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The Condition and Problems of the Practical Use of China's Foreign-Exchange Reserves

Zhongling Qi *

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Although it controls monetary policies, a central bank can occasionally experience a situation where its financial situation worsens and excessive liabilities occur. In such instances, the central bank may be unable to fulfill its policy objectives. This study focuses on the People's Bank of China (PBC), which is the central bank of China and possesses large foreign reserves, and investigates whether the costs it has incurred during its intervention in the foreign exchange market have contributed to its present financial situation. We then discuss future estimated PBC results. Against the background of an expanding international balance of payments surplus, the PBC continued intervention in the foreign exchange market to ensure Renminbi exchange rate stability. This intervention rapidly increased foreign reserves. This study examines the PBC balance sheet to estimate the costs of its foreign exchange market intervention after January 2002 using several assumptions. The results show that the losses experienced through its intervention policy are expansionary, and were 18.5% of its overseas assets by the end of 2011. Analyzing the factors affecting intervention costs individually, we see that exchange rate changes have a higher impact than interest rate fluctuations on intervention costs, and this effect can be identified at an earlier stage. The study concludes that the improvement of its financial situation, whilst still fulfilling its monetary policies, will be a significant challenge for the PBC.

Keywords: Foreign-exchange reserve; Sterilization; Central bank bill

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1. Introduction

The central bank of each country achieves its policy target of commodity price stability through such tools as lending and borrowing, or purchasing and selling financial assets. As it deals with financial assets, a central bank is exposed to the risks associated with a change in the value of these assets, and it can fall into an insolvency situation. If a situation arises where asset losses are increasing and the risk of insolvency becomes serious, it becomes impossible for a central bank to carry out its policy targets, and there is a risk of having a major impact on the domestic economy. Some countries whose central banks could not control inflation, which accelerated as a result of insolvency, experienced extreme difficulties. Such countries include Venezuela, Jamaica, and Argentina.

There are many reasons a central bank may experience an insolvency situation. Revaluation of a home currency is one of the major factors leading to a depreciation of central bank assets if it is holding large-scale foreign reserves. The value of foreign reserves will fall if revaluation of the home currency continues. This worsens the financial position of the central bank.

This study focuses on the People's Bank of China (PBC), which is the central bank of China and controls all the foreign reserves in China. We analyze its foreign exchange market intervention policy, where rapidly increased foreign reserves significantly affected its own financial position, and discuss how such intervention will influence monetary policy in the future.

To quantitatively analyze the influence of foreign exchange market intervention on the assets of the PBC, we first estimate the intervention costs (profits or losses) of the PBC using certain assumptions. We take account of exchange-rate fluctuations and such intervention tools as the issuing of central-bank bills. It should be noted here that the profits or losses stated in this study are not actual, but represent our estimated value.

Section 2 of the study examines the relationship between the financial situation of a central bank and its monetary policy, and clarifies the situation facing the PBC. Section 3 examines the foreign exchange market intervention policy of a monetary authority (central bank), including its definition, purposes and tools. Section 4 illustrates the relationship between the exchange rate level of the Renminbi (RMB) and foreign reserves, which are rapidly increasing. Section 5 focuses on the PCB balance sheet. Section 6 analyzes the profits and losses of the PBC as a result of intervention, estimates the scale of the profits and losses based on available data, and examines its influence on the financial situation of the PBC. Section 7 presents the conclusions and states the future objectives of the PBC and its monetary policies.

2. The financial situation and monetary policy of a central bank

A central bank is a monetary authority possessing certain powers, such as the printing of currency. In many countries (including advanced nations) where the central bank is obliged to provide a part of its profits to the government, the government is also obliged to meet central bank losses with treasury funds. Thus, even if the central bank does not necessarily need to maintain the same equity capital level as a commercial bank, when it does experience temporary, small-scale excessive liabilities, the probability of policy operation difficulties arising is low. However, previous research has investigated whether a central bank will be able to influence monetary policy in a situation of prolonged, large-scale excessive liabilities, where it becomes impossible for a central bank to maintain its policy objectives².

The cause of central bank excessive liabilities is certain. As a typical example "the central bank played a part in a monetary crisis when it was hit by a devaluation of its own currency, after increasing its debts in foreign currencies. At the same time, the central bank needed to meet its industrial policies. In this case, the government did not carry out interest payment on its national bonds." (Ueda [2003], p.53).

When liabilities become excessive, there are two main policy choices a central bank has for the improvement of its financial situation. One is issuing additional currency. This substantially eases central bank obligations through large gains realized from banknote issuance. However, this does trigger inflation and price raises are inevitable. Another is accepting government assistance. However, if it does so, it becomes difficult for a central bank to remain independent of government, and there is a possibility that policy measures, which are not necessarily conformable, may be forced upon government. For these reasons, maintaining a healthy financial situation with suitably monetary policies is an important undertaking for a central bank.

In the case of China, the PBC is a central bank that has not realized independence from government. Currency stability and national law are its policy objectives. Hence, while there is increasing pressure to reevaluate the RMB against a background of large external payments surplus, the PBC must continue intervention to suppress a sudden rise of the RMB exchange rate.

As a result of intervention, Chinese foreign reserves increased rapidly and broke through the one trillion dollar mark at the end of October 2006, and exceeded those of Japan. Thus, China became the world's largest foreign reserve holder. Subsequently, Chinese foreign reserve expansion continued unabated, reaching 2,390 billion dollars—about three times the value of Japan's foreign reserves—by the end of 2009. As the PBC possesses the entire country's foreign reserves, its overseas assets

² For example: Dalton and Dziobek [2005]; Stella [1997, 2002]

comprised over 80% of the total assets as of the end of 2009. While an external payments surplus continued despite intervention by the PBC, RMB quantity does not tend to change. This means an increase in losses from the RMB-denominated overseas assets possessed by the PBC. This reflects the situation described above of excessive central bank liabilities.

3. Monetary authority- foreign exchange market intervention policy

Before analyzing how a rapid increase of foreign reserves through intervention influences the financial situation of the PBC, we first survey the purpose and means of a foreign exchange market intervention policy by a monetary authority.

According to the report³ of the task force prepared during the 1982 Versailles G7 summit, intervention is defined in a narrow sense as "dealing of the foreign exchange which makes a counter value domestic currency which a monetary authority performs in an exchange market." However, in a broader sense, intervention includes public institution dealings in the exchange market and business conducted outside the exchange market such as (1) customer dealings and International Monetary Fund (IMF) dealings, (2) foreign reserves transactions, and (3) business conducted by authorities or private enterprises.

The report pointed out that all of the participating nations in the summit used foreign exchange market intervention as a means of exchange rate policy under a floating exchange rate. This was based on the experience of each country since the major shift to the floating exchange rate system⁴. Intervention as an exchange rate policy is mainly used in two instances. One is to ensure stable exchange rate fluctuations. The other is when the economic fundamentalist judges that exchange rate fluctuations are unjustifiable.

In relation to interventions by monetary authorities, Fukao (1990, p.66) classified two types: (1) sterilized intervention in which the financial market supply and demand changes are wiped out by the open market operations of domestic currency financial assets and (2) non-sterilized intervention, which does not offset supply and demand changes within a financial market.

In the case of Japan, the monetary authority is the Foreign Exchange Fund Special Account of the Bank of Japan. In the case of China, foreign reserves are managed and used by the PBC, and since there is no independent accounting system like that of the Foreign Exchange Fund Special Account

³ *Report of the Working Group on Exchange Market Intervention.*

⁴ We used the premise "the bottom of a floating exchange rate system" since the subject in the report concerned is intervention of the major power after the floating exchange rate system shift. We could conclude that the purpose of intervention by a monetary authority is an exchange rate policy, irrespective of adopting a floating exchange rate system.

of Japan, we can examine the foreign reserve situation in the PBC balance sheet. Table 1 illustrates sterilized intervention and unsterilized intervention in some detail.

First, we consider a dollar-buying intervention example. Assume the PBC performs a wholesale dollar buying intervention. The monetary base, M , increases with the purchase price of a dollar, and the domestic financial market supply and demand reflects these changes and foreign reserves, Q , similarly increase. Such intervention, which alters the monetary base, is known as unsterilized intervention. Intervention where the monetary base is not changed is known as sterilized intervention. This is carried out by the selling of debentures, such as an RMB national bond, and the PBC then absorbs the purchase price of a dollar through performing a dollar-buying intervention. Sterilized intervention is exchange by a monetary authority of its own national financial assets, S , (such as via a national bond or a central bank bill), and foreign financial assets, Q .

Look at a dollar-selling intervention and a dollar-buying intervention. Although the interactions between foreign currency and domestic currency are in different directions, unsterilized and sterilized interventions are possible in both instances.

Table 1 Balance sheet of PBC (illustration)

Assets	Liabilities and Capital
S: RMB-dominated assets (national bond, lending by PBC, etc.)	M: High-powered money (cash, deposit of banks, etc.)
Q: foreign reserves (US TB etc.)	W: others

A monetary authority intervenes to attain stabilization of the exchange rate of the domestic currency. In such instances, the monetary authority chooses sterilized intervention or non-sterilized intervention by considering the supply and demand of the domestic financial market.

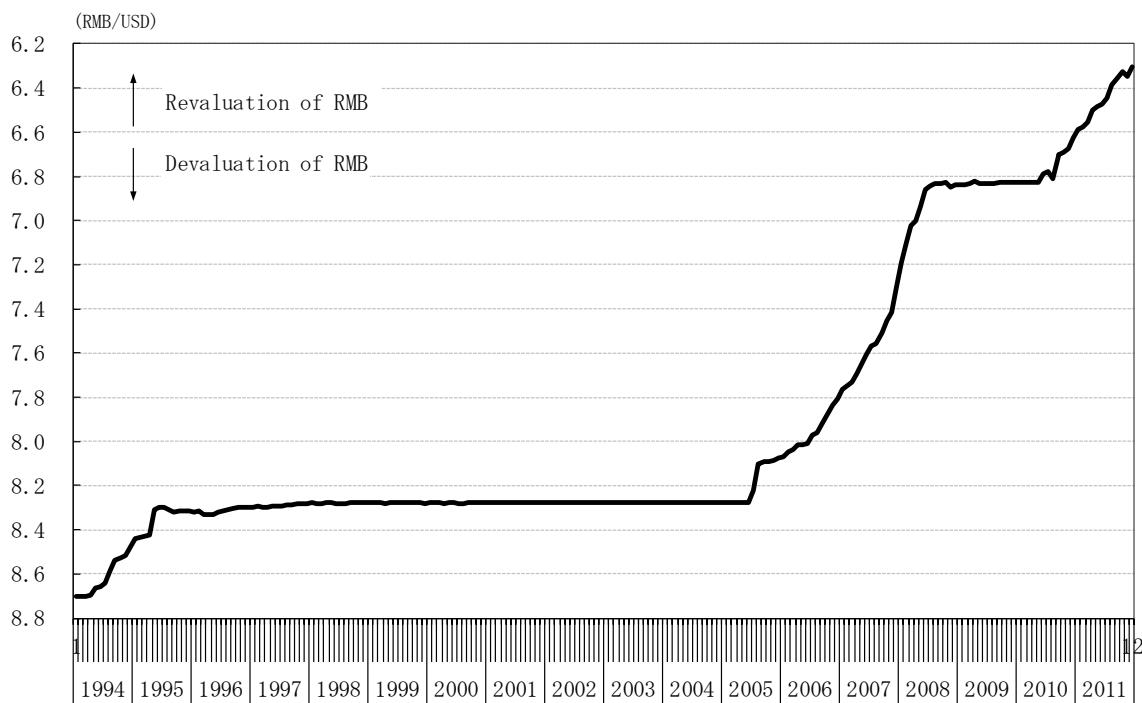
4. RMB exchange rate and foreign currency reserve transitions

How has the RMB exchange rate changed? Fig. 1 shows exchange rates fluctuations from 1994, when the crucial reforms of the Chinese exchange control system were implemented, to 2009. This shows that the exchange rate changed at a steady level from mid-1995 to July 2005. Although the PBC has declared that it carries out a managed-floating system, from this Figure we can conclude that a fixed exchange rate peg with the U.S. dollar was carried out during that period.

When the PBC revalued the RMB by approximately 2% in July 2005, it shifted to a currency basket system whereby an exchange rate is interlocked with several major currencies. Looking at an exchange rate trial calculation made for December 2011, we can see that the margin of increase of the RMB exceeded 23% since July 2005.

Generally, when a monetary authority suppresses the excessive rise of an exchange rate, its intervention policy has an international balance of payments effect. If the pressure to revalue a domestic currency increases because of, for example, the international balance of payments recording large surplus figures, a monetary authority will intervene to purchase foreign currency and sell domestic currency, which usually reduces the pressure. In contrast, when an international balance of payment deficit occurs, the devaluation pressure of the domestic currency increases, and the monetary authority usually intervenes in the foreign exchange market, selling foreign currency and buying domestic currency.

Fig. 1 Transition of RMB exchange rate (monthly average)

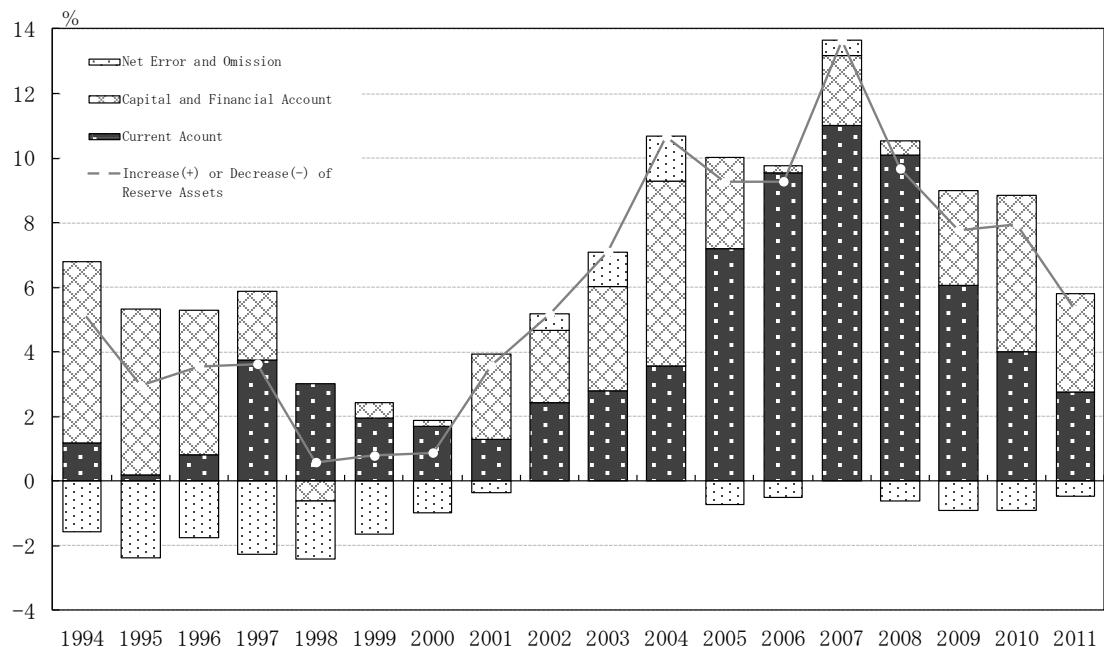


Source: International Financial Statistics (IFS)

Look then at the China's international balance of payments. The current account surplus increased post-2000, and the capital account balance was consistently in surplus from 1994. This was remarkable, particularly given the Asian currency crisis. Fig. 2 shows the international balances of payment from 1994 to 2011. This large external payments surplus placed strong pressure for a revaluation of the RMB. The PBC bought foreign currency (primarily U.S. dollars), fearing too great an economic growth in China. Such growth depends greatly on foreign trade, which can be sharply

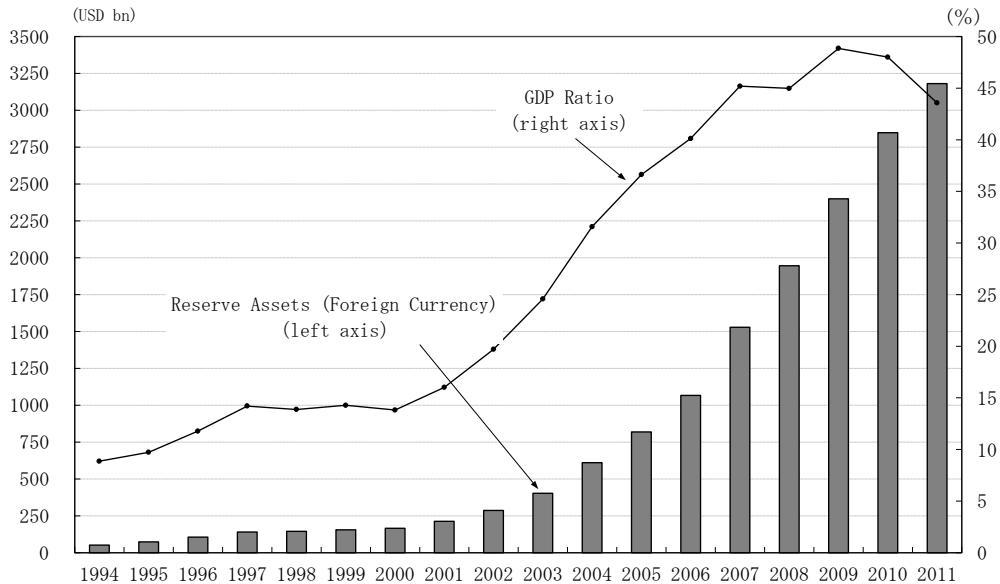
affected by RMB quantity, and thus the PBC was pressed to undertake intervention by selling RMB. In fact, foreign reserves increased coupled with an increase in external payments surplus. Foreign currency reserves broke through the one trillion dollar mark in 2006, surpassing those of Japan to become the largest in the world, and later broke the four trillion dollar mark in 2010. Although the nominal GDP ratio of foreign currency reserves was less than 10% at the end of 1994, it was close to 50% by the end of 2009 and still over 40% in 2011 (Fig. 3).

Fig. 2 International balance of payments (nominal GDP ratio) (1994–2011)



Source: IFS

Fig. 3 Foreign currency reserves and their nominal GDP ratio (1994–2011)



Source: PBC and National Statistics Bureau website

5. Foreign exchange market intervention of RMB

A rapid increase of Chinese foreign reserves means intervening in the exchange market so that the PBC can control excessive exchange rate increases. When estimating intervention profit and loss, it is necessary to understand how the PBC intervened. Thus, this section analyzes in detail the issue of central bank bills, having first examined the PBC balance sheet, which reflects intervention.

5.1 Balance sheet of the PBC

Table 2 shows the PBC balance sheet from 2002, when the foreign funding bank was added, until 2011.

Looking first at the asset side, gross-assets (as opposed to overseas assets) including foreign reserves increase every year. Although the ratio was below 50% in 2002, it increased to 85% in 2011. Moreover, over 95% of overseas assets are foreign currencies, in the form of foreign currencies and short-term bonds from secure foreign countries. The item to the right of “government debt” shows the PBC-owned national bond, which increased rapidly in 2007 because the PBC underwrote the total special national bond of 1,500 billion yuan, mostly using overseas assets. The Ministry of Finance (MOF) established the China Investment Corporation (CIC) using the foreign currency fund established by this government bond, hoping to improve the profitability of overseas assets.

The monetary base liability ratio fell as the gross overseas assets ratio went up. This suggests that the PBC undertook sterilized intervention. Since large-scale items such as national PBC bonds,

which are generally used in sterilized intervention, are not shown if the underwriting of a national bond is specifically removed, the PBC was thus able to expand its liability side by undertaking a new debt. In fact, the PBC issued a debenture (central bank bill) in 2002 as a means of absorbing the excess liquidity (superfluously money) gained through intervention.

Table 2 PBC Balance sheet

Assets (RMB 100 million, %)

End of the period	Total assets	Foreign assets		Foreign exchange	Monetary gold	Other foreign assets	Claims on government		Claims on other depository corporations		Claims on other financial corporations		Other assets	
2002	50685	22820	45%	22107	337	375	2864	6%	12288	24%	7240	14%	5266	10%
2003	61522	30659	50%	29842	337	963	2901	5%	11983	19%	7256	12%	8516	14%
2004	78093	46398	59%	45940	337	683	2970	4%	10424	13%	8865	11%	9300	12%
2005	103676	63339	61%	62140	337	862	2892	3%	8168	8%	17751	17%	11460	11%
2006	128575	85773	67%	84361	337	1075	2856	2%	6517	5%	21950	17%	11413	9%
2007	169140	124825	74%	115169	337	9319	16318	10%	7863	5%	12972	8%	7098	4%
2008	207096	162544	78%	149624	337	12582	16196	8%	8433	4%	11853	6%	8027	4%
2009	227530	185333	81%	175155	670	9509	15662	7%	7162	3%	11530	5%	7799	3%
2010	259275	215420	83%	206767	670	7983	15421	6%	9486	4%	11326	4%	7598	3%
2011	280978	237898	85%	232389	670	4839	15400	5%	10248	4%	10644	4%	6763	2%

Liabilities and Capital (RMB 100 million, %)

End of the period	Total Liabilities and Capital	Total Liabilities	Reserve money	Currency issue		Deposits of private sector	Bond issue	Foreign liabilities	Deposits of government	Other liabilities	Capital					
2002	50685	50465	45138	89.1%	18589	26549	1488	2.9%	0	0.0%	3085	6.1%	754	1.5%	220	0.4%
2003	62004	61784	52841	85.2%	21240	31601	3032	4.9%	0	0.0%	4955	8.0%	957	1.5%	220	0.4%
2004	78093	77873	58856	75.4%	23104	35752	11079	14.2%	0	0.0%	5832	7.5%	2106	2.7%	220	0.3%
2005	103676	103456	64343	62.1%	25854	38489	20296	19.6%	642	0.6%	7527	7.3%	10648	10.3%	220	0.2%
2006	128575	128355	77758	60.5%	29139	48619	29741	23.1%	926	0.7%	10211	7.9%	9720	7.6%	220	0.2%
2007	169140	168920	101545	60.0%	32972	68574	34469	20.4%	947	0.6%	17121	10.1%	14837	8.8%	220	0.1%
2008	206505	206285	129222	62.6%	37116	92107	45780	22.2%	733	0.4%	16964	8.2%	13586	6.6%	220	0.1%
2009	226906	226686	143985	63.5%	41556	102429	42064	18.5%	762	0.3%	21226	9.4%	18649	8.2%	220	0.1%
2010	258618	258398	185311	71.7%	48646	136665	40497	15.7%	720	0.3%	24277	9.4%	7592	2.9%	220	0.1%
2011	280069	279849	224642	80.2%	55850	168792	23337	8.3%	2699	1.0%	22734	8.1%	6438	2.3%	220	0.1%

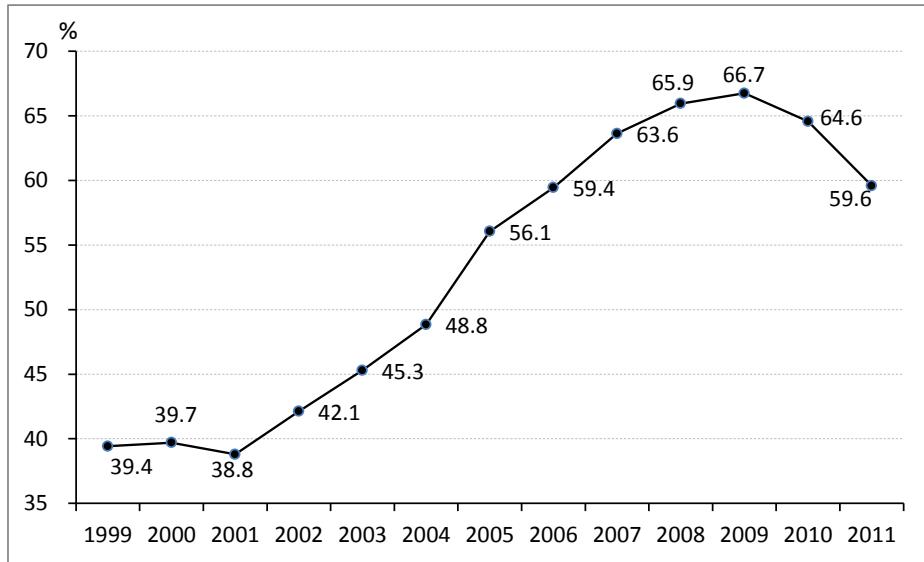
Notes: % means a gross assets comparison ration.

Source: website of the PBC.

As central bank bills are also used to absorb excess liquidity unrelated to intervention, it is hard to estimate when they are used for the purpose of intervention. However, since the amount of central bank bills rise in conjunction with a rise in gross overseas assets while the monetary base falls, it is surmised that a central bank bill is one of the main means of absorbing the excess liquidity caused by intervention. After the peak reached 22.2% in 2008, its ratio to the gross assets turn to drop down, and fall into less than 10% in 2011. Central bank bills are explained in full in Section 5.2.

Since overseas assets increase as a result of an intervention, we extrapolated from the PBC balance sheet, and Fig. 4 shows the nominal GDP ratio of gross assets.

Fig. 4 Nominal GDP ratio of PBC gross assets



Source: The People's Bank of China Quarterly Statistical Bulletin

Although the ratio fluctuated between 40% and 50% from 1999 to 2004, it rose to 50% in 2005, broke the 60% mark in 2007, and reached 66.7% by the end of 2009, and keep the level close to 60% in 2011. Contrast this with the situation in Japan where the nominal GDP ratio of the Bank of Japan gross assets stayed consistent at approximately 10% from the fixed exchange rate system of the 1960s until the end of the 1990s. After the quantitative easing of monetary policy enforcement in 2001, the Bank of Japan current accounts accumulated and their asset base increased; however, it is still only approximately 30%.

Since expansion of PBC assets is mainly dependent on an increase in overseas assets, the PBC vulnerability to changes in exchange rate increases, as is shown in Table 2.

5.2 Central bank bill

The PBC has continually published central bank bills since September 2002 by means of debentures. In some cases, it also floated central bank securities of other countries as a means of managing fund excesses and deficiencies. For example, when dollar-selling dramatically increased in the Tokyo foreign exchange market in August 1971 under the fixed exchange rate system, the Bank of Japan used a bill to allow it to perform a dollar-buying intervention to absorb excess liquidity. The Bank of Japan did not use such a bill again until May 1994, and this bill is still used today.

Silver notes are issued to compensate for a shortage of government debenture bonds. These notes are one of the most important methods of open market operations within the PBC. Moreover, although issuance of securities by a central bank are usually a means of short-term adjustments to the

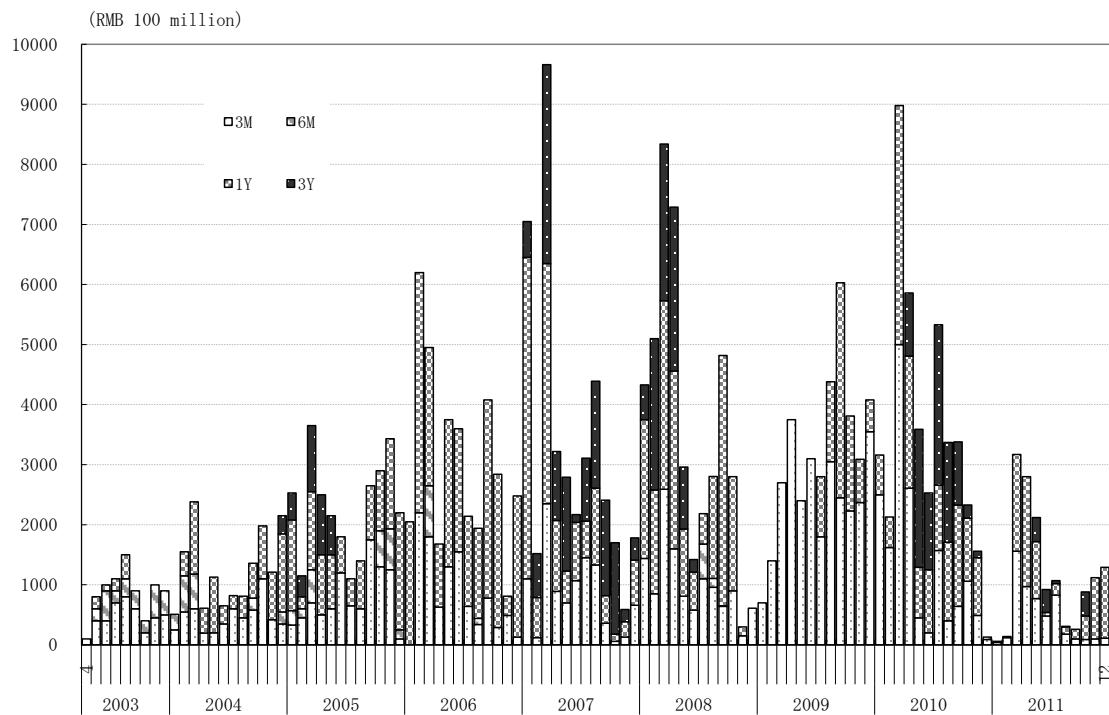
financial market, the PBC is unusual in that it publishes mid-term notes with three years due dates. Section 6 analyzes central bank bills in some detail when discussing intervention profit and loss effects on the interest rate of a central bank bill.

5.2.1 Issue amounts and interest rates

The PBC began to issue central bank bills from April 2003. Since then, it has published four kinds of notes: three-month, six-month, one-year, and three-year. Fig. 5 shows the amount of new issue central bank bills, according to due date, since April 2003. We can see that three-month and one-year bills comprise the greatest portion. When price rises were high and the economy was in an inflationary period from the end of 2006 to the middle of 2008 and from the end of 2004 to the middle of 2005, three-year bills were also issued.

Generally, in an open market central bank bills are issued in the form of a discount bond. In this case, there is a situation whereby the amount of issue and the interest rates are determined by tender.

Fig. 5 New issue of central bank bills



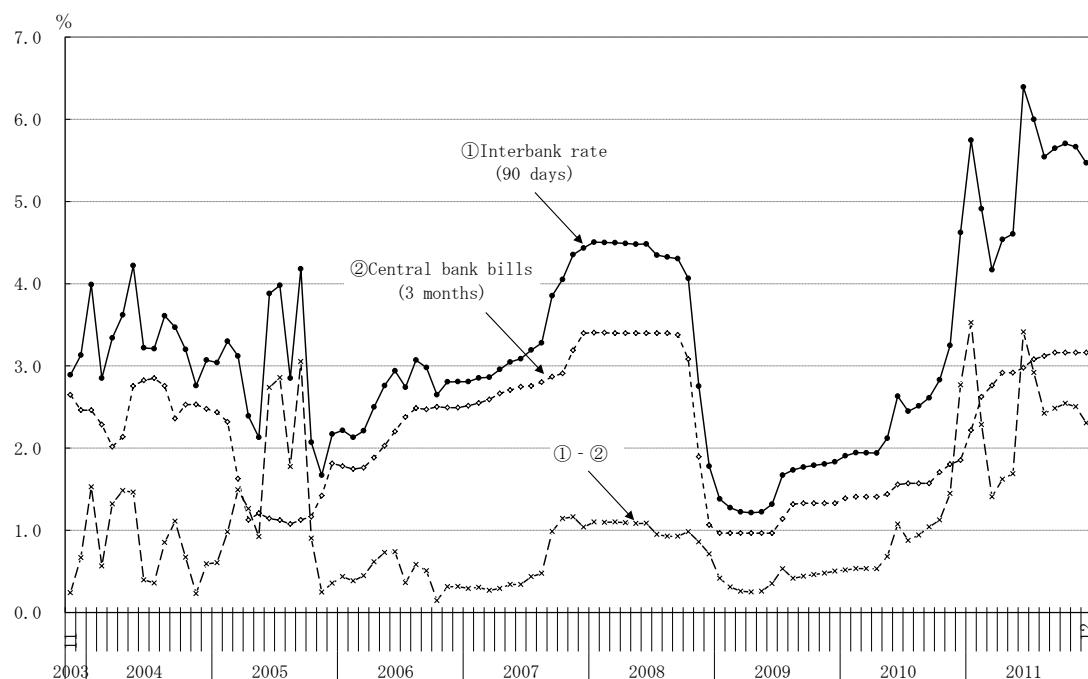
Source: CEIC

The PBC has a high credit rating and so the interest rates of its central bank bills are lower than money market rates (interbank market rate), as seen in Fig. 6. Although the deviation between them is large at first, it narrows gradually from 2006 onwards. The RMB is revalued during the exchange

institutional reform, and a sudden rise of the interbank interest rates in July 2005 is considered to be the point at which financing of the RMB became difficult.

The benefit of issuing a central bank bill at a lower interest rate than that of interbank interest rates is that it reduces the fund-raising cost of intervention for the PBC. However, as tight-money policy via a rising of interest rates is required when the Chinese domestic economy is in danger of overheating, issuance costs of central bank bills also go up. For example, central bank bill three-month interest rates increased by three from the end of 2005 to the second half of 2008, i.e., from 1.1% to 3.3%. If sterilized intervention occurs by issuance of a central bank bill during this period, it will be connected with a cost increase to the PBC. The PBC issues three-year notes when the interest rate is low, in an effort to ease the interest payment burden and to heighten the absorption of excess liquidity.

Fig. 6 Interest rates and money market rates (Chibor) of central bank bills



Notes: The interbank interest rate is Chibor (China interbank offered rate) until September 2006, and Shibor (Shanghai interbank offered rate) after that. The silver note three-month interest rates are monthly averages, and interbank interest rates are weighted average efficiency in a month.

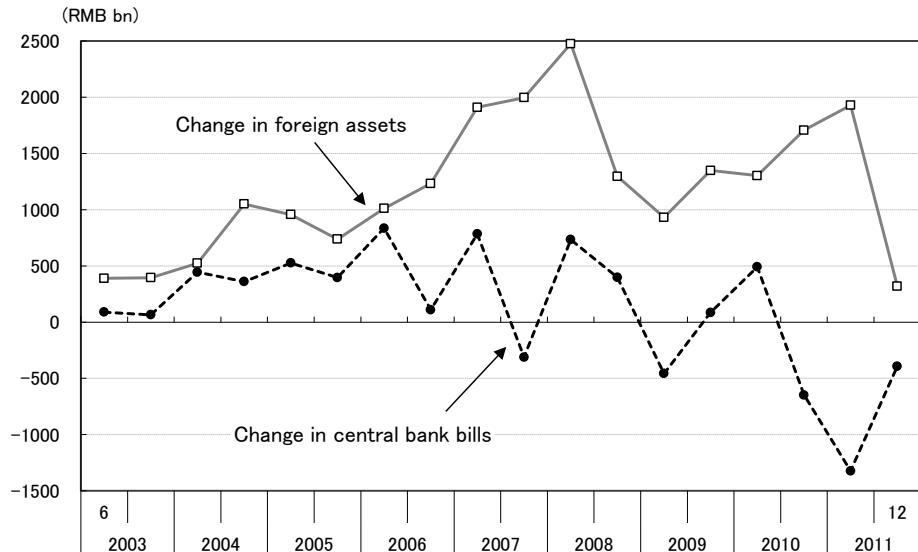
Source: CEIC

5.2.2 PBC's Overseas assets and central bank bills

Looking again at Table 2, central bank bills increased from a little less than 3% of gross assets at the time of issue in 2002 to 18% in 2009. This suggests an increase in incidences in which the PBC used

central bank bills. Fig. 7 shows the relationship between the increases in central bank bills, and the increases in overseas assets of the PBC through intervention.

Fig. 7 Increases and decreases in overseas assets contained within the PBC central bank bill balance



Notes: The June figure reflects the difference of the balance between the end of June and the end of the previous December. The December figure reflects the difference in the balance between the end of December and the end of June.

Source: The People's Bank of China Quarterly Statistical Bulletin

6. PBC profits and losses through intervention

We have cleared demonstrated how the PBC undertook intervention. In this section, we first estimate the amount of intervention undertaken by the PBC, and then estimate the profits and losses incurred by the PBC through its interventions.

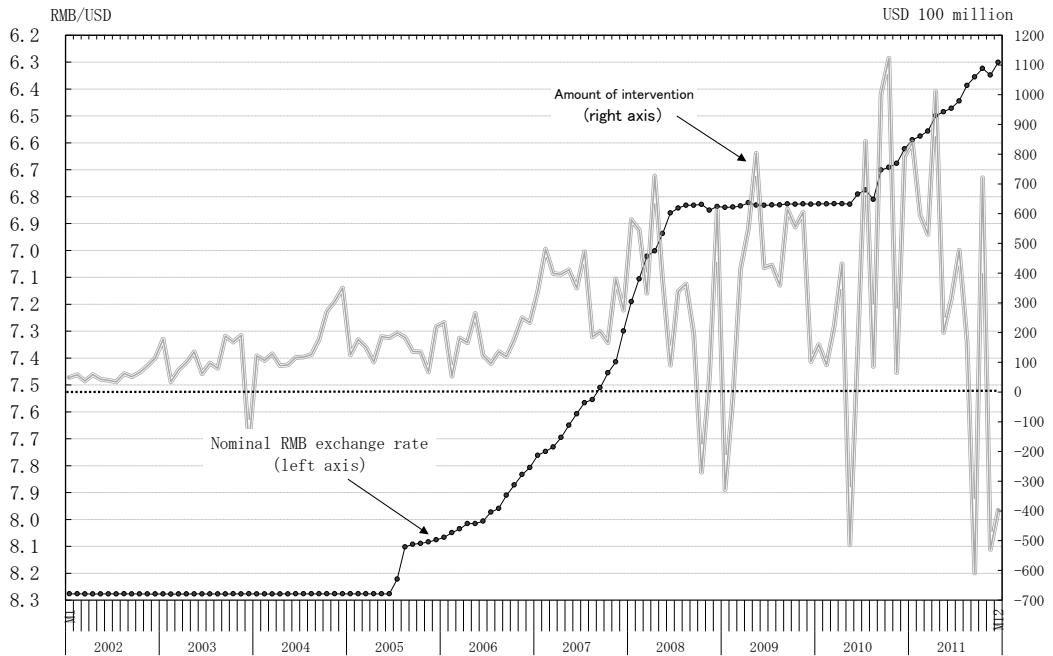
6.1 The amount of intervention

The change in foreign reserves by itself does not imply intervention by the PBC. The National Exchange Control Bureau, the Chinese government organization that manages foreign exchange related dealings, released foreign reserves with the exception of bullion and SDR (IMF Special Drawing Rights). The PBC does own some long-term illiquid assets as a result of foreign reserve exchange through intervention. The operating profit of foreign reserves is shown in the balance sheet. However, the amount of long-term illiquid assets cannot be read from the PBC balance sheet, and is not officially announced either. Here we can estimate the amount of intervention to be the operating profit of foreign reserves deducted from the change in foreign reserves. Additionally, although we do

not know the method of foreign reserves release, the most common method is known to be U.S. dollar-denominated property, such as a U.S. Treasury Bond (TB) or a public loan. Therefore, as a simple estimate of the amount of intervention, we analyze the PBC overseas assets and all its U.S. treasury certificates. We assume three-month intervention, and deduct a percentage of monthly interest from changes in foreign reserve assets, then make the trial calculation for the amount of intervention. Fig. 8 illustrates the amount of intervention estimated, and the nominal exchange rate of the RMB.

When the PBC reserved foreign currency as a source of funds and performed a capital injection into a state bank in December 2003, foreign reserves recorded a reduction for the first time. In addition, a reduction in foreign reserves has occurred twice: in October 2008 and in January 2009. If the Lehman Shock generated in September 2008 is taken into consideration, it can be surmised that the PBC released a foreign currency fund, and the possibility of it having compensated for the lack of demand for the U.S. dollar is high. Apart from that period, the PBC continued its dollar-buying intervention. The intervention scale reached a high of 112.2 billion dollars for one month in October 2010. It is hard to see the likelihood of intervention reducing even after July 2005 when the RMB was revaluated. This means that the revaluation pressure facing the RMB is still high.

Fig. 8 The amount of intervention and nominal exchange rate



Source: The website of the State Administration of Foreign Exchange and IFS.

6.2 Composition of profit and loss of PBC through intervention

It is thought that the profits and losses incurred by the PBC through intervention consist of (a) profit or loss on foreign exchange, (b) employment profit and loss, and (c) and other appraised profits or losses (Fukao et al[2000]).

(a) Profit or loss on foreign exchange

When the PBC performs a dollar-buying intervention, it purchases a dollar at the RMB exchange rate of the time. However, RMB exchange rate changes will generate profits or losses because of differences between the amount of money (book-value evaluation) in RMB paid to acquire the foreign currency, and the (mark-to-market) value of the PBC foreign currency assets on a RMB basis. The difference of the book value and the mark-to-market value reflects profits or losses incurred through foreign exchange. If the RMB is strong, the mark-to-market will be small, and exchange losses will occur. Conversely, if the RMB is devalued, exchange gains will occur. We estimate the accumulation of profit or loss on foreign exchange by the following equation (1):

$$\text{Total profit or loss at time } t = A \times (E_t - E_A) + \sum_{n=1}^t [q_n \times (E_t - E_n)] \quad (1)$$

where

A (100 million dollars) =foreign reserves at the start point

E_A (RMB/USD) =RMB exchange rate at the start point

E_t (RMB/USD) =RMB exchange rate at time t

q_t (100 million dollars) =the amount of intervention from during time $t-1$ to t

(b) Employment profit and loss

When estimating employment profit and loss through intervention, it is necessary to assume the type of intervention fund, and the employment method of a foreign currency fund. As described in Section 5.2.1, the interest rate of central bank bills is less than the money market rates (Chibor). For this reason, financing by means of issuing a central bank bill costs the PBC less than fund-raising from the market, and the incentive to float a security as the financing method for a dollar-buying intervention is strong. Moreover, since the central bank bill is published via the bid system, we know the market mechanism.

Therefore, the PBC raises all the funds for a dollar-buying intervention by publishing a three-month central bank bill. We assume that all raised RMB funds are via three-month U.S. TB dollar-buying interventions. A dollar-selling intervention would repay the RMB TB fund. Central bank three-month bills emerged in November 2003, which means that we can assume the raising of funds

for a dollar-buying intervention by money market rates (Chibor) until then. However, in February 2004 and January 2006 when central bank three-month bills were not published, the borrowing rate was reduced and we estimate the use of Chibor interest differentials and central bank bills.

In this estimation, we first translate the dollar-based foreign currency reserves in the middle of the U.S. TB three-month interest rates term into the employment profit of monthly foreign currency assets valued on a RMB basis. Then, we assume that the RMB fund required for foreign currency acquisition corresponds to the amount of intervention. We can therefore estimate the amount of intervention every month, and when this is multiplied by the central bank bill three-month interest rate, it serves as supply-fund indicator. However, as we assume that the PBC is only using three-month U.S. TBs, it is necessary to re-supply the supply-fund interest with RMB. We must therefore include a funding cost reflecting monthly central bank bill interest. This funding cost consists of two elements, the amount of accumulated intervention, and the accumulated amount of interest paid on the raised RMB fund. When expressed in a formula, we use the following equation (2):

$$\text{Total profit or loss at time } t = F_{t-1} \times i_t^U \times E_t - N_t \times i_t^C \quad (2)$$

And

$$N_t = \underbrace{\sum_{n=1}^t N_{n-1} \times i_t^C}_{\text{interests of funding and refunding}} + \underbrace{\sum_{m=0}^t Q_m}_{\text{The amount of intervention}}$$

where

F_t (dollar) =foreign reserves at time t

i_t^U (%) = TB interest (3 months) at time t

E_t (RMB/USD) =RMB exchange rate at time t

N_t =the amount of funding until time t

i_t^C (%) = interest rate of central bank bills (3 months)

Q_t (RMB) =the amount of intervention based on RMB

(c) Other appraised profits or losses

Foreign interest rate fluctuations affect PCB foreign bond values. We cannot estimate other appraised profits or losses through interest rate fluctuations by methods (1) and (2) above. If foreign interest rates change, the value of PBC foreign bonds will change, and a gap will arise between foreign currency reserves (stock), and foreign reserve assets (flow) in the PBC balance of payments. Hence, if these two statistics are shown, we should be able to estimate any other appraised profits or losses. However, as official balance of payments statistics are only released in half-yearly amounts, it is impossible to acquire monthly data for China. The change in the foreign reserve balance and the change in foreign reserve assets in the balance of payments statistics are mostly in agreement (Table 3). We must therefore assume that other appraised profits or losses incurred through intervention are zero.

Table 3 Change in foreign reserves (month end value). Figures are expressed in 100 million dollars

Year	Month	Change in foreign reserves (base on stock)	Change in foreign reserves (base on BOP)
2002	Jun	30.60	30.6
	Dec	43.65	43.64
2003	Jun	60.07	60.69
	Dec	56.78	56.78
2004	Jun	67.39	67.39
	Dec	139.29	139.23
2005	Jun	101.04	101.04
	Dec	107.90	107.56
2006	Jun	122.24	122.24
	Dec	125.23	125.06
2007	Jun	266.28	266.28
	Dec	195.62	195.62
2008	Jun	280.58	280.58
	Dec	137.20	137.72
2009	Jun	185.58	185.58
	Dec	267.55	267.52

Source: The website of the State Administration of Foreign Exchange

6.3 Estimation of PBC profit and loss through intervention

Although we have investigated elements of PBC profit and loss through intervention, in this section we estimate the accumulated profits and losses. Using the results from equations (1) and (2), we can obtain accumulated profit and loss. Results of this are shown in Fig. 9 (refer to the appended chart for a detailed numerical breakdown).

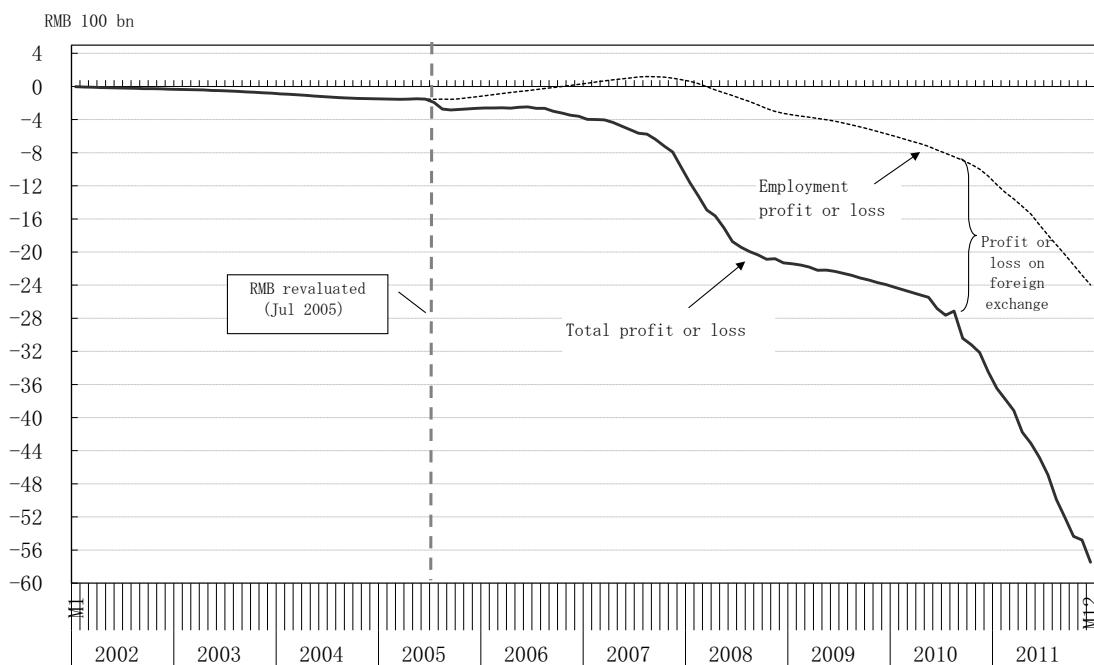
According to our estimated results, the losses incurred by the PBC as a result of intervention grew from 2002 onwards. Until July 2005, when the RMB was revalued, exchange rate variations were very small and most accumulated profit and loss was employment profit and loss. Until January 2005, fund-raising costs were higher than the three-month TB interest rates, and accumulated employment loss occurred. Fig. 10 shows the PBC fund-raising costs and the transition of U.S. Treasury Bond three-month interest rates (TB three-month interest rates), which are employment profit ratios.

After the revaluation of the RMB, accumulated exchange loss gradually increased. TB three-month interest rates exceeded fund-raising costs from February 2005, so an employment profit margin occurs. This changed to an accumulated employment loss in March 2006, and an operating profit began to be generated. Thereafter, accumulation profit and loss, which is the sum total of profit or loss of foreign exchange and employment, reduced in August 2005 because of the revaluation of the RMB and followed this trend until August 2006.

However, when the revaluation of RMB accelerated, the losses expanded increasingly again. Accumulation profit changed to a loss from September 2006 onwards. In addition, three-month TB interest rates started to fall from August 2007, and as the fund-raising cost followed the upward trend, the former fell again in December 2007 to a level below the latter. Therefore, the scale of cumulative losses swelled increasingly.

By December 2011, cumulative losses from intervention reached 4,303.4 billion yuan, over 18.5% of the PBC overseas assets.

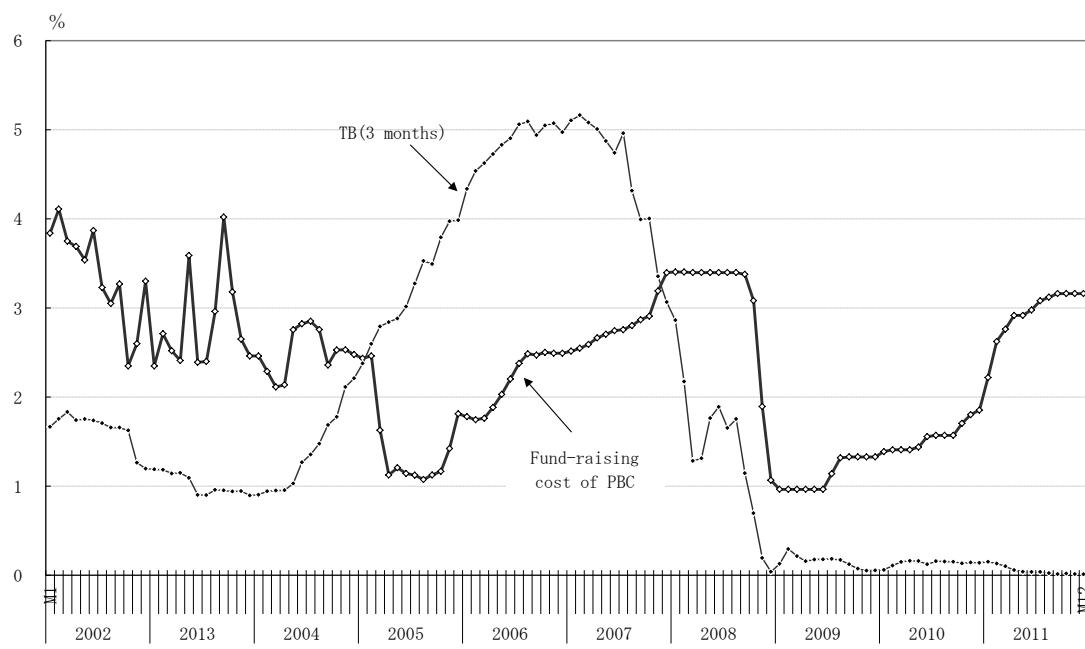
Fig. 9 Accumulation profit and loss of PBC as a result of intervention (post-January 2002)



Note: Assuming that the profits and losses are zero before January 2002.

Source: The People's Bank of China Quarterly Statistical Bulletin, IFS, the website of the National Statistics Bureau

Fig. 10 PBC Fund-raising costs and U.S. TB three-month interest rates

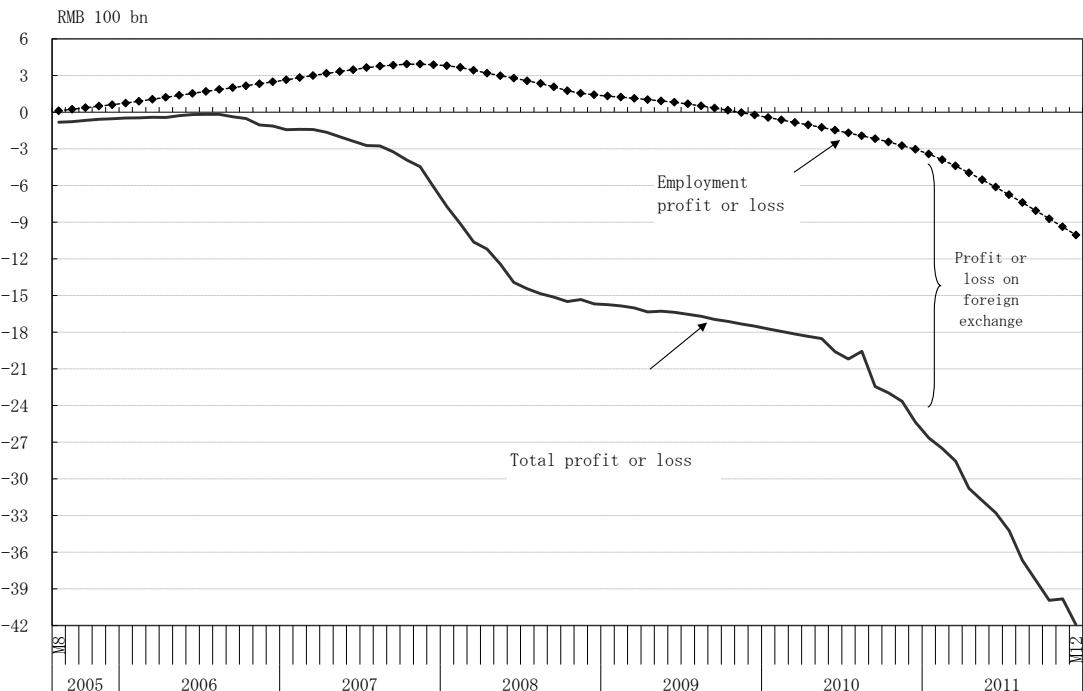


Notes: The fund-raising costs of PBC are Chibor until November 2003 and central bank bill three-month interest rates after it.

Source: IFS, The People's Bank of China Quarterly Statistical Bulletin

Assuming that the accumulated profit and loss before the RMB revaluation is zero, Fig. 11 shows the results from August 2005 onwards. Driven mainly by the revaluation of the RMB, and despite a period of employment profit margin, the PBC was not able to stop the expansion of losses. By the end of 2011, the contrast with our estimated results for January 2002 is 97%, and we can see that the scale of cumulative losses of overseas assets caused by the revaluation of the RMB is huge.

Fig. 11 Accumulated PBC profit and loss due to intervention (August 2005 and onwards)



Note: Assuming that profits and losses are zero before July 2005.

Source: The People's Bank of China Quarterly Statistical Bulletin, IFS, the website of the National Statistics Bureau

7. The future of the PBC

From Section 6.3, it is clear that the PBC is holding a huge latent loss as a result of intervention, corresponding to 85 times that of its equity capital.

Unless results show a positive change to the international balance of payments, they cannot but continue intervention if they want to control the RMB. Looking at Figure 1 again, we can see that from January 2008 the RMB exchange rate rise halted and became level. This is proof that PBC intervention occurred. Moreover, having an employment interest rate less than fund-raising costs cannot compensate for the hole created by short-term investment loss due to intervention. If such a

situation continues, the PBC intervention costs would further increase.

In recent years, the Chinese economy seems to be overheating. The PBC required private financial institutions to control mortgage loans in an effort to stem price increases. However, the overheating continues. Financial tightening measures such as revaluing the RMB to reflect the actual market situation, or sharply increasing interest rates, can be undertaken. However, these policies increase the latent loss in PBC overseas assets. Whether financial tightening is effectively executable, and how to improve the financial health of the country are big future challenges for the PBC.

The Chinese government has already begun to move on the operating profit of foreign reserves. In January 2007, Prime Minister Wen Jiabao announced a plan for the diversification in the employment of foreign reserves in the "national financial work meeting" held for the first time in five years. The MOF established the CIC in September to manage foreign reserves by issuing a special government bond funding of 200 billion dollars (over 15% of foreign reserves) from the PBC.

However, compared with an interest differential, the influence which a change in the exchange rate has on the appraised amount of overseas assets is not only strong, but is also identifiable early on. Although it is also important to consider a more effective employment method of foreign reserves, it is not a solution.

Therefore, future losses by intervention can be prevented through implementing a monetary policy looking at tightening an economy liable to overheating. One of the methods of gradually reducing the scale of foreign reserves is to revalue the RMB to reflect the actual market situation, and to return to a positive international balance of payment. However, in implementing a policy such as this, the PBC will incur temporary large-scale losses by a further revaluation of RMB, and top-level PBC political commitment would be required.

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