital controls, the less influential the financial turmoil caused by capital inflow and outflow, which will decrease the demand of reserve holding. Therefore, the coefficient of and EXVOL should be negative.

Fifthly, we also use a new variable to keep the financial depth into consideration. When comes to financial depth and development, M2/GDP is commonly used by literatures, e.g. [19]-[21], etc. But simply using that proxy cannot reflect the degree of China's financial depth correctly, as Edwards (1996) [22] pointed out that "under an immature market with restrictions on borrowing and lending money, there is always a negative trend between them (financial depth and M2/GDP)". Thus we will use another variable to represent the financial depth of China, Funds outstanding for Foreign exchange (FOFX)/GDP. On the one hand, over this period, 20% to 60%

of monetary supply was contributed by FOFX, which shows some passiveness on monetary policy and imperfection of financial development; on the other hand, the variation of this ratio also reflected whether the central bank has enough financial instruments and assets to neutralize the excess FOFX. Compared with M2/GDP, FOFX/GDP will be more appropriate as a proxy of China's financial depth. The bigger the ratio, the more superficial the financial depth, and will need more reserves. Thus, the coefficient should be positive.

Sixthly, to satisfy the speculative demand of foreign exchange reserves, there will be opportunity cost (OC) for this session of reserve holding. Therefore we can use OC to measure the speculative demand of reserves, namely the differentials between 3-month Treasury Bill Rate and China's 3-month Redemption Rate. And a negative relation between OC and reserve holding demand are expected.

Then we establish the model as follows,

$$RES = \gamma_0 + \gamma_1 OC_{t-1} + \gamma_2 HM_{t-1} + \gamma_3 EXVOL_t + \gamma_4 FOFX_{t-1} + \gamma_5 \Delta R_{t-2} + \gamma_6 STED_{t-1} + \gamma_7 API_{t-2} + \gamma_8 FDI_t + \varepsilon_t \quad (2)$$

which RES means the ratio between the newly added reserves and GDP, OC is the differentials between 3-month Treasury Bill Rate and China's 3-month Redemption Rate, HM is Hot Money/GDP, EXVOL is the expected volatility of RMB exchange rate, FOFX is the ratio of FOFX and GDP, is the differential between benchmark interest rate of China' monetary market and US$ LIBOR, STED is STED/GDP, API is the amount of import/GDP, FDI is FDI/GDP. We will use logarithm value on, EXVOL, STED and FDI.

4. Empirical Results

The data used in this study are quarterly observations and the sample period spans from 1997: 01 to 2013: 04 base on the data's availability. All data are openly published by People's Bank of China, Ministry of Commerce of PRC, General Administration of Customs, National Bureau of Statistics, State Administration of Foreign Exchange and Federal Reserve Bank of ST. Louis, USA.

We consider two traditional unit root tests, which are augmented Dickey-Fuller test (ADF) and Phillips-Perron test (PP), to confirm the stationary of variables. The result of unit root tests is presented in **Table 1**. All variables included in the model are found to be integrated of order one, *i.e.* I(1).

Given that variables are non-stationary, it is not justified to estimate the reserve demand function using OLSs because the results might be spurious. Therefore, we apply the cointegration test developed by Johansen (1988) [23] to investigate the presence of long-run relation among variables. The results of Johansen cointegration (**Table 2**) show that the null hypothesis of no cointegration is strongly rejected in favor of one cointegrating relation with plausible (normalized) coefficients. This implies that all variables share a common stochastic trend and do move together in the long-run.

Based on the estimated normalized cointegrating vector, the long-run relationship between foreign exchange reserves and its determinants is expressed below **Table 3**.

The results of regression showed that: 1) despite the conventional model or the new model, with introduction of the factors of capital controls and financial depth, the R-squared, Adjusted R-squared and F-statistic are significantly improved, which means the explanation of the model is better; 2) the coefficient of HM/GDP is more significant than that of FDI/GDP and the new model is superior to the conventional one, which mean that

Table 1. Results of unit root test.

At level	RES	OC	HM	EXVOL	FOFX	Δ R	STED	API	FDI
ADF	−0.36*	−2.45	−0.25	−3.3	0.42	−1.63	−1.91	−3.55*	−1.31
PP	−4.47	−2.52	−1.29	−2.54	−0.67	−1.62	−1.91	−3.55*	−2.88
At 1st difference	dRES	dOC	dHM	dEXVOL	dFOFX	d Δ R	dSTED	dAPI	dFDI
ADF	−11.74***	−2.84***	−5.63***	−4.32***	−4.56***	−3.47***	−4.08***	−7.08***	−4.70***
PP	−10.38***	−2.85***	−5.24***	−4.33***	−3.93***	−3.39***	−4.11***	−6.36***	−2.82***

Note: (1) Optimal lags for ADF is determined based on AIC and for PP test it is Newey-West bandwidth selection using Bartlett kernel. (2) Probability values for ADF and PP test is as per MacKinnon one-sided p-values. *Indicates significant at 10% critical level. **Indicates significant at 5% critical level. ***Indicates significant at 1% critical level.

Table 2. Results of Johansen cointegration test: reserve demand function.

Trace Test			Max-eigenvalue test		
Rank	Eigenvalue	Trace-Stat.	Rank	Eigenvalue	Max-stat.
None	0.896039	182.8032**	None	0.896039	87.6838**
At most 1	0.738574	105.3975**	At most 1	0.738574	65.5478**
At most 2	0.547406	62.7138	At most 2	0.547406	49.13162
At most 3	0.424308	51.1889	At most 3	0.424308	37.32434
At most 4	0.375070	40.64101	At most 4	0.375070	23.50677
At most 5	0.281482	37.13424	At most 5	0.281482	19.36261
At most 6	0.220867	29.96095	At most 6	0.220867	10.14829

Note: (1) VAR specification: optimal lag length selected using AIC, (2) deterministic trend assumptions of the cointegration test: intercept and trend in cointegrating relationship and no trend in VAR.* Indicates significant at 10% critical value.** Indicates significant at 5% critical value.

Table 3. The comparison of results.

	Conventional model	Conventional model with cc, fd	New model	New model with cc, fd
Hot Money/GDP (HM)			0.177***	0.046***
			(0.039)	(0.012)
			[4.575]	[3.757]
FDI/GDP	0.007	0.012		
	(0.046)	(0.017)		
	[0.146]	[0.7]		
Opportunity Cost (OC)	−0.864**	−0.734***	−0.513*	−0.724***
	(0.288)	(0.157)	(0.244)	(0.076)
	[−2.997]	[−4.672]	[−2.102]	[−9.503]
Short-Term Debt Ratio (STED)	0.044***	0.02**	0.027*	0.009*
	(0.012)	(0.007)	(0.014)	(0.004)
	[3.669]	[2.844]	[1.913]	[2.119]
Average Propensity to Import (API)	1.142	0.02	1.422**	0.595**
	(0.739)	(0.396)	(0.502)	(0.19)
	[1.546]	[0.151]	[2.831]	[3.136]
Funds Outstanding for Foreign Exchange (FOFX)		0.075**		0.747***
		(0.026)		(0.077)
		[2.848]		[9.658]
the Expected Volatility of RMB Exchange Rate (EXVOL)		0.007**		−0.006***
		(0.002)		(0.001)
		[3.207]		[−6.664]
the Differential of Interest Rate (ΔR)		0.01***		−0.008***
		(0.002)		(0.001)
		[5.608]		[−5.725]
R-squared	0.787	0.977	0.864	0.99
Adjusted R-squared	0.654	0.95	0.804	0.978
Prob (F-statistic)	0.014	0.000	0.003	0.000

Note: cc and fd represent the factors of capital controls and financial depth separately; The figures in () are standard deviation and those in [] are t-statistics; * Indicates significant at 10% critical level. ** Indicates significant at 5% critical level. *** Indicates significant at 1% critical level.

HM/GDP is more proper variable as an indicator for the productive demand of foreign reserves, 3) with the consideration of capital control and financial depth, the coefficients of demand in transaction, protection and speculation are, though still significantly, all witnessed huge drops by 60%, 70% and 40%, separately. They illustrated that huge amount of foreign reserves are not only accumulated actively, but passively, because of the immature of financial system, especially the foreign exchange management. 4) and we found that the strict capital controls also cause passively accumulation of foreign reserves.

So the model of demand of foreign reserves is displayed as follows:

$$\begin{aligned} RES = {} & 0.06 - 0.72\mathrm{OC}_t + 0.05HM_t - 0.006EXVOL_t + 0.75FOFX_t \\ & - 0.008\Delta R_t + 0.01STED_t + 0.6API_t + \varepsilon_t \\ & (3.298***)\ (-9.50***)\ (3.757***) \\ & (-6.664***)\ (9.656***) \\ & (-5.725***)\ (2.119**)\ (3.136***) \end{aligned} \tag{3}$$

The results of the reserve demand function show that hot money, funds outstanding for foreign exchange, short-term external debt and average propensity to import are statistically significant and have positive impacts on the demand of foreign exchange reserves; yet the measure of the opportunity cost, exchange rate volatility and differentials between international and domestic interest rate is found to be negative and significant, which all agrees with a priori reasoning. All the estimated parameters, except foreign direct investment, are significant at the 5% level and signs of all the coefficients are consistent with the theoretical explanations. Further, our results also show that foreign direct investment is not an important determinant of reserve demand in China.

5. Conclusions

Firstly, this paper considered the issue of conventional measurement and 'internal drain' and used the yearly data from 2002 to 2013 to calculate China's adequate and excess foreign reserves, found that China held a lot of excess reserves and undertake considerable opportunity cost.

Secondly, we took capital controls and financial depth into consideration and renew the conventional model of foreign reserves demand, which caused the passive accumulation on foreign reserves demand.

Thirdly, compared to FDI/GDP, in the new model we noticed that HM/GDP is more significant and lead to a better outcome. In order to avoid the volatility caused by short-term speculative capital, HM/GDP is a more specific index to the protective demand of foreign reserves.

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