Journal of Economic Policy Reform

Neutralization in China: evidence from the balance sheet of the People's Bank of China

Zhuo Tan [a] & Shenggang Yang [b]

[a] Department of Economics, University of Miami, Coral Gables, FL, 33146-6550, USA

[b] College of Finance and Statistics, Hunan University, Changsha, Hunan, 410079, China

Available online: 31 Jan 2012

PLEASE SCROLL DOWN FOR ARTICLE

Neutralization in China: evidence from the balance sheet of the People's Bank of China

Zhuo Tan[a]* and Shenggang Yang[b]

[a]Department of Economics, University of Miami, Coral Gables, FL 33146-6550, USA; [b]College of Finance and Statistics, Hunan University, Changsha, Hunan, 410079, China

We evaluate China's neutralization policy by monthly estimations based on the central bank balance sheet from 1999:6 to 2011:6. Our results suggest that China effectively neutralizes 66% of the change of net foreign assets under a pegged currency regime. Consequently, a purchase of one yuan of net foreign assets leads to an effective increase of 1.4 yuan in the money supply, rather than 4 yuan in the absence of neutralization. In the face of rapid growth of foreign reserves, neutralization in China is becoming increasingly difficult, consistent with Mundell's hypothesis.

Keywords: neutralization; foreign reserves; money supply; central bank balance sheet; money multiplier

JEL Classification: E51, E52, E58

1. Introduction

On January 1, 1994 China identified its currency regime as a 'managed floating exchange rate regime based on market supply and demand.' However, in practice, the renminbi (RMB) exchange rate was rigidly pegged at 8.28 yuan per dollar from 1997 until July 21, 2005. Then China announced that the RMB would be more flexible, and managed 'with reference to a basket of currencies' rather than pegged to the US dollar. However, the implementation of the new reform has been questioned. Some studies argue that, in practice, China still pegs its currency to the dollar (Goldstein and Lardy 2006, Fidurmuc 2010). Others suggest the euro has a higher weight in the basket (Frenkel 2009). Nevertheless, there is common agreement that China has pegged its exchange rate for nearly two decades, albeit appreciating at a gradual 3.4% per annum since 2005. The slow appreciation has been accompanied by a policy of buying the foreign exchange at set rates.[1]

Since 1998, China has registered surpluses on both of its current and capital accounts due to strong net exports and net capital inflows. As a result, the People's Bank of China (PBC) has passively purchased foreign exchange from enterprises and financial entities at pegged rates under the exchange settlement and purchase system. Consequently, the PBC's holding of net foreign assets increased to US$2.2 trillion in 2011.

*Corresponding author. Email: ztancs@gmail.com

Table 1.   Balance sheet of monetary authority.

Assets	Liabilities and equity
Foreign assets	Currency in circulation and deposits (monetary base)
Domestic assets	Foreign liabilities
Other assets	Domestic liabilities
	Other liabilities
	Equity

Source: *International Financial Statistics (IFS)*.

While intervention in the foreign exchange market maintains a stable exchange rate, it also leads to increases in base money. This would normally increase the money supply in the economy, as illustrated in the balance sheet of the central bank (Table 1).

Such increases in the money supply could lead to high inflation. Thus, the PBC attempts to neutralize the growth in the money supply from its purchases of foreign assets. He *et al*. (2005), Ouyang *et al*. (2010) and Wang (2010) summarize neutralization tools used by the PBC.

The PBC has two ways to offset the impact on the money supply of a rise in its foreign assets. It can reduce the change in monetary base through open market operations, i.e. contracting domestic credit of the PBC. Alternatively, it can decrease the money multiplier by raising the reserve requirement ratio or imposing bank loan ceilings to slow growth in commercial bank credit. In fact, the PBC both neutralizes by selling central bank bills and raising the required reserve ratio (Wang 2010). Nonetheless, as some point out (Prasad 2005; Prasad and Wei 2005; and Xie 2006), it is inherently difficult for the PBC to neutralize its purchases of foreign assets while experiencing growing trade surpluses and rising capital inflows.

In this paper, we ask the question: How much of China's foreign asset purchases are effectively neutralized? In other words, can China maintain a sovereign monetary policy under its pegged exchange rate regime? In theory, we know from Mundell (1968) that a central bank can either fix the exchange rate and let the money supply float, or fix the money supply and let the exchange rate float.

To answer this question, we perform empirical tests on monthly data from June 1999 to June 2011 based upon the balance sheet of the PBC. We first estimate the sterilization coefficient over the whole sample period. Second, we estimate neutralization for two sub-periods, from 1999:6 to 2005:7, and 2005:8 to 2011:6, after the 2005 currency reform. The empirical results suggest that the central bank in China does not effectively neutralize the contemporaneous change in net foreign assets. Consequently, China's control on domestic credit under a pegged exchange rate regime is weak, confirming Mundell's argument. Indeed, results from the two subsamples imply that neutralization in China is becoming increasingly difficult.

In the literature, several studies are related to ours. Using monthly data from 2000:7 to 2008:9, Ouyang *et al*. (2010 estimate a simultaneous equation model based on Brissimis, Gibson and Tsakalotos (BGT) (2002), finding China's sterilization is successful. Wang (2010) finds that China's neutralization is almost perfect in terms of monetary base (IFS line 14), but not in terms of M2 (IFS line 34 plus 35) using monthly data from 1999:6 to 2009:3 (from the International Financial Statistics (IFS) database). Using monthly data from 1998:1 to 2004:12, He *et al*.'s (2005) Vector Auto Regression (VAR) analysis find the PBC's complete and contemporaneous neutralization of its purchases of foreign exchange: a one yuan purchase of net foreign assets leads to a corresponding

decline of one yuan in net domestic assets: i.e. a sterilization coefficient of one. Our results suggest that this is no longer the case.

This paper is organized as follows. Section 1 is the introduction. Section 2 presents the model. Section 3 reports our empirical results. Section 4 concludes.

2. Model specification

We employ a simple model based on the balance sheet of the central bank as the theoretical basis for our empirical estimation. From the simplified balance sheet of the PBC, a change in monetary base, H, the liabilities of the central bank, equals the change in its assets, either caused by a change in net foreign assets, F, or a change in net domestic assets, D.

$$\Delta H \equiv \Delta D + \Delta F \tag{1}$$

where Δ is the first difference operator. This identity suggests that an increase in foreign assets, due to the PBC's purchase of foreign exchange, tends to increase the monetary base, and hence the overall money supply.

However, to limit the impact of an increase of net foreign assets on monetary base, the central bank can neutralize the monetary effects by reducing domestic credit. A direct way to measure the effectiveness of PBC's neutralization is to test how domestic assets respond to a change in net foreign assets.

Neutralization can be characterized by a sterilization coefficient, θ, representing the fraction of the change in net foreign assets that is neutralized:

$$\Delta D = -\theta \Delta F \text{ where } 0 \leqslant \theta \leqslant 1 \tag{2}$$

The coefficient of $\theta = 1$ implies full monetary neutralization, or $\Delta D = -\Delta F$ so $\Delta H = 0$, while $\theta = 0$ implies no monetary neutralization. Ouyang *et al.* (2010) and Wang (2010) define a 'sterilization coefficient' as how much domestic money creation responds to a change in international reserves. Here we define the sterilization coefficient narrowly from the central bank balance sheet perspective. It is the fraction of a change in net foreign assets that is neutralized by a reduction in the PBC's domestic credit.

We also test the impact of an increase in net foreign assets on broader monetary supply such as M2. Recall that the money supply M equals monetary base times the money multiplier m:

$$M = mH \tag{3}$$

which implies for a constant multiplier:

$$\Delta M = m\Delta H = m(\Delta F + \Delta D) \tag{4}$$

Substituting equation (2) into equation (4), we have:

$$\Delta M = m(1 - \theta)\Delta F \tag{5}$$

where ΔM denotes the change in commercial banks' domestic credit due to a change in net foreign assets, ΔF, and $m(1 - \theta)$ is the effective money multiplier, which de-multiplies the effect of the purchase of net foreign assets on the money supply. Note that

in the case of perfect neutralization $\theta = 1$, so the effective money multiplier $m(1 - \theta) = 0$. In general, $m(1 - \theta) > 0$.

We now estimate equations (3) and (4) using monthly data from June 1999 to June 2011, then derive the effective money multiplier.

3. Empirical results

Because the PBC passively absorbs the increase in its net foreign assets at pegged rates, we assume the changes in net foreign assets are exogenous, and we estimate equation (2) by OLS regression from 1999:7 to 2011:6.[2] We then estimate the money multiplier based on equation (3). We also run regressions on two subsample periods, from 1999:7 to 2005:7, and 2005:8 to 2011:6 after the 2005 currency reform of managed floating, gradual appreciation of the RMB.

We use M2 (IFS line 34 plus 35) as a measure of the overall money supply, M, in the economy. Data for monetary base, H (IFS line 14), and net foreign assets, F (IFS line 11n), are also from International Financial Statistics (IFS) database. We calculate net domestic assets D by subtracting net foreign assets F from monetary base H using equation (1). Following Ouyang *et al.* (2010), Wang (2010) and others, we normalize the first difference of F and H by monthly GDP. Because monthly GDP data for China are not available, we construct the series following Wang (2010) by using Industrial value added and quarterly GDP data, which are from the China Statistics Bureau website and CEIC China Premium Database.

We apply the Augmented Dicky-Fuller (ADF) test with the lag length selection by the Akaike Information Criterion (AIC). The results indicate that all variables in our regressions are stationary, as shown in Table 2, so we may perform a meaningful time-series regression.

The inclusion of a lag variable is statistically insignificant. Thus, we regress on the contemporaneous variables for both equations. On the complete sample period, OLS regression gives an estimated sterilization coefficient of 0.66, significant at the 5% level, suggesting that the PBC only neutralizes 66% of the change in net foreign assets effectively. This is illustrated by the negative slope of the regression line in Figure 1.

The estimated money multiplier is 4.04. This implies an effective money multiplier of 1.4, that is, a one yuan increase in net foreign assets would lead to a 1.4 yuan increase in the money supply due to sterilization. From July 1999 to June 2011, China's foreign reserves rose by 66.9 trillion yuan, at the nominal exchange rate. Given an effective money multiplier of 1.4, this led to an increase of 27.3 trillion yuan in the money supply, which is 41% of the total increase of 66.9 trillion yuan during the same period. In other words, 41% of money growth is accounted for by the growth of foreign reserves alone. This high percentage suggests that the PBC cannot effectively neutralize the change in its net foreign assets, contrary to previous results (He 2005; Ouyang *et al.* 2010; Wang 2010).

Table 2.   Augmented Dickey-Fuller unit root tests (1999:7–2011:6)

Variable	Deterministic terms	Lags	Test value
ΔF	constant	1	−9.57***
ΔD	constant	1	−5.20***
H	constant, trend	1	−3.55***
M	constant, trend	1	−7.03***

Notes: *, ** and *** denote that the ADF test statistic is significant at 10, 5 and 1% respectively.
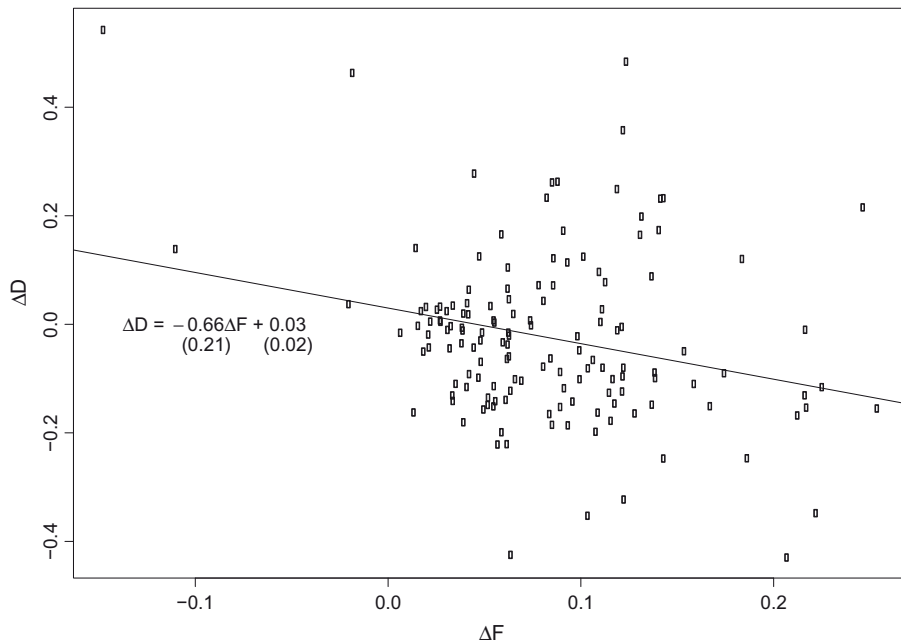
Estimated Equation:

$$\Delta D = -0.66\Delta F + 0.03$$
$$(0.21) \qquad (0.02)$$

Note: Standard errors are reported in brackets.

Figure 1.   The change in domestic credit, ΔD and the change in net foreign assets, ΔF of the PBC.

Ouyang *et al.* (2010) mentioned a selection problem in evaluating the effectiveness of neutralization. That is, if the central bank wants the money supply to grow to accommodate growth in money demand due to growth in real GDP, it would not completely neutralize the increase in reserves. But this does not necessarily mean the central bank has lost control of the domestic monetary process.

Our estimates, however, strongly suggest that the PBC's control over the money supply is weak. Next, we divide the whole sample into two subsamples using the 2005 currency reform as the break point. The first subsample contains 73 observations from July 1999 to July 2005. The second has 71 observations from August 2005 to June 2006. The estimates are significant at the 5% level except for the sterilization coefficient in the second subsample, whose *p*-value is less than 0.12. Estimated sterilization coefficients for these two subsamples are 0.82 and 0.57 respectively, and for the money multiplier are 5.53 and 3.59 respectively.

The size of the sterilization coefficient decreases considerably in the second period, and the degree of statistical significance is lower, indicating it has become more difficult for the PBC to pursue a policy of neutralization. The decrease in the money multiplier could be explained by the frequent increases of reserve requirements for commercial banks: from July 2006 to September 2008, the legal reserve ratio for commercial banks was raised 19 times, from 8% to 17.5% (Wang 2010).

Given our estimates for the sterilization coefficient and money multiplier, we estimate the effective money multiplier to be 1.01 for the first period and 1.56 for the second.

That is, an increase of 1 yuan in net foreign assets would lead to an increase of approximately 1 yuan in the money supply in period one, and a 1.56 yuan in period two. The substantial increase in the effective money multiplier suggests that neutralization is increasingly difficult for PBC. Growth of foreign reserves accounts for 29% of the increase in the money supply in the first period, but 64% in the second one.

4.   Conclusion

The empirical results over the whole sample period from 1999:7 to 2011:6 indicate that the People's Bank of China does not effectively neutralize the contemporaneous change in net foreign assets, contrary to most studies. An estimated neutralization coefficient of 0.66 and money multiplier of 4.04 yields an effective money multiplier of 1.4 with sterilization. That is, a 1 yuan increase in net foreign assets leads to an increase of 1.4 yuan in the money supply. Thus, 41% of the increase in money supply during the whole sample period is accounted for by the rapid accumulation of foreign reserves. This strongly suggests that China cannot retain its control on the money supply under a pegged exchange rate regime, as Robert Mundell (1968) hypothesized. Mundell noted that the monetary authorities can fix the exchange rate and let the money supply float, or fix the money supply and let the exchange rate float: but it cannot fix both the exchange rate and the money supply. Our results from two subsamples further suggest that a policy of neutralization is increasingly difficult in the face of the rapid buildup of foreign reserves of the PBC.

Notes

1.   Under the pegged exchange rate, China implements strict capital control. For example, among others, the People's Bank of China (PBC) forbids most domestic enterprises and entities other than import/export companies from opening and maintaining foreign exchange accounts. In addition, PBC also enforces the foreign exchange settlement and purchase system under which all domestic enterprises and entities without foreign exchange accounts should sell their foreign exchange revenues to the state via banks licensed to conduct foreign exchange transactions. When foreign exchange payments are to be made, they need to purchase foreign exchange funds from the banks, which in most cases, requires the advance approval of the State Administration of Foreign Exchange (SAFE).
2.   The estimation using quarterly data yields similarly results.

References

Brissimis, S., Gibson, H., and Tsakalotos, E., 2002. A unifying framework for analyzing offsetting capital flows and sterilization: Germany and the ERM. *International Journal of Finance and Economics*, 7, 63–78.

Fidrmuc, J., 2010. Time-varying exchange rate basket in China from 2005 to 2009. *Comparative Economic Studies*, 52 (4), 515–529.

Frankel, J.A., 2009. New estimation of China's exchange rate regime. *Pacific Economic Review*, 14 (3), 346–360.

Goldstein, M., and Lardy, N.R., 2006. China's exchange rate policy dilemma. *American Economic Review*, 96, 422–426.

He, D., Chu, C., Shu, C., and Wong, A., 2005. Monetary management in mainland China in the face of large capital inflows. Hong Kong Monetary Authority (HKMA) Research Memorandum, 07/2005, April.

Mundell, R.A., 1968. Barter theory and the monetary mechanism of adjustment. *International Economics*. New York: Macmillan, 130–133.

Ouyang, Y.A., Rajan, S.R., and Willet, T.D., 2010. China as a reserve sink: the evidence from offset and sterilization coefficients. *Journal of International Money and Finance*, 29 (10), 951–972.

Prasad, E., 2005. Next steps for China. *Finance and Development*, 42 (3), IMF.

Prasad, E., and Wei, S.J., 2005. Understanding the structure of cross-border capital flows: the case of China. Unpublished Working Paper, Presented at Columbia University Conference, *China at crossroads: FX and capital markets policies for the coming decade*, 2–3 February 2006.

Wang, Y., 2010. Effectiveness of capital controls and sterilizations in China. *China and World Economy*, 18 (3), 106–124.

Xie, A., 2006. *Asia Pacific: hot money leaving?* Morgan Stanley Global Economic Forum, May 25.