Capital Mobility and Monetary Sterilization Policies in Selected Asia Economies Before and After the 1997 Asian Currency Crises

BY

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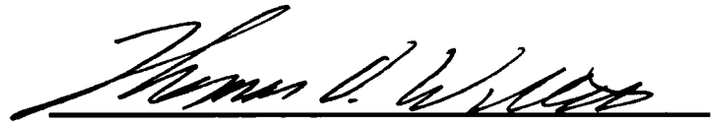

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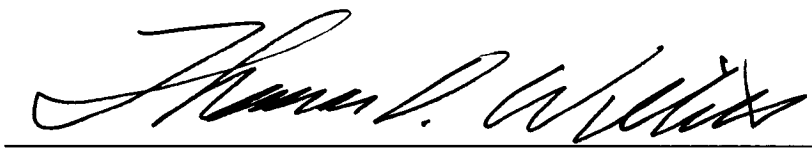

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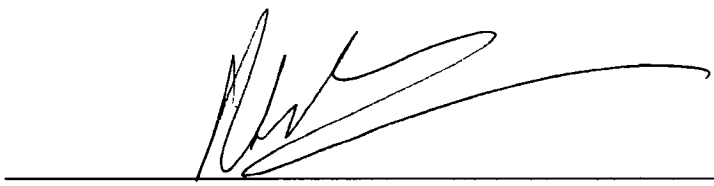

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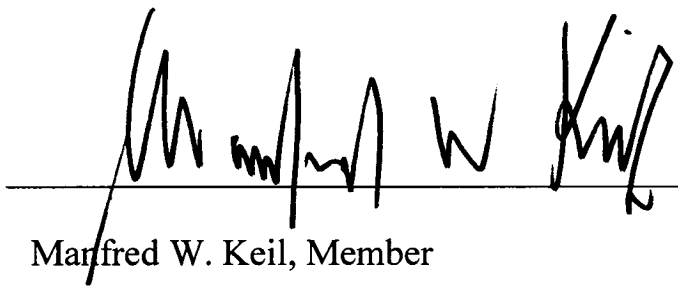

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Abstract of the Dissertation

Capital Mobility and Monetary Sterilization Policies in Selected Asia Economies Before and After the 1997 Asian Currency Crises

By

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The Claremont Graduate University, 2007

Many emerging economies in Asia and elsewhere have been plagued by sharp booms and bust cycles of capital inflows and outflows. The heavily managed exchange rate, current account improvement, and surge of capital inflows inevitably placed significant upward pressure on the domestic currency. To keep inflation under control, the monetary authorities have often used monetary sterilization policies to offset the liquidity impact of their foreign exchange rate intervention.

The aim of my dissertation is to examine the extent of sterilization and the degree of *de facto* capital mobility in nine Asian economies before and after the 1997 Asian currency crises, namely China, India, Indonesia, Korea, Malaysia, the Philippines, Singapore, Taiwan, and Thailand. To do so I estimate what the literature refers to as the "sterilization coefficient", i.e. the how much domestic credit changes in response to a change in international reserves, as well as the "offset coefficient", i.e. how much private capital changes in response to a change in domestic credit. The estimated equations were derived from the expanded theoretical model based on Brissimis, Gibson, and Tsakalotos (2002). Two-stage least square methodology is used to estimate the simultaneous equations. Various types of sterilization instruments are also discussed in the dissertation.

The empirical results suggest that China's effective degree of capital mobility has risen substantially in recent years with offset coefficients rising from around 0.1 to 0.2 in 2003 to above 0.6 for the most recent data. This is consistent with the judgments of a number of economists that China's capital controls have been becoming increasingly less binding.

With regard to the other Asian economies, in the pre-crisis period, the offset coefficients ranged from a low of 0.29 in the case of Indonesia to a high of 1 (perfect *de facto* capital mobility) in the cases of Thailand. The coefficients for India, Korea, Malaysia, the Philippines, Singapore, and Taiwan hovered around 0.53 – 0.9. In the post-crisis period the offset coefficients fell somewhat in India (0.65-0.71), Indonesia (positive 0.01-0.03), Korea (0.47-0.55), the Philippines (0.42-0.47), Taiwan (0.7-0.8), and Thailand (0.8-1.08), and increased marginally in Malaysia (0.91-0.95) and Singapore (1.05-1.19). Monetary sterilization appears to have been complete in the cases of Indonesia, Korea, the Philippines, Singapore, Taiwan, and Thailand, and moderate-to-high in the case of India and Malaysia (0.6 – 0.8). Post-crisis, the sterilization coefficient fell sharply for Indonesia and also lost statistical significance, suggesting that monetary policy was focused on other objectives. Estimated sterilization coefficients also declined in Korea (0.21-0.79) and Thailand (0.36-0.59), and increased slightly in India (0.93-1.21) and Malaysia (0.91-1.01), but remained stable and moderate-to-high levels in the cases of the Philippines (0.97-1.07), Taiwan (0.92-1.07), and Singapore (0.37-0.91).

Dedication

To my family, Chi-Feng Ouyang, Huei-Chin Duan, Yuan-Jen Ouyang,

and Yuan-Ting Ouyang.

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My deepest appreciation goes to Professor Thomas D. Willett, my dissertation chair and advisor, for his patient and brilliant guidance. All the trainings and opportunities he has provided will benefit the rest of my academic life. I also want to thank Prof. Ramkishen S. Rajan for his consistent support and pushing. Without his countless emails and phone calls, I would never finish my dissertation on time.

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Finally, I owe special thanks to my lovely fiancé, Jie Li, for all the happiness and bright future that he brought to me. All the time we have been in the states, all the friends we have met here, and all the difficulties we have overcome will be our most precious memory together. With him, my dream has been accomplished one by one. Thank God to bring him to my life.

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Chapter 1: Introduction and the Objectives of the Study

Many emerging economies in Asia and elsewhere have been plagued by sharp booms and bust cycles of capital inflows and outflows. Beginning at the end of the 1980s, a larger amount of international capital flew into Asian emerging markets, and drove sharp economic growth due to both "push" and "pull" factors.[1] Since most Asian countries are export-oriented economies, many of them had pegged their exchange rates to the US dollar until the 1997 Asian crises. The heavily managed exchange rate, current account improvement, and surge of capital inflows inevitably placed significant upward pressure on the domestic currency. To keep inflation under control, the monetary authorities have often used monetary sterilization policies, such as open market operations and reserve requirement adjustment, to offset the liquidity impact of their foreign exchange rate intervention.

Although there was a large amount of capital that flowed out of Asia during the crises period, the sharp depreciation and the prompt economic recovery have improved Asian economies' current account and attracted more international capital flows back into Asia. However, the frightened experience of a sudden reversal in capital flows during the crises period has made many Asian economies begin to accumulate international reserves, even though most of them have abandoned the pegged exchange rate and adopted a more flexible exchange rate policy. The consequence of this is that the top seven reserve

[1] To be sure, while "push" factor from industrial countries determine the timing and magnitude of capital flows, "pull" factor determine the geographical distribution of the flows (see Montiel and Reinhart, 1999). Takagi and Esaka (1999) note that the "push" factors included lower interest rates, recessions, and regulatory changes favoring international portfolio diversification in the industrialized countries, while the "pull" factors include trade and capital market liberalization, exchange rate stability and deposit guarantees in the East Asian economies

holders are all Asian economies (They are China, Japan, Taiwan, Korea, India, Singapore, and Hong Kong).[2]

There is evidence that many supposed floaters in Asia seem to heavily manage their currencies vis-à-vis the US dollar (Cavoli and Rajan, 2006, Willett et al., 2005, and McKinnon and Schnabl, 2004). This heavy foreign exchange market intervention by many Asian developing countries even post 1997-98 has in turn contributed to a notable global macroeconomic development, viz. the rapid buildup of reserves in Asia (for instance, see Kim et al., 2005 and references cited within). The most dramatic case will be China. It has overtaken Japan and become the world's largest reserve holder since February 2006.[3]

The most prominent debate on China's reserve growth has focused on whether this payments imbalance signals the need for a substantial revaluation or appreciation of the Chinese Renminbi (RMB), both to help reduce global economic imbalances and to protect China from imported inflation and a misallocation of resources (including the opportunity costs of holding low-yielding international reserves).[4] An alternative view sees the reserve build-up as a prudent response to the risks of currency crises in a world of high capital mobility. Still another view, particularly associated with McKinnon (2003a,b, 2004) argues that a fixed exchange rate is optimal policy for China and the region on grounds both of macroeconomic stability and economic development.

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[2] Each of them has held over US$ 100 billion in reserves.

[3] China is the world's largest reserve holder (even overtaking Japan), having amassed over US$ 850 billion of reserves by the end of February 2006.

[4] See Bird and Rajan (2002) and Rodrik (2006) for discussions and simple computations of the opportunity costs of reserve hoarding.

The global monetarist approach of McKinnon is based on the assumption of little or no sterilization of reserve accumulation and the consequent conclusion that China's current payments surplus is temporary. Other commentators have suggested that the Chinese government's concern with inflation has led them to heavily sterilize the reserve inflows, but that this has become increasingly difficult as reserves continue to rise and capital controls become more porous. Indeed, given the potential liquidity overhang concerns in China due to a massive and rapid reserve buildup, the People's Bank of China (PBOC) has actively used a combination of market-based and administrative measures to mop up the excess liquidity. However, the extent and success of sterilization remains in doubt. After a long period of debate and discussion, China finally loosened its strict US dollar peg and allowed for a small revaluation from 8.28 to 8.11 per US dollar in July 21, 2005 and simultaneously announced that the RMB would be pegged to a basket of currencies.[5]

The aim of this paper is to examine the extent of sterilization and the degree of capital mobility in nine Asian economies—China, India, Indonesia, Korea, Malaysia, the Philippines, Singapore, Taiwan, and Thailand. I estimate what the literature refers to as the "sterilization coefficient", i.e. how much domestic credit changes in response to a change in international reserves. Theoretically, higher financial integration makes sterilization more difficult. The sale of government securities tends to raise interest rates, attracting further capital inflow if capital mobility remains very high. The central banks may not have the ability to offset a large amount of capital flows. I also estimate what the literature refers to as the "offset coefficient", i.e. how much balance of payments changes

[5] The RMB has been on a very gradual appreciating path since July 2005.

in response to a change in domestic credit, to examine if financial markets grown sufficiently large to make sterilization ineffective. Because the foreign exchange market and the domestic monetary market are tightly interrelated, ignoring such inter-relationships can lead to highly-biased results.

The empirical analysis in this paper is informed by the formal framework developed by Brissimis, Gibson, and Tsakalotos (2002) (BGT henceforth). In particular, BGT construct a unifying theoretical framework that can yield both balance of payments function and monetary reaction function simultaneously by minimizing the loss function of the monetary authorities. The estimating equations in the BGT model are derived from explicit optimization, thus providing more solid theoretical bases for the empirical study.

In addition, there is a basic dilemma involved in sterilization (Calvo, 1991). Insofar as sterilization effectively involves keeping money supply growth in check, sterilization implies that the price of money, namely the interest rate, remains high. This in turn provides incentives for sustained capital inflows (given the higher returns that foreign investors can earn by investing in a country). Thus, the monetary authority is faced with a spiral of capital inflows, growing reserves and high interest rates. In addition, sterilization can have high fiscal costs as it often requires the monetary authorities to purchase relatively low-yielding foreign assets and pay high interest rates on the domestic government debt issued to minimize the effect of reserve growth on its domestic monetary level.[6] Hence, different sterilization instruments as well as their advantages and disadvantages will be discussed.

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[6] For some estimates of the fiscal costs of sterilization, see Calvo, et al (1993) and Khan and Reinhart (1994).

This dissertation is divided into six chapters. Following this introduction, chapter 2 offers a comprehensive literature review and an overview of some of the main empirical research and findings on monetary sterilization in Asia. Chapter 3 builds up a theoretical model based on the BGT model. The solution of the theoretical model derives the necessary set of estimating equations. Chapter 4 summarizes and provides an overlook of the data to be used in the formal empirical exercise. In this chapter, I will undertake the empirical investigation, and discuss the main empirical results for all the sample economies, except China. The capital inflow episode and policy responses will also be described in this chapter. Since the theoretical model cannot be applied directly to China which maintained a fixed peg to the US dollar until July 2005, China's case will be discussed separately in chapter 5. Chapter 6 offers a summary and conclusion.

Chapter 2: Literature Review

In this chapter, I provide a comprehensive literature review and evaluation of the different methodologies used in previous studies.

There are many different methods to measure the degree of capital mobility. In addition to other literatures comparing the correlation between national saving and investment rates (such as Feldstein and Horioka, 1980 and Montiel, 1994), utilize the covered interest differential measurement (such as Chinn and Frankel, 1994 and Cavoli, 2005) and create an index of capital mobility (Alesina, Grilli and Milesi-Ferreti, 1994, Montiel and Reinhart, 1999, and Quinn, 1997), I focus my studies on the theoretical framework of the monetarist model and portfolio balance models. Obstfeld and Rogoff (1996) argued that the saving-investment regressive correlation does not offer a clear economic interpretation for capital mobility since it cannot be directly derived from a theoretical model. As for the covered interest differential measurement, Chinn and Dooley (1995) have criticized that examining money market rates' linkage might lead to a false inference since bank lending rates might be heavily regulated by the government, which is exactly the case in most of Asian countries. With regard to the index of capital mobility, it is an ordinal level of measurement that can only be categorized into certain different levels. So, it may be difficult to measure and distinguish each country's capital mobility accurately. Many problems measuring in capital mobility, but offset coefficients may give us a good approximate for capital mobility.

Most existing studies that estimate the extent of sterilization can be classified into three groups. The first group estimates the sterilization coefficient by running simple Ordinary Least Square (OLS) method on the monetary reaction function, while the second group uses a Vector Autoregression (VAR) model. The third group, on the other hand, estimates the nexus between net domestic assets (NDAs) and net foreign assets (NFAs) by using a set of simultaneous equations.[7] The detail discussion can be found in the following sections.

2.1 Two Basic Models to Estimate the Degree of Capital Mobility

Here, I discuss two basic models: a monetarist model and a portfolio balance model. A monetarist model focuses on the relationship between money market equilibrium and the overall balance of payments (BOPs henceforth). The balance of payments disequilibrium is essentially a monetary phenomenon, indicating that a BOPs deficit is a reflection of an excess in the supply of money, while a BOPs surplus is a reflection of an excess demand for money. The portfolio balance model, however, concentrates on the capital account of the balance of payments and assumed that only capital flows are responsive to changes in the domestic component of the monetary base (i.e. NDAs), whereas the current account is exogenous. In this model, the money demand and supply can only affect balance of payments indirectly viz. domestic interest rate changes.

(1) Monetary Approach (Balance of Payment Function)

[7] The monetary base equals to the sum of net domestic assets and net foreign assets of monetary base. Net foreign assets are mainly contributed by foreign reserves, while net domestic assets are contributed by domestic credit. They are both listed on the central bank's balance sheet.

Based on Aghevli and Khan (1977), the monetary approach emphasizes the results of changes in the money demand and supply and suggests that the only thing that matters is the ultimate change of international reserves, not the sources. Frenkel and Johnson (1976) also indicate that a balance of payments disequilibrium is caused by excess demand or supply of money. Hence, the balance of payments should be balanced if the money market is cleared, indicating that money supply equals money demand.

A simple monetary approach has four assumptions. First, the money multiplier is constant. Second, the net domestic assets (the domestic component of the monetary base) is assumed to be exogenous since it is one of the policy instruments. Third, monetarists assume that monetary authorities do not implement sterilization policy. They argue that the balance of payments disequilibrium is temporary and self-correcting. Without sterilization, the disequilibrium will be eliminated once the money market reaches balance. Finally, the money market disequilibrium directly influences the balance of payments.

If the money market is cleared, then the money supply equals to money demand:

$$M^s = M^d \tag{2-1}$$

Since money supply equals the product of the money multiplier and the monetary base (MB henceforth), whereas monetary base is the sum of the net foreign assets and net domestic assets, we can rewrite the money supply as:

$$\begin{aligned} M^s &= m \times MB \\ &= m \times (NFA + NDA) \end{aligned} \tag{2-2}$$

In addition, the money demand is the function of the change in price, real output and the interest rate. So the equation (2-1) can be written as:

$$m \times (NFA + NDA) = M^d(p, y, i) \tag{2-3}$$

Logarithmic differentiation of (2-3) can yield the balance of payments function:

$$\frac{\Delta NFA_t}{MB_t} = a_0 + a_1 \frac{\Delta NDA_t}{MB_t} + a_2 \Delta \log p_t + a_3 \Delta \log y_t + a_4 \Delta \log i_t + \varepsilon_t \tag{2-4}$$

Since the money multiplier is assumed to be constant, we can omit it from the function. Here, the coefficient of a_1 is called the offset coefficient, which can be used to measure the degree of capital mobility. Offset coefficient is the value which falls within 0 and -1. If the capital mobility is perfect, then balance of payments will offset a change in domestic credit. So $a_1 = -1$. On the other hand, $a_1 = 0$ if the capital market is close, indicating that the disequilibrium in domestic money market will not be able to affect the external balance due to zero capital mobility. A summary of previous empirical studies that estimated by the monetary approach is listed in Table 2-1.[8]

[8] Most of the summaries of previous empirical studies (Table 2-1 to Table 2-5) are updated from Sarjito (1996) and Kasavapanich (1999).

Table 2-1: A Summary of Offset Coefficient Estimates from the Monetary Approach (Balance of Payment Function)

Author(s)	Country(s) / Freq. & Interval	Method	Estimated Offset Coefficient
Developed Countries			
Bean (1976)	Japan/ Q: 1959-70	OLS	-0.58 ~ -0.72
Genberg (1976)	Sweden/ Q: 1950-68	2SLS	-1.11
Guitian (1976)	Sapin/ A: 1955-71	OLS	-0.96
Kulkarni (1985)	Netherlands/ A: 1985-78	OLS	-0.67
Ujiie (1978)	Japan/ Q: 1959-72	OLS	-0.66
Zecher (1976)	Austria/ Q: 1950-71 A: 1950-71	OLS	-1.06 -1.23
Developing Countries			
Aghevli and Khan (1977)	39 Countries/ A: 1957-66	Pooled	-0.41
Bilquess (1989)	Pakistan/ A: 1959-82	OLS	0.04 ~ 0.07
Kamas (1986)	Venezuela/ Q: 1970-82 Mexico/ Q: 1971-81	OLS OLS	-0.88 0.05
Miller and Askin (1976)	Brazil/ A: 1955-71 Chile/ A: 1955-71	2SLS	-0.18 -0.29
Schadler et al. (1993)	Chile/ Q: 1980-91 Colombia/ Q: 1976-91 Egypt/ Q: 1976-91 Mexico/ Q: 1978-91 Spain/ Q: 1976-91 Thailand/ Q: 1977-91	OLS	-0.14 -0.55 -0.17 -0.33 -0.08 -0.89
Takagi (1986)	Costa Rica/ M: 1951-56 El Salvador/ M: 1953-58 Nicaragua/ M: 1955-60	2SLS	-0.73 -0.75 -0.7
Wilford and Wilford (1978)	Honduras/ A: 1950-74	OLS	-0.88
Wilford and Zecher (1979)	Mexico/ A: 1955-74	OLS	-0.95 ~ -1.18
Wohar et al (1987)	Honduras/ A: 1960-83	OLS	-1
Wohar and Burkett (1989)	Venezuela/ A: 1960-83	OLS	-1.1

(2) Portfolio Balance Model (Capital Flow Function)

The main difference between the portfolio balance model and the monetary model is that the former puts more attention on the capital account rather than the overall balance of payments. It also implies that the current account is exogenous. A second difference is that the capital account is mainly affected by the change in domestic interest rate, which is determined by the domestic money market. A rise in domestic interest rate will attract more private capitals flow into the country and increase the capital account. Hence, the degree of capital mobility is determined by the speed of substitutability between interest-bearing assets of different currency denomination.

The portfolio balance model was developed by Kouri and Porter (1974). The typical reduced-form of capital flow function is:

$$KA_t = b_0 + b_1 \Delta NDA_t + b_2 CA_t + b_3 \Delta \log Y_t + b_4 \Delta \log i_t^* + v_t \qquad (2\text{-}5)$$

where KA_t and CA_t are capital account (i.e. net private capital inflows) and current account on the balance of payments, respectively. Because nominal output is used as the explanatory variable, the change in prices is not included in the model. The domestic interest rate is also not included due to the endogenous relationship between the domestic interest rate and capital flows. Again, b_1 is the offset coefficient, which lies within 0 (no capital mobility) and -1 (perfect capital mobility).

A monetary approach emphasizes the overall balance of payments, while the portfolio balance model focuses on the private capital flows. The monetarist model has

been criticized that it is the estimation of an accounting identity rather than a behavioral relationship since net foreign assets and net domestic assets are two main components on a central bank's balance sheet.[9] In addition, the estimation of both models might contain a simultaneity bias if monetary authorities implement a monetary sterilization policy.[10] Therefore, previous literature has been used to adopt a simultaneous equation to measure the capital flows and monetary reaction function together. A detailed discussion can found in the following simultaneous equations section. Table 2-2 lists the previous empirical results estimated by portfolio balance models.

Table 2-2: A Summary of Offset Coefficient Estimates from the Portfolio Balance Model (Capital flow Function)

Author(s)	Country(s) / Freq. & Interval	Method	Estimated Offset Coefficient
Developed Countries			
Neuman (1978)	Germany/ Q: 1963-70	OLS	-0.41 ~ -0.53
Kouri and porter (1974)	Germany/ Q: 1960-70 Italy/ Q: 1964-70 Netherlands/ Q: 1960-70 Australia/ Q: 1961-72	OLS	-0.77 -0.43 -0.59 -0.47
Obsfeld (1982)	Germany/ Q: 1960-70	OLS CORC[11]	-0.93 -0.97
Porter (1974)	Australia/ Q: 1961-72	OLS	-0.48

[9] A detail discussion about problems caused by the accounting identity issue will be discussed in the chapter 5.

[10] When monetary authorities do a sterilized intervention, the net domestic assets will adjust in response to the change in net foreign assets.

[11] CORC represents the Cochrane-Orcutt iterative procedure.

2.2. Three Basic Models to Estimate the Extent of Sterilization

As stated before, most studies of measuring the extent of sterilization can be categorized into three groups: a simple monetary reaction function (OLS); a VAR model; and a set of simultaneous equations.

(1) Monetary Reaction Function

The first group estimates the sterilization coefficient by running simple OLS on the monetary reaction function. But the monetary reaction function can be written in different forms. A general monetary reaction function is specified as follows:

$$\Delta DC_t = c_0 + c_1 \Delta R_t + X'\beta + u_t \qquad (2\text{-}6)$$

where ΔDC_t and ΔR_t represent the change in domestic credit and international reserves, respectively. X represents other explanatory variables that might cause monetary authorities' reaction.

Most studies, such as Kwack (2001) and Cavoli and Rajan (2005), use changes in net domestic assets to proxy ΔDC_t. So, the coefficient of $c_1 = -1$ represents monetary authorities fully sterilizing the reserves increase. If $c_1 = 0$, then no sterilization. On the other hand, there are some other papers, such as Burdekin and Siklos (2005) that use changes of monetary base (or broad money) as the dependent variable. If this is the case, then $c_1 = 0$ represents full sterilization since a rise of international reserves does not significantly impact on the monetary base (or broad money).

Because this method ignores the problem of endogenity between domestic and foreign components of the monetary base, it may cause serious estimation bias. Please refer to Table 2-3 for a summary of previous empirical research estimating by a monetary reaction function.

Table 2-3: A Summary of Sterilization Coefficient Estimates from A Monetary Reaction Function

Author(s)	Country(s) / Freq. & Interval	Method	Estimated Sterilization Coefficient
Developed Countries			
Darby and Stockman (1983)	Canada/ Q: 1957-76 France/ Q: 1957-76 Germany/ Q: 1957-76 Italy/ Q: 1957-76 Japan/ Q: 1957-76 Netherlands/ Q: 1957-76 UK/Q: 1957-76	2SLS	-0.86 -0.76 -0.72 -1.19 -0.35 -0.85 -0.88
Herring and Marston (1977)	Germany/ Q: 1957-76	2SLS	-0.91
Obstfeld (1983)	Germany/ M: 1975-81 M: 1974-81	NLSQ[12]	-0.92 -0.86
Developing Countries			
Burdekin and Siklos (2005)	China/Q: 1990-02	GMM	-1.1 ~ -1.2 [13]
Cavoli and Rajan (2005)	5 Asian countries/ M: 1990-97:05 South Korea Thailand Indonesia Malaysia The Philippines	OLS	 -1.11 -0.91 -0.77 -0.94 -0.98
Joyce (1991)	Mexico/ Q: 1959-81 South Korea/ Q: 1961-79	OLS	1.06 -0.63

[12] NLSQ represents the Nonlinear Least Squares method.

[13] Burdekin and Siklos (2005) regress the change of base money on the change of foreign reserves and find that one unit increases in the change of foreign reserves will decrease 0.1 to 0.2 units in the change of base money (based on OLS and GMM), suggesting that the PBOC has been over-sterilized the foreign reserves. However, they also find that the change of foreign reserves has significantly increased M2 growth, indicating that sterilization measures have not been sufficient to prevent M2 (broader money supply) from increasing.

	India/ Q: 1960-70 Zambia/ Q: 1976-83		-0.53 -0.65
Kim (1990)	South Korea/ Q: 1971-78 Q: 1979-85	OLS	-0.68 ~ -0.76 -0.88 ~ -0.93
Lee (1985)	South Korea/ Q: 1971-78	OLS	0.17
Cumby and Obstfeld (1983)	Mexico/ Q: 1971-78	2SLS	-1.15
Siklos (2000)	Hungary/ M: 1992-97:03	OLS/2SLS	-1 ~ -1.4

(2) Vector Autoregression (VAR) Model

The second group uses a VAR model to estimate the lagged effects of NDAs and NFAs. Since a VAR model allows tracing the time path of the various shocks on the variables contained in the VAR system (i.e. the impulse response function), more and more recent papers use this method to find the monetary policy reaction to a shock on the capital inflows. The standard form of a VAR model is below:

$$\Delta DC_t = \alpha_{10} + \sum_{i=1}^{k} \alpha_{1i} \Delta DC_{t-i} + \sum_{i=1}^{k} \beta_{1i} \Delta R_{t-i} + e_{1t} \qquad (2\text{-}7)$$

$$\Delta R_t = \alpha_{20} + \sum_{i=1}^{k} \alpha_{2i} \Delta R_{t-i} + \sum_{i=1}^{k} \beta_{2i} \Delta DC_{t-i} + e_{2t} \qquad (2\text{-}8)$$

ΔDC_t and ΔR_t represent the change in domestic credit and international reserves respectively. Of course, each paper may include more variables in their VAR model. The additional variables are domestic interest rate, price level, or exchange rate, depending on the specific model.

To measure the effectiveness of sterilization, the recent literatures, such as Moreno (1996), Christensen (2004), and Oh (2005), use changes in NDAs (or domestic credits) and changes in NFAs (or foreign reserves denominated in domestic currency) to proxy the ΔDC_t and ΔR_t respectively. They check the impulse response function to examine the responses to shocks of foreign assets and domestic credit. If a shock from foreign assets (say an unexpected increase in foreign assets) is associated with an offsetting decrease in domestic credit, then the sterilization is significant and concluded. However, some other papers, such as Takagi and Esaka (1999) and Kim et al (2004), prefer to use change of M1 (or M2) to proxy ΔDC_t. They argue that it is inappropriate to use a conventional way to measure the effectiveness of sterilization given the variety of policy instruments used in sterilization in addition to open market operations. Examining the change of domestic credit may not indicate the actual effectiveness of sterilization. If M1 (or M2) is used in the VAR model, then full sterilization will be concluded if an unexpected increase in foreign assets is not associated with a corresponding increase in M1 (or M2). Table 2-4 includes the previous empirical evidence estimated from a VAR model.

The disadvantage of the VAR approach, however, is that it tends to treat all variables as symmetrically endogenous. As equation (2-7) and (2-8) show, a standard form of the VAR model only yields the estimated values of lagged NDAs and NFAs due to the identification issue. So it cannot estimate the contemporary effect of variables without restrictions.

Table 2-4: A Summary of Offset Coefficient and Sterilization Coefficient Estimates from A VAR Model

Author(s)	Country(s) / Freq. & Interval	Method	Estimated Offset Coefficient	Estimated Sterilization Coefficient
Developing Countries				
Christensen (2004)	Czech Republic/ M: 1993-95	VAR	-0.15	-0.11
Kim et al. (2004)	South Korea/ Q: 1980-1989 Q: 1990-1999 Q: 1990-1997	VAR		Heavy sterilized
Moreno (1996)	South Korea/ M: 1981-94 Taiwan/ M: 1981-94	VAR	Taiwan is more restricted on capital flows.	Heavy sterilized Moderate sterilized
Oh (2005)	South Korea/ M: 1999-04	VAR		Heavy sterilized
Takagi and Esaka (1999)	5 Asian countries[14]/ Q: 1987-97:q2	VAR		Heavy sterilized

(3) Simultaneous Equations

Finally, the third group measures the nexus between NDAs and NFAs by using a set of simultaneous equations. Argy and Kouri (1974) followed the Kouri and Porter's (1974) portfolio balance model analysis, but argued that the effect of ΔNFA_t to ΔNDA_t will be stronger than the converse if monetary authorities continually sterilize the capital flows. Because of this endogenity issue, using simple OLS estimation only yields biased results. Therefore, the Two-Stage Least Square method (2SLS henceforth) or Instrumental Variables method (IV henceforth) might be better when assessing the simultaneous equations.

[14] Five Asian countries are Indonesia, South Korea, Malaysia, The Philippines, and Thailand.

The recent representative papers in this group are Fry (1993), Kim (1995), Nyatepe-Coo (1995), Sarjito (1996), Rooskareni (1998), and Brissimis, Gibson, and Tsakalotos (2002). The basic model specification for a set of simultaneous equations is:

$$\Delta NFA_t = \alpha_{10} + \alpha_{11}\Delta NDA_t + X_1'\beta_1 + u_{1t} \quad (2\text{-}9)$$

$$\Delta NDA_t = \alpha_{20} + \alpha_{21}\Delta NFA_t + X_2'\beta_2 + u_{2t} \quad (2\text{-}10)$$

where ΔNFA_t and ΔNDA_t represent the change in net foreign assets and net domestic assets respectively.[15] X_1 and X_2 are the other explanatory variables in balance of payment function and monetary reaction function respectively.

There are two advantages to using a simultaneous equation. First of all, a simultaneous equation may be the most proper methodology to deal with the endogenity issue[16] and provides consistent estimators. Second the estimation yields the estimated values of contemporary NDAs and NFAs in both balance of payment function and monetary reaction function respectively. Therefore, I estimate a set of simultaneous equations that yield coefficients for both the degree of sterilization and effective financial capital mobility for selected Asian countries. There have accumulated a large amount of literature that used simultaneous equations to estimate both offset and sterilization coefficients (please refer to Table 2-5).

[15] Depending on what model is used, some papers use change in capital flows as the dependent variable in (2-9) if they use the portfolio balance model. Here we follow the monetary approach.

[16] Since the foreign exchange and the domestic money markets are tightly interrelated, it is important to recognize the contemporaneous relationship between net domestic assets (NDAs) and net foreign assets (NFAs).

One must be concerned about the model specification problem. The theoretical model in the dissertation is based on the model constructed by Brissimis, Gibson, and Tsakalotos (2002). The advantage of this model is that both balance of payment function and the monetary policy reaction function can be derived by a simple loss function of the monetary authorities subject to a number of constraints that reflect the working of the economy. The detailed theoretical model specification will be discussed in Chapter 3.

Table 2-5: A Summary of Offset and Sterilization Coefficient Estimates from A Set of Simultaneous Equations

Author(s)	Country(s) / Freq. & Interval	Method	Estimated Offset Coefficient	Estimated Sterilization Coefficient
Developed Countries				
Argy and Kouri (1974)	Germany/ Q: 1963-70 Netherlands/ Q: 1964-70 Italy/ Q: 1964-70	2SLS	-0.47 -0.51 -0.53	-0.23 ~ -0.45 -0.74 ~ -0.87 -0.67 ~ -1.37
Brismiss et al. (2002)	Germany / Q: 1979-92	2SLS 3SLS	-0.22 -0.40	-0.74 -0.96
Hodjera (1976)	France/ Q: 1963-71	2SLS	-0.38 ~ -0.59	-0.73
Developing Countries				
Clavijo and Varela (2003)	Colombia / Q: 1990-2003	2SLS	-0.78	-0.42
Emir et al. (2002)	Turkey / M: 1990-93 M: 1995-99	2SLS	-0.29 -0.78	-0.54 -0.88
Fry (1988)	19 Countries/ Q: 1961-72 5 Pacific basin countries 14 other countries	3SLS/ pooled	-0.32 -0.66 -0.3	-0.15 -0.54 -0.1
Fry (1990)	Sri Lanka/ A: 1960-87	2SLS 3SLS	-0.65 -0.67	0.89 0.72
Fry (1996)	27 Developing Countries[17] 6 Pacific Basin Countries /		-0.18 ~ -0.17 -0.41	-0.23 ~ -0.25 -0.13

[17] 27 developing countries are Algeria, Argentina, Brazil, Chile, Côte D'Ivoire, Egypt, Ghana, Greece, India, Indonesia, Korea, Malaysia, Mexico, Morocco, Nigeria, Pakistan, Peru, Philippines, Portugal, Sri Lanka, Taiwan, Tanzania, Thailand, Turkey, Venezuela, Yugoslavia and Zaire.

	A: 1960-1991 Indonesia Korea Malaysia Philippines Taiwan Thailand		 -2.88 -0.25 1.30 1.17 1.86 -2.92	 -0.27 -0.24 0.15 -0.33 -0.49 0.33
Kamas (1986)	Venezuela/ Q: 1970-82 Mexico / Q: 1971-81	2SLS	-0.82 0.04	-1.04 1.55
Kasavapanich (1999)	Thailand/Q: 1978-95	2SLS with lags	-0.61 ~ -0.72 -0.64 ~ -0.84	-0.8 -1.1
Kim (1995)	Korea / Q: 1980-1994	2SLS	-0.35	-0.76
Rooskareni (1998)	Indonesia/ Q: 1978-93	2SLS	-0.25	-0.42 ~ -0.68
Author(s)	Country(s) / Freq. & Interval	Method	Estimated Offset Coefficient	Estimated Sterilization Coefficient
Sarjito (1996)	Indonesia/ Q: 1976-92	2SLS with lags	-0.5 -0.34	-0.47 ~ -0.67 -0.64 ~ -0.87
Savvides (1998)	Cameroon / A: 1975-88; Cote d'Ivoire / A: 1970-91; Gabon / A 1969-92; Ghana / A: 1966-92; Nigeria / A: 1964-91	2SLS	-0.23	-0.13
Uddin (1985)	India/ A: 1960-80 Pakistan/ A: 1960-80 Thailand/ A: 1960-80	2SLS	0.52 -0.17 -0.71	0.3 -1.26 -0.81

Chapter 3: Theoretical Model

The theoretical model used here takes as a starting point -- but modifies -- the model developed by Brissimis-Gibson-Tsakalotos or BGT (2002) which derives both the balance of payment and the monetary reaction functions from explicit minimization of a simple loss function of the monetary authority, subject to a number of constraints that reflect the workings of the economy.

The loss function is:

$$L_t = \beta(\Delta p_t)^2 + \gamma(Y_{c,t})^2 + \delta(\sigma_{r,t})^2 + \varepsilon(\sigma_{s,t})^2 \qquad (3\text{-}1)$$

The monetary authority's loss function is determined by the change in the logarithm of the price level (i.e. the difference in p_t and p_{t-1}); cyclical income (Y_{ct}); and the volatilities of the interest rate ($\sigma_{r,t}$) and the exchange rate ($\sigma_{s,t}$).[18] All the parameters are assumed to be positive.

The evolution of key variables including inflation and cyclical income is discussed below.

a) Inflation

[18] I have simplified the original BGT model by including actual changes in inflation and cyclical output in the loss function rather than changes of actual (inflation and output) from their respective target levels. Other changes include incorporation of the role of government spending on cyclical output and endogenization of the current account.

$$\Delta p_t = \pi_1[(\Delta NFA_t + \Delta NDA_t)mm_t + MB_t \Delta mm_t] + \pi_2 \Delta p_{t-1} + \pi_3 \Delta s_t \qquad (3\text{-}2)$$

where $\pi_1 > 0, 0 < \pi_2 < 1, \pi_3 > 0$. Eq. (3-2) states that inflation is a monetary phenomenon with a lagged effect. In addition, depreciation of the nominal exchange rate (rise in s_t) could increase inflationary pressures due to increased prices of imports.

b) Cyclical income

$$Y_{c,t} = \varphi_1[(\Delta NFA_t + \Delta NDA_t)mm_t + MB_t \Delta mm_t] + \varphi_2 Y_{c,t-1} + \varphi_3 \Delta G_t \qquad (3\text{-}3)$$

$$\varphi_1 > 0,\ 0 < \varphi_2 < 1, \varphi_3 > 0.$$

where: G_t is the government expenditure.[19] I assume that both expansionary fiscal and monetary policies can boost cyclical output.

c) Balance of Payments

$$\Delta NFA_t = CA_t + \Delta NK_t \qquad (3\text{-}4)$$

where: CA is the current account balance and ΔNK_t is the net capital inflow in time t.

[19] More precisely, one would want to use a measure of broader fiscal stance, viz. full employment fiscal balance.

The current account mainly depends on output and lagged real effective exchange rate (to account for inertial effects of real exchange rate change on the trade balance), while the net capital inflow depends on the uncovered interest differentials:

$$CA_t = -\alpha_1 Y_{c,t} - \alpha_2 \Delta REER_{t-1},\ \alpha_1 > 0, \alpha_2 > 0 \tag{3-5}$$

$$\Delta NK_t = (1/c)\Delta(s_t - E_t s_{t+1} + r_t - r_t^*) \tag{3-6}$$

where: $REER$ is the real effective exchange rate;[20] s_t is the current exchange rate (logarithm); $E_t s_{t+1}$ is the current expectation of the exchange rate at time t+1; r_t is the domestic interest rate; r_t^* is the foreign interest rate; and c represents the degree of relative risk aversion between domestic and foreign assets and the extent of capital controls.

In addition, the interest rate is determined by the change in money supply relative to money demand:

$$\Delta r_t = -\psi_1[(\Delta NDA_t + \Delta NFA_t)mm_t + MB_t \Delta mm_t] \quad \psi_1 > 0 \tag{3-7}$$

From (3-6), I get:

$$\Delta s_t = c\Delta NK_t + \Delta E_t s_{t+1} - \Delta r_t + \Delta r_t^* \tag{3-8}$$

After Substituting (3-3), (3-4), (3-5), (3-7) and (3-8) into (3-2), I derive:

[20] A rise implies a currency appreciation.

$$\begin{aligned}\Delta p_t = {} & (\pi_1 mm_t + c\pi_3 + \pi_3 c\alpha_1\varphi_1 mm_t + \pi_3\psi_1 mm_t)\Delta NFA_t \\ & + (\pi_1 mm_t + \pi_3 c\alpha_1\varphi_1 mm_t + \pi_3\psi_1 mm_t)\Delta NDA_t \\ & + (\pi_1 MB_t + \pi_3 c\alpha_1\varphi_1 MB_t + \pi_3\psi_1 MB_t)\Delta mm_t \\ & + (\pi_3 c\alpha_1\varphi_2)Y_{c,t-1} + (\pi_2)\Delta p_{t-1} + (\pi_3 c\alpha_1\varphi_3)\Delta G_t + (\pi_3 c\alpha_2)\Delta REER_{t-1} \\ & + (\pi_3)\Delta(r_t^* + E_t s_{t+1})\end{aligned} \tag{3-9}$$

d) Interest rate volatility

$$\sigma_{r,t} = \eta\sigma_{r,t-1} - \theta(\Delta NDA_t - d_1\Delta NDA_t) \quad \eta,\theta > 0 \tag{3-10}$$

Interest rate volatility depends negatively on the absolute amount of intervention undertaken by the central bank in the domestic money market. d_1 is the dummy which takes on a value of 0 when the money market is in deficit and a value of 2 when it is in surplus.[21]

e) Exchange rate volatility

$$\sigma_{s,t} = \kappa\sigma_{s,t-1} - \varsigma(\Delta NFA_t - d_2\Delta NFA_t) \quad \kappa,\varsigma > 0 \tag{3-11}$$

---

[21]For estimation purpose, $\sigma_{r,t} = \eta\sigma_{r,t-1} - \theta\,|\,\Delta NDA_t\,|$ is transferred to non-absolute term (eq. 3-10). For example, the original BGT model assumes that the central bank injects money ($\Delta NDA_t > 0$) to prevent the interest rate rises while the money market is in deficit. Therefore, if the money market is in deficit and then $\Delta NDA_t > 0$, $\sigma_{r,t} = \eta\sigma_{r,t-1} - \theta\,|\,\Delta NDA_t\,|$ can be rewritten as $\sigma_{r,t} = \eta\sigma_{r,t-1} - \theta(\Delta NDA_t) = \eta\sigma_{r,t-1} - \theta(\Delta NDA_t - d_1\Delta NDA_t)$ with $d_1 = 0$. The same logic can be applied to the case that the money market is in surplus. When money market is in surplus, the central bank withdraws money to prevent interest rate falls so that $\Delta NDA_t < 0$. We can rewrite the volatility of interest rate as $\sigma_{r,t} = \eta\sigma_{r,t-1} - \theta\,|\,\Delta NDA_t\,| = \eta\sigma_{r,t-1} - \theta(-\Delta NDA_t) = \eta\sigma_{r,t-1} - \theta(\Delta NDA_t - d_1\Delta NDA_t)$ with $d_1 = 2$. The same methodology is also applied to the volatility of exchange rate in eq. (3-11).

Exchange rate volatility depends negatively on the absolute amount of intervention undertaken by the central bank in the foreign exchange market. d_2 is a dummy which takes on a value of 2 when there is an excess demand for foreign currency (and the central bank is losing reserves) and a value of 0 when foreign currency is in excess supply (and the central bank is stock-piling reserves).

Solving for $\partial L_t / \partial \Delta NDA_t = 0$ and $\partial L_t / \partial \Delta NFA_t = 0$ and substituting the constraints into the loss function derives the semi-reduced-form equations.

$$
\begin{aligned}
\Delta NFA_t = &-\{[\beta c\pi_3(\pi_1 + \pi_3\psi_1 + c\alpha_1\varphi_1\pi_3)mm_t + \beta(\pi_1 + \pi_3\psi_1 + c\alpha_1\varphi_1\pi_3)^2 mm_t^2 + r\varphi_1^2 mm_t^2]/u_1\}\Delta NDA_t \\
&-\{[\beta c\pi_3(\pi_1 + \pi_3\psi_1 + c\alpha_1\varphi_1\pi_3)MB_t + \beta(\pi_1 + \pi_3\psi_1 + c\alpha_1\varphi_1\pi_3)^2 mm_t MB_t + r\varphi_1^2 mm_t MB_t]/u_1\}\Delta mm_t \\
&-\{[\beta\pi_2(\pi_3 c + (\pi_1 + \pi_3\psi_1 + c\alpha_1\varphi_1\pi_3)mm_t)]/u_1\}\Delta p_{t-1} \\
&-\{[\beta c\alpha_1\varphi_2\pi_3(\pi_3 c + (\pi_1 + \pi_3\psi_1 + c\alpha_1\varphi_1\pi_3)mm_t) + r\varphi_1\varphi_2 mm_t]/u_1\}Y_{c,t-1} \qquad (3\text{-}12) \\
&-\{[\beta c\alpha_1\varphi_3\pi_3(\pi_3 c + (\pi_1 + \pi_3\psi_1 + c\alpha_1\varphi_1\pi_3)mm_t) + r\varphi_1\varphi_3 mm_t]/u_1\}\Delta G_t \\
&-\{[\beta c\alpha_2\pi_3(\pi_3 c + (\pi_1 + \pi_3\psi_1 + c\alpha_1\varphi_1\pi_3)mm_t)]/u_1\}\Delta REER_{t-1} \\
&-\{[\beta\pi_3(\pi_3 c + (\pi_1 + \pi_3\psi_1 + c\alpha_1\varphi_1\pi_3)mm_t)]/u_1\}\Delta(r_t^* + E_t s_{t+1}) \\
&-\{[\varepsilon\varsigma\kappa(d_2 - 1)]/u_1\}\sigma_{s,t-1}
\end{aligned}
$$

where: $u_1 = \beta[\pi_3 c + (\pi_1 + \pi_3\psi_1 + c\alpha_1\varphi_1\pi_3)mm_t]^2 + r\varphi_1^2 mm_t^2 + \varepsilon\varsigma^2(d_2 - 1)^2 > 0$.

$$
\begin{aligned}
\Delta NDA_t = &-\{[\beta c\pi_3(\pi_1+\pi_3\psi_1+c\alpha_1\varphi_1\pi_3)mm_t+\beta(\pi_1+\pi_3\psi_1+c\alpha_1\varphi_1\pi_3)^2 mm_t^2+r\varphi_1^2 mm_t^2]/u_2\}\Delta NFA_t \\
&-\{[\beta(\pi_1+\pi_3\psi_1+c\alpha_1\varphi_1\pi_3)^2 mm_t MB_t+r\varphi_1^2 mm_t MB_t]/u_2\}\Delta mm_t \\
&-\{[\beta\pi_2(\pi_1+\pi_3\psi_1+c\alpha_1\varphi_1\pi_3)mm_t]/u_2\}\Delta p_{t-1} \\
&-\{[\beta c\alpha_1\varphi_2\pi_3(\pi_1+\pi_3\psi_1+c\alpha_1\varphi_1\pi_3)mm_t+r\varphi_1\varphi_2 mm_t]/u_2\}Y_{c,t-1} \\
&-\{[\beta c\alpha_1\varphi_3\pi_3(\pi_1+\pi_3\psi_1+c\alpha_1\varphi_1\pi_3)mm_t+r\varphi_1\varphi_3 mm_t]/u_2\}\Delta G_t \\
&-\{[\beta c\alpha_2\pi_3(\pi_1+\pi_3\psi_1+c\alpha_1\varphi_1\pi_3)mm_t]/u_2\}\Delta REER_{t-1} \\
&-\{[\beta\pi_3(\pi_1+\pi_3\psi_1+c\alpha_1\varphi_1\pi_3)mm_t]/u_2\}\Delta(r_t^*+E_t s_{t+1}) \\
&-\{[\delta\theta\eta(d_1-1)]/u_2\}\sigma_{r,t-1}
\end{aligned}
\qquad (3\text{-}13)
$$

where: $u_2 = \beta[(\pi_1+\pi_3\psi_1+c\alpha_1\varphi_1\pi_3)mm_t]^2+r\varphi_1^2 mm_t^2+\delta\theta^2(d_1-1)^2>0$

Eqs. (3-12) and (3-13) are the balance of payments and the monetary reaction functions, respectively. The former estimates the impact of a change in net domestic assets (NDAs) on net foreign assets (NFAs) – the so-called "offset coefficient." The expected value of the offset coefficient is bound by 0 on the upper end in the event of no capital mobility and -1 in the event of perfect capital mobility. The sterilization coefficient is measured by the estimated coefficient of the change of net foreign assets in the monetary reaction function. The expected value of the sterilization coefficient is 1 if a reserve buildup is perfectly sterilized, and 0 if the central bank does not sterilize at all. The detailed variable definition and explanatory will be discussed in the next chapter.

Chapter 4: Empirical Estimation Procedures and Results

To measure the extent of sterilization and the degree of capital mobility in selected Asian economies, we estimate a set of balance of payments and monetary reaction functions. Both estimated equations are derived from the theoretical model in chapter 3. Based on equation (3-12) and (3-13), the estimated simultaneous equations are simplified as follows:

$$\begin{aligned}\Delta NFA_t^* = \alpha_0 &- \sum_{i=0}^{n}\alpha_{1i}\Delta NDA_{t-i}^* - \sum_{i=0}^{n}\alpha_{2i}\Delta mm_{t-i} - \sum_{i=1}^{n}\alpha_{3i}(\Delta p_{t-i}) - \sum_{i=1}^{n}\alpha_{4i}Y_{c,t-i} - \sum_{i=0}^{n}\alpha_{5i}\Delta G_{t-i} \\ &- \sum_{i=1}^{n}\alpha_{6i}\Delta REER_{t-i} + \sum_{i=0}^{n}\alpha_{7i}\Delta(r_{t-i}^* + E_t S_{t+1-i}) - \sum_{i=1}^{n}\alpha_{8i}(d_2 - 1)\sigma_{s,t-i} + \varepsilon_t\end{aligned} \tag{4-1}$$

$$\begin{aligned}\Delta NDA_t^* = \beta_0 &- \sum_{i=0}^{n}\beta_{1i}\Delta NFA_{t-i}^* - \sum_{i=0}^{n}\beta_{2i}\Delta mm_{t-i} - \sum_{i=1}^{n}\beta_{3i}\Delta p_{t-i} - \sum_{i=1}^{n}\beta_{4i}Y_{c,t-i} - \sum_{i=0}^{n}\beta_{5i}\Delta G_{t-i} \\ &- \sum_{i=1}^{n}\beta_{6i}\Delta REER_{t-i} - \sum_{i=0}^{n}\beta_{7i}\Delta(r_{t-i}^* + E_t S_{t+1-i}) - \sum_{i=1}^{n}\beta_{8i}(d_1 - 1)\sigma_{r,t-i} + \nu_t\end{aligned} \tag{4-2}$$

The balance of payments function (Eq. 4-1) consists of seven control variables, incorporating both "push" versus "pull" factors. The former refers to factors that motivate capital to leave creditor countries in search of better returns. The latter refers to factors motivating capital flows into specific recipient countries. One, a rise in the money multiplier for M2 increases the domestic money and pushes the interest rate down, hence reducing capital inflows. Two, higher inflation perpetuate concerns about the exchange rate depreciation, interest rate hikes and capital losses thereof, hence causing a reduction in capital inflows.[22] Three, higher lagged real output could worsen the current account

[22] Additionally, in practice, higher inflation could engender greater uncertainty, leading to reduced capital

(due to the income effect), reducing foreign reserve accumulation. Four, an expansionary fiscal policy (higher government expenditure) will raise cyclical income and once again worsen the current account as discussed above.[23] Five, foreign reserves will be decumulated due to a decrease in the current account if the real effective exchange rate is overvalued (price effect). Six, higher exchange rate adjusted foreign interest rates can also lead to capital withdrawals from the country. Finally, to keep exchange rate less volatile, the central bank tends to buy or sell foreign reserves (i.e. foreign exchange market intervention) when there is an excess in supply or demand for foreign currency, respectively. The more volatile the exchange rate, the heavier the central bank will intervene. Therefore, the expected sign for the interaction term should be negative.

The monetary policy function (Eq. 4-2) consists of seven control variables in the monetary reaction function in addition to the change of net foreign assets. These control variables are considered as important factors influencing monetary policy actions. The theoretical model suggests that the expected sign for these explanatory variables are negative, indicating that monetary authorities generally implement a contractionary monetary policy to defend its currency, and adjust to a rise in inflation, the money multiplier or the expected exchange rate depreciation. In addition, monetary authorities adopt an acyclical monetary policy if they contract domestic credit when there is a rise in real GDP growth rate or fiscal deficit. However, we note that the expected sign for the

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flows.

[23] Three caveats should be noted. One, it is important to consider the context of expansionary fiscal policy. If done in the event of an economic downturn, the impact may not be similar as if when done when output is at or above trend. Two, the focus here is on short term rates; in most circumstances one would expect higher budget deficits to cause a rise in long term interest rates. Three, it is also important to consider the impact of market expectations. If higher government expenditure is viewed as a sign of fiscal profligacy, this could lead to rise in country risk premium and consequent capital flight.

fiscal deficit should be positive if monetary authorities monetize a government's fiscal deficit. Also, both an overvalued real effective exchange rate and higher exchange rate adjusted foreign interest rates can cause a deficit in balance of payments. Monetary authorities tend to implement a high interest rate policy (i.e. contractionary monetary policy) to attract more capital inflows to reach external balance. Finally, to keep domestic interest rates less volatile, the central bank will inject or withdraw funds from the market when the domestic money market is in deficit or in surplus, respectively. Again, the more volatile the domestic interest rate, the heavier the central bank will intervene. We also anticipated a negative sign for the interaction term.

4.1 Data and Methodology

The estimation of the eight selected Asian economies is based on quarterly data over the sample period from 1990: q1 to present, depending on the data availability. Since there is a significantly structure change in the behavior of exchange rates during the currency crises period, the whole sample period is divided into two sub-samples: 1990:q1 to 1997:q2, and 1998:q3 to present. By comparing the different values of offset and sterilization coefficients in these two sub-samples, we are able to know how the extent of sterilization and degree of capital mobility change over time in each of sample countries.

All the data are obtained either from the *IMF-IFS* or the central banks' official websites. The definitions and sources of the various data used in the estimating equations can be found in Appendix 1. The relevant variables, such as the change in net foreign assets, net domestic assets, and fiscal deficit, are scaled by nominal output. To check

stationary, the unit roots test (Augmented Dickey Fuller test) also applied to each of the variables, and found that all variables are stationary at the ten percent significant levels during both pre- and post-crisis periods (see Table 4-1-1, and Table 4-1-2).

I used the Hodrick-Prescott method to measure the trend of real output. If it is positively deviated from the trend, we can say the economy is overheated. In addition, I used the standard deviation of the within quarterly change in the monthly exchange rate (real effective exchange rate) and interest rate (bank rate) to proxy the volatility of exchange rate and domestic interest rate. On the other hand, I assume that economic agents have perfect foresight of future exchange rates. So, the actual nominal exchange rate at the next period is used to proxy the expected exchange rate for the next period. In addition, static expectations of future exchange rate is also used to check the robustness. If this is the case, then the current nominal exchange rate is used to proxy the expected exchange rate for the next period.

In this paper, I use the two-stage least square (2SLS) method to estimate the simultaneous equations (4-1) and (4-2). To solve the model specification problem, I use both *F*-statistic and the Log likelihood ratio to test the statistical significance of a subset of the explanatory variables. The null hypothesis is whether the estimated coefficients of a subset of variables in an equation are jointly zero, and could be dropped from the equations. Autocorrelation and heteroskedasticity tests are also applied to the residuals from the estimated equations.[24] Newey-West HAC consistent covariance estimates are

[24] Serial correlation Lagrange multiplier (LM) test is used to test for the autocorrelation, while White's heteroskedasticity test is used to test the heteroskedasticity in the residuals.

used if there is a problem.[25] To check robustness, I consider the case if current account is exogenous and is not determined by the lagged real effective exchange rate and output change. Therefore, I replaced the lagged real effective exchange rate with the trade balance. In addition, I also do the estimation without the change in money multiplier to check if money multiplier has significant impact in the estimation. All the estimation and robustness check will be listed in the case study for each of the sample Asian economies (except China)[26] in section 4-3.

[25] Newey and West (1987) have derived a consistent covariance matrix estimator in the presence of both heteroskedasticity and autocorrelation.
[26] China's case will be discussed separately in Chapter 5.

Table 4-1-1: Unit-Root Test (ADF test): Pre-Crises Period (1990:q1-1997:q2)

	India	Indonesia	Korea	Malaysia	Philippines	Singapore	Taiwan	Thailand
ΔNFA_t^*	-2.980264**	-3.493953**	-3.046657**	-3.562164**	-3.909453***	-5.220960***	-4.006842***	-3.521159**
ΔNDA_t^*	-4.936721***	-3.188651**	-7.033587***	-3.265470**	-4.273189***	-4.613542***	-4.452462***	-5.284827***
Δmm_t	-5.000175***	-7.101822***	-6.316739***	-3.046701**	-5.182929***	-3.712562***	-3.332996**	-6.542068***
Δp_t	-7.454393***	-5.704478***	-4.361959***	-4.958796***	-3.173628**	-3.594687**	-5.846811***	-4.198407***
$Y_{c,t}$	-5.808038***	-3.232472**	-4.916529***	-4.718159***	-6.007211***	-4.357497***	-3.627123**	-2.711073*
ΔG_t	-3.904605***	-8.091423***	-6.999078***	-6.662933***	-6.577555***	-7.038346***	-5.499141***	-8.538304***
$\Delta(r_t^* + E_t S_{t+1})$	-3.714387***	-3.476542**	-3.268219**	-4.649726***	-2.639109*	-2.809463*	-2.648645*	-5.195128***
$\Delta REER_t$	-4.331499***	-5.659991***	-4.375018***	-3.897179***	-3.896383***	-5.592689***	-4.977831***	-3.575261**
$(d_2 - 1)\sigma_{s,t}$	-4.233445***	-5.606592***	-1.885510*	-3.689676**	-4.861855***	-4.341812***	-4.167763***	-1.656828*
$(d_1 - 1)\sigma_{r,t}$	-4.606633***	-4.273742***	-4.967713***	-2.308989**	-3.553572**	-4.633916***	-7.284666***	-4.029730***

Table 4-1-2: Unit-Root Test (ADF test): Post-Crises Period

	India	Indonesia	Korea	Malaysia	Philippines	Singapore	Taiwan	Thailand
Sample Period	1998Q3-2004Q4	1998Q3-2004Q3	1998Q3-2004Q3	1998Q3-2004Q4	1998Q3-2005Q1	1998Q3-2005Q2	1998Q3-2004Q3	1998Q3-2004Q3
ΔNFA_t^*	-3.690041**	-6.022882***	-4.517243***	-2.667027*	-3.765252***	-3.784483***	-2.968496*	-3.282049**
ΔNDA_t^*	-2.831913*	-6.191822***	-4.082712***	-2.898106*	-6.754192***	-3.362439**	-3.338737**	-3.045852**
Δmm_t	-5.466935***	-6.056088***	-4.333649***	-3.011974**	-3.724418***	-4.064590***	-3.431358**	-5.576592***
Δp_t	-4.854475***	-4.032343***	-5.089553***	-5.381079***	-2.672250*	-2.945301*	-3.601504**	-3.426308**
$Y_{c,t}$	-6.611288***	-3.256510**	-2.753272*	-4.045450***	-8.266598***	-2.896773*	-4.064334***	-3.597692**
ΔG_t	-4.132656***	-3.729387***	-4.664224***	-5.483348***	-5.807702***	-10.80876***	-6.973730***	-8.095750***
$\Delta(r_t^* + E_t S_{t+1})$	-4.050187***	-4.715048***	-2.799711*	-5.330627***	-4.264308***	-4.493170***	-4.033766***	-2.637008*
$\Delta REER_t$	-3.416033**	-3.725783**	-4.111790***	-3.079819**	-4.010996***	-3.103011**	-3.219860**	-4.179845***
$(d_2 - 1)\sigma_{s,t}$	-3.560398**	-4.728612***	-3.424594**	-26.76693***	-3.941639***	-5.260268***	-3.494789**	-3.784206***
$(d_1 - 1)\sigma_{r,t}$	-5.672158***	-2.630562*	-4.792383***	-2.779474*	-2.944156*	-4.726174***	-3.948670***	-4.478720***

4.2 Issues about Monetary Authorities' Balance Sheets

Since both the changes of NFAs and NDAs are taken from monetary authorities' balance sheets, we must be careful of how monetary authorities report the revaluation effects derived from exchange rate fluctuations, interest earnings earned from foreign reserves accumulation, and loans borrowed from international organizations (such as International Monetary Fund, World Bank, and etc.). Using the book values of NFAs and NDAs to conduct empirical research may cause sever bias since they are all affected by the effects mentioned above. The table below shows how International Monetary Fund (IMF) reports monetary authorities' balance sheet for each of countries.

Monetary Authorities' Balance Sheet

Assets	Liabilities and Equity
Foreign Assets (FA)	Currency in Circulation and Deposits (MB)
Domestic Assets (DA)	Foreign Liabilities (FL)
Other Assets (OA)	Domestic Liabilities (DL)
	Other Liabilities (OL)
	Equity (K)

Note: The format is taken from the *International Financial Statistics* (*IFS*) report.

Because the balance sheet is one of the accounting financial reports, total assets must equal total liabilities plus equity. The identity can be written as

$$FA + DA + OA = MB + FL + DL + OL + K \tag{4-3}$$

This can be organized and re-written as

$$MB = (FA - FL) + (DA - DL) + (OA - OL) - K$$

$$= NFAs + NDAs + NOAs - K \tag{4-4}$$

So, the monetary base is equal to the sum of net foreign assets, net domestic assets, and net other assets minus equity. I discuss the way monetary authorities recognize the revaluation effect, interesting earnings, and international loans on the balance sheet case by case. Since reserves go up or down due to revaluation changes and interest earnings will not change the domestic currency value of the banking system's holding of high power money, we exclude these effects from the book value of NFAs and NDAs before we use them conduct the estimation. Hence, I also propose a method to calculate the new NFAs and NDAs after taking these effects under consideration.

(1) Revaluation Effects from Exchange Rate Fluctuations

The revaluation effect is defined as the change of book value of the reserves, denominated in domestic currency due to exchange rate changes. It is just a game of numbers on the accounting financial reports, and does not have real effects on the domestic money market. Hence, monetary authorities do not need to do any sterilization to adjust domestic liquidity. The revaluation effect is particularly important for the post-currency crises period since most Asian economies implemented more flexible exchange rate policies after the crises.

In general, monetary authorities recognize the end-year revaluation of foreign currency liabilities and assets in the Profit and Loss account of the income statement.[27] Since the end-year income statement balance will be included in the equity (K) account of balance sheet, the change of net foreign assets due to the revaluation effect can be

[27] At year-end, the balance of foreign assets and liabilities are translated into domestic currency at new exchange rates prevailing on the balance sheet date. (These new rates will also be quoted as book rates for the following year). The discrepancies derived from the translation are also recorded in the "Gain or Loss from Foreign Exchange" account and this account will be shown on the profit and loss account. (Refer to the 1999 annual monetary policy report issued by the Bank of Thailand).

offset by the change of equity so that the domestic monetary base will be the same. For example, assuming that the Bank of Thailand (BOT) incurred substantial foreign exchange gains of around Baht 100 billion through end-year revaluation of foreign currency liabilities and assets, the same amount of Baht 100 billion would be recognized in BOT's equity account of balance sheet and completely offset the increase of NFAs. Hence, the domestic monetary base will not be influenced by the revaluation effect due to the exchange rate fluctuations (see eq. 4-5).

$$\overline{MB} = NFAs \uparrow + NDAs + NOAs - K \uparrow \qquad (4\text{-}5)$$

However, this accounting principle (rule) will cause an estimation bias if we broadly define the net domestic assets (NDA_t^*) as $NDAs + NOAs - K$, and the net foreign assets (NFA_t^*) is as $NFAs$.[28] If we rewrite (4-5) as $\overline{MB} = NFA_t^* \uparrow + NDA_t^* \downarrow$, we can see there is a opposite relationship between NDA_t^* and NFA_t^* due to revaluation effect. If we use NDA_t^* and NFA_t^* as two dependent variables without correcting the revaluation effect, the sterilization and offset coefficients will be over-estimated.[29]

(2) Interesting Earnings from Foreign Reserves Accumulation

Similar to revaluation gains or loss, interest earnings from foreign reserves accumulation are recognized in the Profit and Loss account on the income statement, which will also be recognized in the Equity account on the balance sheet. Again, the

[28] For Korea, Singapore, and Taiwan, the equity account does not reported on *International Financial Statistics* (*IFS*). I assume that the equity account is included to "net other liabilities" item on IFS since the monetary authorities' balance sheets are still balanced.

[29] Without correcting the revaluation effect, we will easy to get that both estimated offset and sterilization coefficients equal -1.

domestic monetary base should not be affected by interest earnings. However, it is empirically more difficult to measure the interest earnings for a central bank due to data unavailability. If we do not know a central bank's investment portfolio, we will not be able to know the interest rates and maturity dates. Since interest earnings are not usually considered as significant as revaluation effect, the interest earnings will be ignored in the following empirical research.

(3) Loans from International Organizations

When we discuss the movement of domestic monetary base, we should always consider both foreign assets and foreign liabilities, indicating that it is the *net* foreign assets that affect the monetary base rather than just foreign assets. For example, if a central bank borrows $10 billion from the *IMF*, then both foreign assets and foreign liabilities will increase by $10 billion (see eq. 4-6. Foreign assets increased by $10 billion because the central bank got $10 billion foreign reserves from the *IMF*). In this case, the domestic money base is not affected by this borrowing. However, if we only use the change of foreign assets to estimate the extent of sterilization, we may get misleading results.

$$\overline{MB} = (FA \uparrow - FL \uparrow) + NDAs + NOAs - K \qquad (4\text{-}6)$$

(4) How to Measure NDA_t^* and NFA_t^* ?

Since NDA_t^* and NFA_t^* are the most important variables in the model, how to correctly measure them becomes the most crucial task in the paper. To correctly measure NDA_t^* and NFA_t^*, we have to exclude the revaluation effect and interest earnings from

the *net* foreign assets (i.e. foreign assets minus foreign liabilities). As mentioned before, I assume that the interest earnings are not substantial and can be ignored for now. In addition, foreign assets include monetary gold and foreign exchange. To exclude monetary gold from the foreign assets, I use the product of foreign reserves denominated in US dollar and exchange rates (domestic currency/US$) to proxy foreign assets. The net foreign assets without monetary gold are as follows:

$$NFA_t = R_t \times e_t - FL_t$$

where R_t is the foreign reserves denominated in US$; e_t is the exchange rate against US$.

Since the revaluation effect is the change of NFAs due to exchange rate fluctuation, I measure the revaluation effect as follows:

$$\text{Revaluation effect} = NFA_{t-1}(\frac{e_t}{e_{t-1}} - 1)$$

$$\text{Therefore, the revised change of net foreign assets} = \Delta NFA_t^* = NFA_t - NFA_{t-1}(\frac{e_t}{e_{t-1}})$$

As I mentioned in (1) in this section, revaluation effect not only affects NFA_t^* but also NDA_t^*. We have to exclude the revaluation effect from NDA_t^* as well. Since revaluation effect is deducted from Equity account before, we have to plus it back. Therefore, the new ΔNDA_t^* is

$$\Delta NDA_t^* = \Delta NDA_t + \Delta NOA_t - \Delta K_t + \text{Revaluation effect}$$

$$= \Delta NDA_t + \Delta NOA_t - \Delta K_t + NFA_{t-1}(\frac{e_t}{e_{t-1}} - 1)$$

ΔNFA_t^* and ΔNDA_t^* will be used as the dependent variables in equation (4-1) and (4-2) respectively.

4.3 Empirical Results and an Overview of the Capital Flows Episode and Policy Response in Selected Asian Economies.

The empirical results for India, Indonesia, Korea, Malaysia, the Philippines, Singapore, Taiwan, and Thailand will be discussed in the following sections, as well as the evolution of balance of payments and their monetary sterilization policies. As mentioned in the section 4.1, I use the quarterly data over the sample period from 1990: q1 to the latest data that could be found for each of the countries. Since there were significant exchange rate policy change during the 1997 Asian currency crises period, I divide the whole sample period into two sub-periods: 1990: q1 to 1997: q2, and 1998: q3 to present. So the crises period will be eliminated from my sample.

In addition, to check the robustness of empirical results, I try both the change of the lagged real effective exchange rate and current account as the explanatory variables. I only apply them into the model one at a time since I assume that current account is the function of the change in real effective exchange rate. To account for inertial effects of real exchange rate change on the trade balance, I use the lagged value. Also, both perfect

foresight and static expectations are used to proxy the different expectation about the movement of exchange rates.

Therefore, the empirical results for each selected economy are listed in two tables. The first table is the model that includes the change of lagged real effective exchange rate as one of the explanatory variables, while the second one is the model that includes the current account.[30] Each table is divided into two big categories: the fist category follows the assumption of perfect foresight, while the second one follows static expectations. Hence, there are four sets of estimated simultaneous equations in each table. Again, by comparing the different values of offset and sterilization coefficients in these two sub-samples, we are able to know how the extent of sterilization and degree of capital mobility change before and after the currency crises with different assumption of expectations about exchange rates. The case studies for each of the economies will be discussed below.

4.3.1 India

(1) The Evolution of Balance of Payments in India

The reserve accumulation in India has accumulated to US$155.97 billion by the second quarter of 2006 (Figure 4-3-1a). The majority of the foreign reserves were mainly contributed by a consistent capital account surplus, while the current account has remained mostly in deficit since 1990.[31] India's current account was persistently contributed by the positive current transfer, but it has been frequently offset by a larger

[30] I use trade balance to proxy current account directly since quarterly current account data is unavailable.
[31] The current account was in surplus only in 2001 to 2003 during the sample period (1990 onwards).

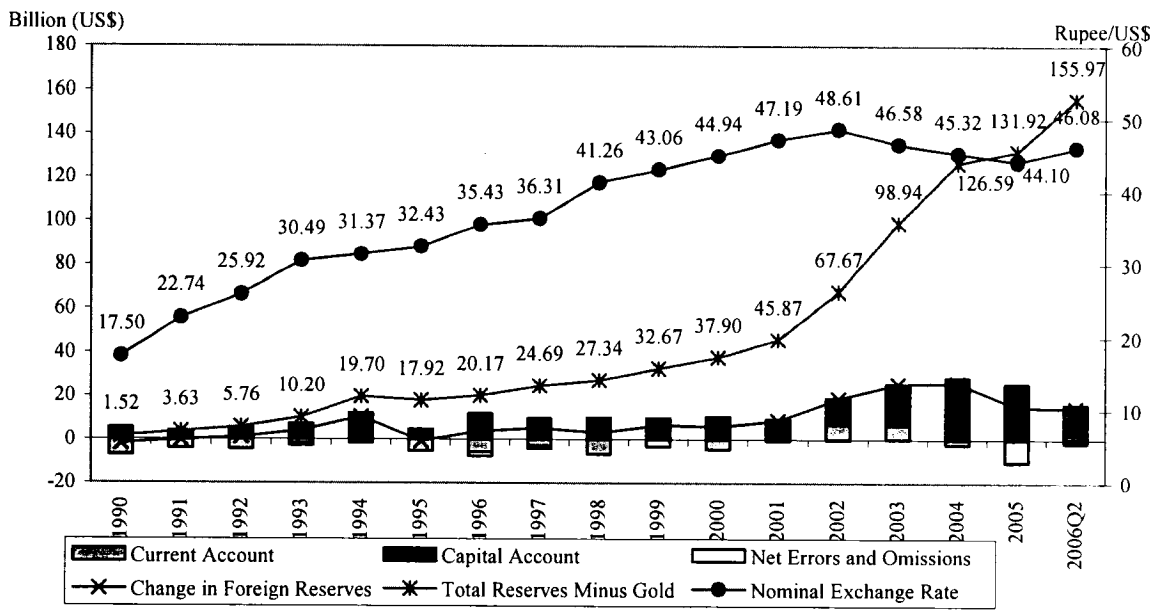
amount of trade balance deficit. Based on the different patterns of evolution of India's BOPs, the whole sample period can be separated into two sub-periods.

Before 2000, the reserve accumulated gradually since part of the capital account surplus was offset by the current account deficit. During this period, the Reserve Bank of India (RBI) had conducted several reforms on its exchange rate regime and financial sectors. A dual, both official as well as market determined, exchange rates was established in March 1992 to improve the increasing current account deficit. However, the dual exchange rates did not last long and were unified into one exchange rate in the following year. Since then, India has adopted a market determined exchange rate system and reclassified as managed floating in 2000. The exchange rate of Rupee against US dollar had gradually depreciated during this period, but did not significantly improve the current account. The capital account surplus before 2000 was mainly contributed by the consistent other investment inflows as well as increasing portfolio investments and FDI (Figure 4-3-1b). Due to the financial sector reform in early 1990s, a large amount of portfolio investment on equity securities investment flew into India, particular from 1993 to 1997. Although the portfolio investment turned deficit in 1998 due to the Asian crises, a large amount of capital inflows through other investment still resulted in a capital account surplus at that year. This might be because that India is one of few countries not been hit by the crises.

From 2001 onwards, the speed of reserve accumulation has been rising substantially. The BOPs surplus was contributed by both current and capital accounts surplus in early 2000s. Due to the steady growth in the global economy and the rebound in the information technology industry, the persistent trade balance deficit improved

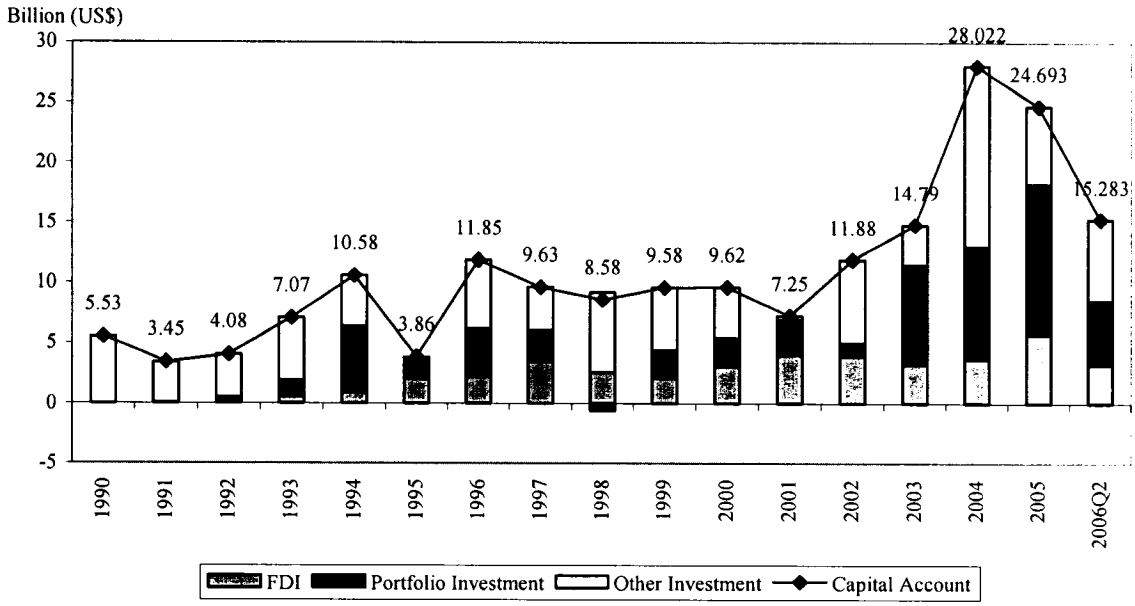
marginally and turned current account into surplus since 2001, but the surplus only lasted for three years and turned back to deficit again in 2004. A substantial amount of international capitals flew into the country during this period due to the market expectation of appreciation. There was a historical record high of US$28 billion capital inflows in 2004. Among them, over half of the capitals were through the other investments. To mitigate the BOPs surplus, the RBI has begun to appreciate rupee since 2003 and fluctuated around R46.08 per US dollar by mid 2006.

Figure 4-3-1a: Trends in India's Balance of Payments Transactions



Data Source: IFS and the Reserve Bank of India (RBI) official website.

Figure 4-3-1b: Capital Account Components in India



Data Source: IFS and the Reserve Bank of India (RBI) official website.

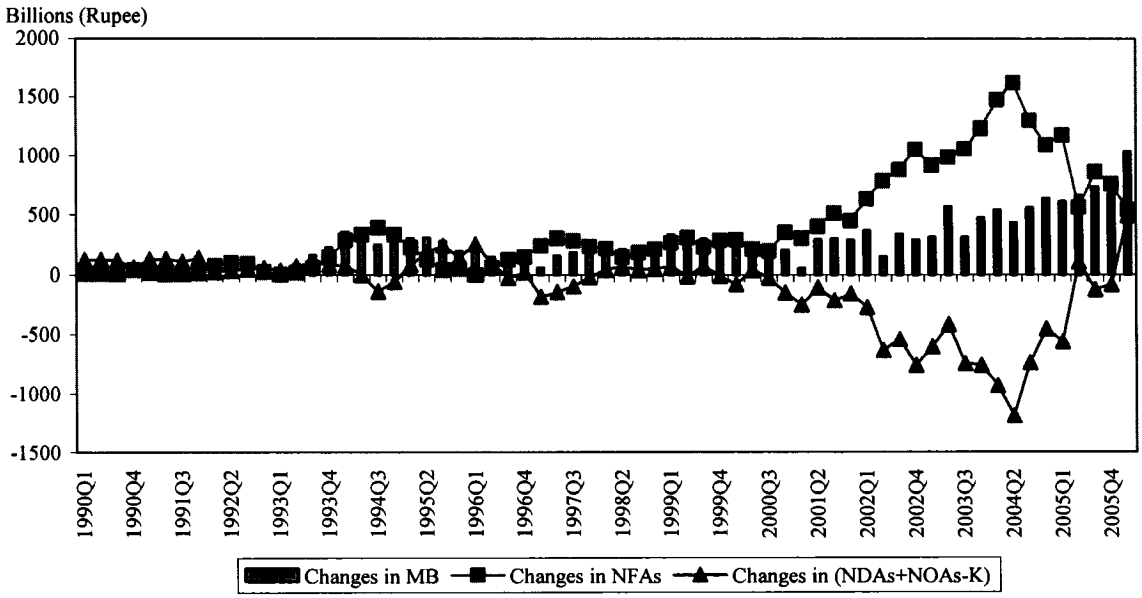
(2) Monetary Sterilization Policies in India

Before the financial sector reform in 1992, the financial market in India was highly regulated. The commercial banks were required to set aside substantial portions, a statutory liquidity ratio (SLR), of their liabilities for investment in government securities at below market interest rates. But the SLR had been reduced gradually from 38.5% in 1992 to 25% in 1997 for financial reform. The monetary policy during the early 1990s was mainly used to finance government budget deficit and eliminate the consequent inflationary pressure. The major monetary sterilization instrument was cash reserve ratio.

After the reform, the monetary policy has been focused on deepening money market, such as build up the government securities markets and market-determined

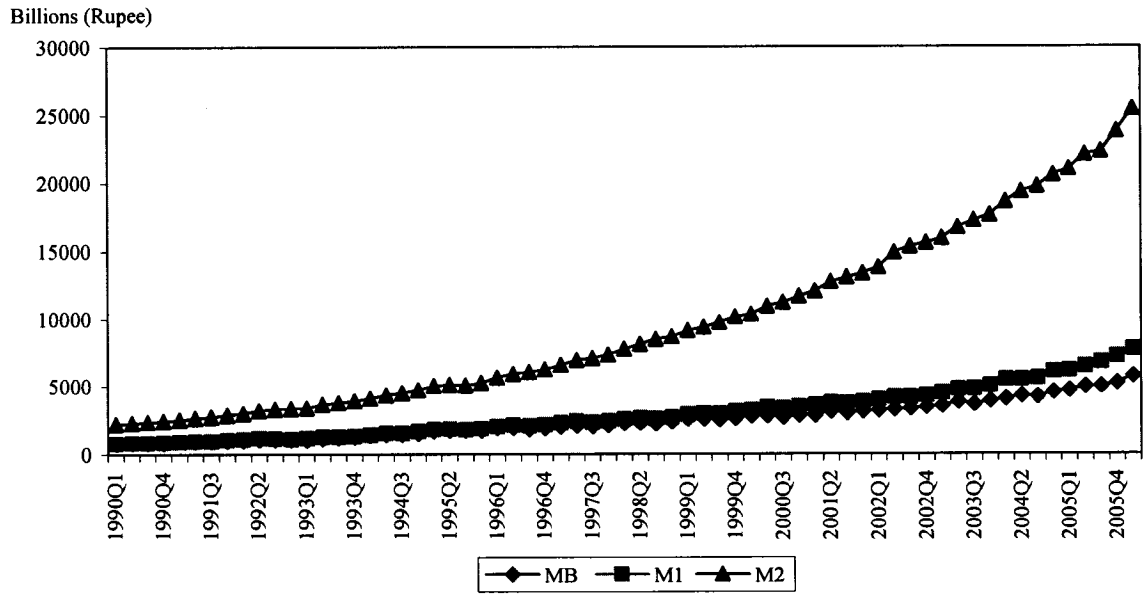
interest rates. Again, the main objective of India's monetary policy is to maintain price stability, while monetary supply (M3) is the intermediate target. To manage domestic liquidity, the RBI has changed its sterilization instrument from cash reserve requirement to open market operations and repurchase transactions. In addition, interbank participation certificates, certificates of deposit (CDs), and commercial paper (CP) were introduced to adjust short-term liquidity, as well as the treasury bills with different maturities (14-, 91- and 364-day) (Reddy, 1999). So currently, the RBI has mainly conducted OMOs to sterilize capital inflows accompanied with the adjustment of cash reserve requirement. Capital controls have also been conducted due to rapid reserve accumulation recently. Figure 4-3-1c and Figure 4-3-1d show that most of the capital inflows have been offset by the decrease in NDAs, and the monetary base has gradually increased since 2000. The price level (Figure 4-3-1e) was quite stable during the sample period, except there was a high inflation caused by the depreciation during the crises period. India's monetary sterilization policies are summarized below.

Figure 4-3-1c: Quarterly Annual Change in NFAs, NDAs, and Reserve Money in India, 1990: Q1 – 2006: Q1



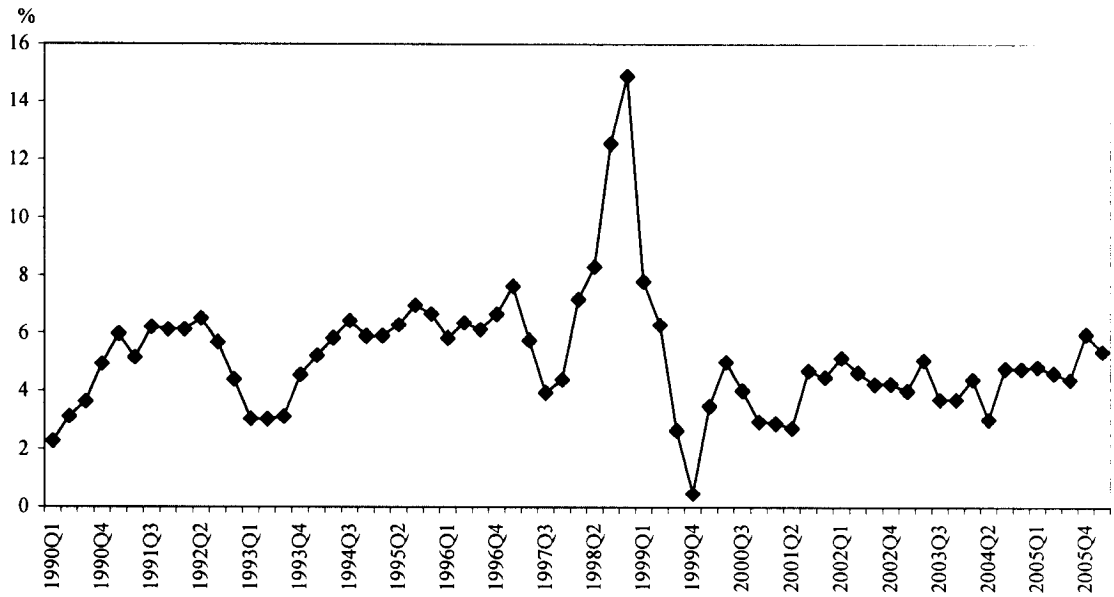
Source: IFS.

Figure 4-3-1d: Reserve Money, M1, and M2 in India, 1990: Q1 – 2006: Q1



Data Source: IFS.

Figure 4-3-1e: Inflation (CPI % Change) in India, 1990: Q1 – 2006: Q1

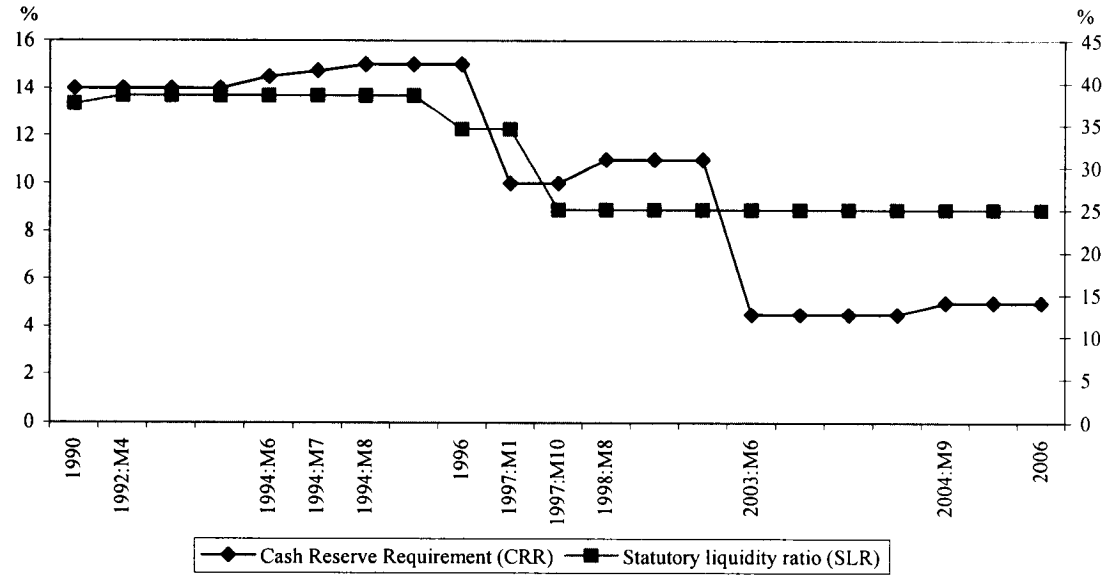


Data Source: IFS.

a. Reserve Requirements

Since early 1990s, the RBI has progressively reduced cash reserve requirement and statutory liquidity ratio to increase financial sectors' flexibility of liquidity management. The cash reserve requirement was declined from the highest point of 15% in 1994 to 5% in 2004, while the statutory liquidity ratio was reduced from 38.5% in 1992 to 25% currently. However, the RBI uses more open market operations than adjusting the reserve requirements after the domestic bond market has been improved.

Figure 4-3-1f: Cash Reserve Requirement and Statutory Liquidity Ratio in India



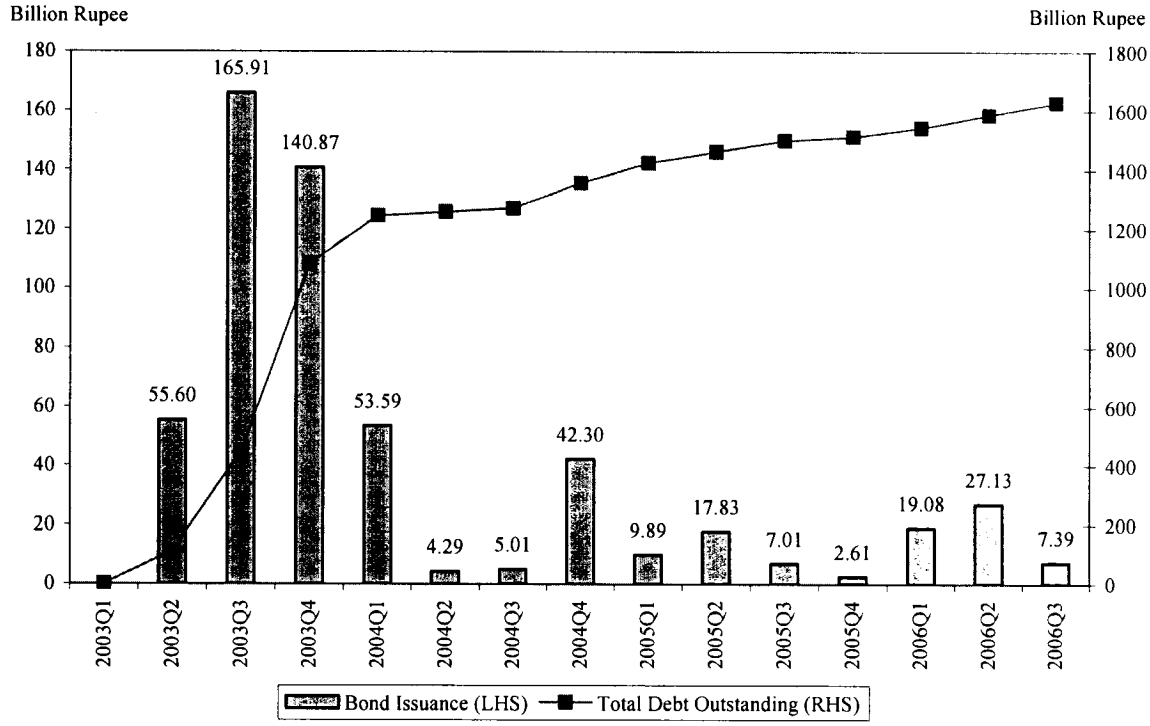
Source: Patnaik (2004), Reddy (1999) and Mohan (2005)

b. Open Market Operations (OMOs)

After financial and money market reform, the RBI has frequently used OMOs to manage short-term money fluctuation. The most common instruments are outright purchases/sales of government securities and daily repurchase and reverse repurchase operations. The following figure shows that the RBI had issued a substantial amount of government securities in 2003, but came down significantly afterward. Due to shortage of existing government securities, Market Stabilisation Scheme (MSS) was introduced in March 2004 to provide addition instrument to mop up excess liquidity. Under the MSS, the RBI can conduct periodic auctions of dated Government of India securities and treasury bills. To distinguish it from the normal borrowing requirement, the RBI operates a separate identifiable cash account, called MSS Account. Currently, the annual ceiling of

the issuance of government securities and bills are R800 billion. Under the way the MSS designs, the sterilization cost is totally borne by the government.

Figure 4-3-1g: The Issuance of OMOs bonds and Total Debt Outstanding in India, 2003Q1-2006:Q3



Source: The RBI official website

c. Capital Controls

During the 1997 Asian crises period, the RBI required all the foreign currency loans under the $3 million scheme and short-term loans/credits with maturities of less than three years to get approved, while authorized dealers were permitted to lend and borrow up to $10 million in the overseas money markets. But post-crises, India's capital market has been gradually opened up. For example, India opened its bond market in 1999 and allowed Foreign Institutional Investors (FIIs) to purchase or sell Indian treasury bills

within the overall approved debt ceilings, while banks began to offer foreign currency swaps without limits in 2000 (previous limit was up to US$50 million). Also, started from 2003, India allowed Sri Lankan companies to issue securities in India, and raised the limit of mutual funds investment in India in companies listed abroad from US$500 million to US$1 billion. But meanwhile, due to the irregular investment activities of overseas corporate bodies (OCBs) and the increasing portfolio investments, the RBI has barred the OCBs from investing in securities market and FDI since 2003. This suggested that the RBI still supervised capital flows closely with open up capital market.

(3) The Empirical Results for India

Table 4-3-1a and Table 4-3-1b list the empirical results for India. When the change in the lagged REER is used (Table 4-3-1a), the estimated offset coefficient pre-crisis is around 0.68 to 0.74 while the estimated sterilization coefficient is about 0.61 to 0.85. This suggests that India had moderate capital mobility and the Bank of India (BOI) sterilized fairly high capital inflows before the crisis. During the post-crisis period, the estimated offset coefficient increased slightly to 0.72 from 0.68 with the assumption of perfect foresight, but declined to about 0.65 from 0.74 with the assumption of static expectations. While the movement of capital mobility in India pre- and post-crisis is ambiguous, the estimated sterilization coefficients increase post crisis if the lagged REER is used in the model. The results show that the BOI has sterilized over 90 percent of reserve accumulation after the crises. In addition, the estimated coefficients for the change in the money multiplier are consistently significant both pre and post-crisis, while the exchange rate adjusted foreign interest rate variables are significant in the balance of

payments function pre-crisis and both functions post-crisis. The lagged volatility of exchange rate is significant in the balance of payments function post-crisis only, but with incorrect sign.

When the current account is used (Table 4-3-1b), the estimated offset coefficient pre-crisis is around 0.65, while the estimated sterilization coefficient ranges from 0.72 to 1.1. These results also suggest that India had moderate capital mobility and fairly high sterilization pre crisis. During the post-crisis period, both estimated offset coefficients with different assumptions of expectation increase to around 0.75 to 0.78 from 0.65, which consistently suggest that the capital mobility in India has increased slightly after the crises. Similar to the previous results, the estimated coefficients for the change in the money multiplier are consistently significant both pre and post-crisis, while exchange rate adjusted foreign interest rate variables are only significant with the assumption of perfect foresight pre and post crisis. The current account variables are positive and significant in the balance of payments function pre crisis only.

To check if money multiplier has significant impact on both balance of payments and monetary reaction functions, I re-estimated both function without the change of money multiplier variable and listed the results in Table 4-3-1c and Table 4-3-1d. Given that RBI frequently used cash reserve requirement to adjust domestic liquidity, dropping the money multiplier variable has substantially reduced the significance and the magnitude of estimated offset and sterilization coefficients, particular during the pre-crises period with the assumption of static expectations.

To sum up, the empirical results show that India had moderate degree of capital mobility pre-crises, but it has gradually increased during the post-crises period. The estimated offset coefficients rise marginally from 0.65 to 0.75. The results demonstrate the fact that India has gradually opened up its capital market by loosing its controls on domestic bond market and allowing FIIs to participate in during the post-crises period. On the other hands, the results also show that RBI had sterilized over 70 percent of its reserve accumulations pre-crises, and increased its extent of sterilization even more after the crises. The average degree of sterilization post-crises is over 90 percent, indicating that over 90 percent of reserve accumulation had been sterilized by the increasing open markets operations and the new Market Stabilisation Scheme. In addition, money multiplier has significantly impact in both estimating functions since the RBI has frequently used cash reserve requirements and statutory liquidity ratio to adjust domestic liquidity, even though this policy has been gradually replaced with OMOs.

Table 4-3-1a: India - Estimated Simultaneous Equations, 1990:Q1-1997:Q2 and 1998Q3-2004:Q4

India: 2SLS	Perfect Foresight				Static expectations			
	1990:Q1-1997:Q2		1998Q3-2004:Q4		1990:Q1-1997:Q2		1998Q3-2004:Q4	
	ΔNFA_t^*	ΔNDA_t^*	ΔNFA_t^*	ΔNDA_t^*	ΔNFA_t^*	ΔNDA_t^*	ΔNFA_t^*	ΔNDA_t^*
Intercept	**0.021***	0.027	**0.026*****	**0.030*****	0.020	0.018	**0.028*****	**0.021***
	(0.011)	(0.016)	(0.003)	(0.007)	(0.014)	(0.020)	(0.006)	(0.010)
ΔNDA_t^*	**-0.685*****	-	**-0.716*****	-	**-0.744*****	-	**-0.653*****	-
	(0.181)		(0.070)		(0.220)		(0.158)	
ΔNFA_t^*	-	**-0.854*****	-	**-1.214*****	-	**-0.616****	-	**-0.928*****
		(0.231)		(0.127)		(0.210)		(0.184)
Δmm_t	**-0.434*****	**-0.601*****	**-0.296*****	**-0.394*****	**-0.508****	**-0.622*****	**-0.314****	**-0.450*****
	(0.145)	(0.115)	(0.057)	(0.072)	(0.179)	(0.124)	(0.109)	(0.096)
Δp_{t-1}	0.140	-0.107	0.018	0.057	-0.057	-0.094	-0.151	0.051
	(0.347)	(0.497)	(0.126)	(0.181)	(0.424)	(0.582)	(0.224)	(0.253)
$Y_{c,t-1}$	-0.002	0.212	-0.071	0.196	-0.121	0.144	-0.146	0.331
	(0.285)	(0.325)	(0.280)	(0.388)	(0.340)	(0.356)	(0.482)	(0.523)
ΔG_t	-0.160	-0.193	-0.625	0.060	-0.277	-0.106	-1.115	0.130
	(0.338)	(0.352)	(0.524)	(0.721)	(0.401)	(0.392)	(0.893)	(0.975)
$\Delta(r_t^* + E_t S_{t+1})$	**-0.152****	-0.110	**-0.508*****	**-0.594*****	-0.007	0.023	-0.226	0.194
	(0.058)	(0.072)	(0.093)	(0.157)	(0.075)	(0.072)	(0.222)	(0.218)
$\Delta REER_{t-1}$	0.000	-0.0004	-0.002	-0.002	0.00004	-0.001	-0.003	-0.0004
	(0.001)	(0.001)	(0.002)	(0.002)	(0.001)	(0.001)	(0.003)	(0.003)
$(d_2 - 1)\sigma_{s,t-1}$	-0.001	-	**0.008***	-	-0.007	-	0.011	-
	(0.007)		(0.004)		(0.009)		(0.008)	
$(d_1 - 1)\sigma_{r,t-1}$	-	0.0002	-	0.00004	-	-0.0001	-	0.001
		(0.001)		(0.001)		(0.001)		(0.001)
Q1	0.007	-0.001	0.002	-0.003	0.005	0.002	-0.003	-0.006
	(0.017)	(0.021)	(0.007)	(0.010)	(0.021)	(0.024)	(0.012)	(0.014)
Q2	-0.010	-0.005	-0.007	-0.008	-0.004	-0.001	0.002	-0.004
	(0.009)	(0.011)	(0.005)	(0.008)	(0.011)	(0.011)	(0.009)	(0.011)
Q3	-0.011	-0.005	-0.005	-0.007	-0.005	-0.002	-0.0002	-0.007
	(0.012)	(0.014)	(0.004)	(0.005)	(0.014)	(0.014)	(0.007)	(0.007)
R-square	0.718	0.825	0.958	0.930	0.597	0.802	0.877	0.871
Adj. R-square	0.524	0.705	0.924	0.874	0.320	0.666	0.781	0.770

Table 4-3-1b: India - Robustness Check, Replace $\Delta REER_{t-1}$ with CA_t

India: 2SLS	Perfect Foresight				Static expectations			
	1990:Q1-1997:Q2		1998Q3-2004:Q4		1990:Q1-1997:Q2		1998Q3-2004:Q4	
	ΔNFA_t^*	ΔNDA_t^*	ΔNFA_t^*	ΔNDA_t^*	ΔNFA_t^*	ΔNDA_t^*	ΔNFA_t^*	ΔNDA_t^*
Intercept	**0.024****	**0.030***	**0.027*****	**0.032*****	**0.026***	0.019	**0.023****	0.014
	(0.009)	(0.016)	(0.005)	(0.008)	(0.013)	(0.020)	(0.009)	(0.011)
ΔNDA_t^*	**-0.657*****	-	**-0.783*****	-	**-0.665*****	-	**-0.756*****	-
	(0.153)		(0.075)		(0.213)		(0.168)	
ΔNFA_t^*	-	**-1.166*****	-	**-1.101*****	-	**-0.720****	-	**-0.859*****
		(0.265)		(0.112)		(0.256)		(0.164)
Δmm_t	**-0.386*****	**-0.599*****	**-0.338*****	**-0.438*****	**-0.435****	**-0.654*****	**-0.349****	**-0.428*****
	(0.128)	(0.108)	(0.064)	(0.074)	(0.171)	(0.115)	(0.118)	(0.105)
Δp_{t-1}	0.329	0.291	0.110	0.209	0.059	-0.069	-0.052	0.052
	(0.301)	(0.563)	(0.126)	(0.167)	(0.375)	(0.601)	(0.215)	(0.227)
$Y_{c,t-1}$	0.137	0.230	0.172	0.632	0.040	0.116	-0.209	0.150
	(0.239)	(0.324)	(0.386)	(0.437)	(0.298)	(0.359)	(0.644)	(0.632)
ΔG_t	-0.068	-0.081	-0.110	0.730	-0.237	-0.133	-0.668	0.187
	(0.279)	(0.356)	(0.520)	(0.574)	(0.346)	(0.397)	(0.867)	(0.840)
$\Delta(r_t^* + E_t S_{t+1})$	**-0.154*****	**-0.180****	**-0.531*****	**-0.630*****	-0.052	0.020	-0.108	0.277
	(0.049)	(0.078)	(0.101)	(0.161)	(0.067)	(0.079)	(0.236)	(0.222)
CA_t	**0.920****	0.883	0.145	0.446	**0.992***	0.181	-0.225	-0.226
	(0.359)	(0.582)	(0.255)	(0.327)	(0.489)	(0.641)	(0.418)	(0.454)
$(d_2 - 1)\sigma_{s,t-1}$	-0.003	-	0.008	-	-0.009	-	0.011	-
	(0.006)		(0.005)		(0.007)		(0.009)	
$(d_1 - 1)\sigma_{r,t-1}$	-	-0.0001	-	-0.0004	-	-0.0001	-	0.001
		(0.001)		(0.001)		(0.001)		(0.001)
Q1	0.007	0.008	0.0002	-0.004	0.003	0.005	-0.002	-0.004
	(0.014)	(0.021)	(0.008)	(0.010)	(0.018)	(0.024)	(0.013)	(0.014)
Q2	-0.008	-0.008	-0.008	-0.005	-0.001	0.00005	-0.006	-0.008
	(0.008)	(0.011)	(0.006)	(0.008)	(0.010)	(0.012)	(0.010)	(0.011)
Q3	-0.007	-0.008	-0.005	-0.003	0.001	0.0001	-0.005	-0.010
	(0.010)	(0.014)	(0.005)	(0.006)	(0.012)	(0.015)	(0.008)	(0.009)
R-square	0.804	0.827	0.955	0.936	0.693	0.797	0.868	0.872
Adj. R-square	0.669	0.708	0.919	0.885	0.482	0.658	0.765	0.772

Table 4-3-1c: India - Robustness Check, Without Δmm_t

India: 2SLS	Perfect Foresight				Static expectations			
	1990:Q1-1997:Q2		1998Q3-2004:Q4		1990:Q1-1997:Q2		1998Q3-2004:Q4	
	ΔNFA_t^*	ΔNDA_t^*	ΔNFA_t^*	ΔNDA_t^*	ΔNFA_t^*	ΔNDA_t^*	ΔNFA_t^*	ΔNDA_t^*
Intercept	0.021	0.032	**0.028*** **	**0.028** **	0.024	0.030	**0.032*** **	0.019
	(0.016)	(0.026)	(0.006)	(0.011)	(0.020)	(0.030)	(0.007)	(0.015)
ΔNDA_t^*	**-0.658** **	-	**-0.555*** **	-	**-0.676***	-	**-0.401** **	-
	(0.281)		(0.105)		(0.348)		(0.163)	
ΔNFA_t^*	-	**-0.711***	-	**-1.208*** **	-	-0.462	-	**-0.907*** **
		(0.376)		(0.219)		(0.331)		(0.285)
Δp_{t-1}	0.467	0.107	0.096	0.274	0.142	-0.089	-0.187	0.248
	(0.457)	(0.792)	(0.210)	(0.303)	(0.556)	(0.913)	(0.278)	(0.386)
$Y_{c,t-1}$	0.009	0.340	-0.167	0.204	-0.105	0.354	-0.318	0.390
	(0.399)	(0.519)	(0.469)	(0.667)	(0.463)	(0.554)	(0.590)	(0.807)
ΔG_t	0.131	0.117	-1.470	-0.395	-0.016	0.113	**-2.025***	-0.296
	(0.464)	(0.556)	(0.837)	(1.231)	(0.535)	(0.612)	(1.026)	(1.498)
$\Delta(r_t^* + E_t S_{t+1})$	**-0.191** **	-0.123	**-0.606*** **	**-0.733** **	-0.073	-0.039	**-0.510***	0.072
	(0.079)	(0.116)	(0.153)	(0.267)	(0.094)	(0.110)	(0.243)	(0.333)
$\Delta REER_{t-1}$	-0.001	-0.002	-0.003	-0.003	-0.002	**-0.003***	-0.005	-0.002
	(0.001)	(0.002)	(0.002)	(0.004)	(0.002)	(0.002)	(0.003)	(0.005)
$(d_2 - 1)\sigma_{s,t-1}$	0.002	-	0.007	-	-0.004	-	0.014	-
	(0.010)		(0.007)		(0.012)		(0.010)	
$(d_1 - 1)\sigma_{r,t-1}$	-	0.001	-	0.0002	-	0.001	-	0.001
		(0.002)		(0.001)		(0.002)		(0.002)
Q1	0.005	-0.014	0.004	0.0004	-0.001	-0.018	-0.003	-0.005
	(0.024)	(0.033)	(0.012)	(0.017)	(0.028)	(0.037)	(0.015)	(0.021)
Q2	**-0.032** **	**-0.032***	**-0.017***	**-0.029** **	**-0.026***	-0.026	-0.004	-0.025
	(0.012)	(0.015)	(0.009)	(0.012)	(0.015)	(0.016)	(0.011)	(0.015)
Q3	**-0.032** **	-0.028	-0.0004	-0.003	-0.025	-0.021	0.006	-0.002
	(0.015)	(0.020)	(0.006)	(0.009)	(0.018)	(0.022)	(0.008)	(0.011)
R-square	0.432	0.525	0.872	0.777	0.248	0.483	0.801	0.670
Adj. R-square	0.097	0.246	0.786	0.629	-0.194	0.179	0.668	0.451

Table 4-3-1d: India - Robustness Check, Without Δmm_t, Replace $\Delta REER_{t-1}$ with CA_t

India: 2SLS	Perfect Foresight				Static Expectations			
	1990:Q1-1997:Q2		1998Q3-2004:Q4		1990:Q1-1997:Q2		1998Q3-2004:Q4	
	ΔNFA_t^*	ΔNDA_t^*	ΔNFA_t^*	ΔNDA_t^*	ΔNFA_t^*	ΔNDA_t^*	ΔNFA_t^*	ΔNDA_t^*
Intercept	**0.022***	0.037	**0.020****	0.020	**0.027***	0.024	0.020	-0.001
	(0.012)	(0.027)	(0.008)	(0.013)	(0.014)	(0.035)	(0.011)	(0.016)
ΔNDA_t^*	**-0.455****	-	**-0.592*****	-	-0.265	-	**-0.459****	-
	(0.182)		(0.108)		(0.214)		(0.176)	
ΔNFA_t^*	-	**-1.019****	-	**-1.129*****	-	-0.433	-	**-0.810*****
		(0.459)		(0.205)		(0.457)		(0.243)
Δp_{t-1}	**0.645***	0.454	0.137	0.294	0.267	0.030	-0.097	0.153
	(0.354)	(0.933)	(0.207)	(0.300)	(0.416)	(1.031)	(0.261)	(0.325)
$Y_{c,t-1}$	0.094	0.346	-0.446	0.077	-0.031	0.231	-0.779	-0.408
	(0.301)	(0.537)	(0.605)	(0.768)	(0.337)	(0.614)	(0.741)	(0.885)
ΔG_t	0.118	0.118	-1.151	0.092	-0.124	0.071	-1.680	-0.342
	(0.343)	(0.587)	(0.792)	(1.021)	(0.390)	(0.679)	(0.969)	(1.192)
$\Delta(r_t^* + E_t S_{t+1})$	**-0.191*****	-0.212	**-0.567*****	**-0.628****	-0.115	0.022	-0.378	0.339
	(0.060)	(0.129)	(0.166)	(0.290)	(0.071)	(0.137)	(0.269)	(0.320)
CA_t	**1.145****	0.785	-0.414	-0.336	**1.458****	-0.103	-0.663	-0.991
	(0.438)	(0.979)	(0.381)	(0.539)	(0.522)	(1.113)	(0.473)	(0.593)
$(d_2-1)\sigma_{s,t-1}$	-0.003	-	0.011	-	-0.010	-	**0.018***	-
	(0.008)		(0.007)		(0.008)		(0.010)	
$(d_1-1)\sigma_{r,t-1}$	-	0.001	-	0.001	-	0.001	-	0.002
		(0.002)		(0.001)		(0.002)		(0.002)
Q1	0.007	-0.005	0.006	-0.0003	0.002	-0.010	0.002	0.001
	(0.018)	(0.036)	(0.013)	(0.017)	(0.020)	(0.041)	(0.016)	(0.020)
Q2	**-0.023****	**-0.038****	**-0.028*****	**-0.035*****	-0.010	-0.031	**-0.021***	**-0.037*****
	(0.010)	(0.016)	(0.007)	(0.010)	(0.012)	(0.018)	(0.010)	(0.012)
Q3	**-0.020***	-0.029	-0.007	-0.009	-0.005	-0.021	-0.005	-0.017
	(0.012)	(0.021)	(0.008)	(0.011)	(0.014)	(0.024)	(0.010)	(0.013)
R-square	0.672	0.492	0.868	0.777	0.581	0.367	0.795	0.718
Adj. R-square	0.479	0.194	0.780	0.628	0.335	-0.006	0.658	0.531

4-3-2 Indonesia

(1) The Evolution of Balance of Payments in Indonesia

Due to the open capital market policy and the deregulation of interest rates in 1983, the international capitals have kept flowing into Indonesia until the crises happened. In the early 1990s, the capital account was dominated by other investments, mainly contributed by the foreign borrowings from both the public and private sectors (Figure 4-3-2b). [32] However, the capital inflows viz. FDI and portfolio investments have become more substantial since 1993 due to the deregulation of the domestic capital market, the bullish stock market, and the improvement of the credit rating of Indonesia firms.[33] During the crises period, there were large capital flew out of the country, and resulted in the capital account deficit for the succeeding seven years. But since 2002, the portfolio investment has been picking up due to the increasing capital inflows from stock transactions and the overseas initial public offerings (IPOs) for some state-owned companies. Because of the surge of foreign investments in the stock market, IHSG (Jakarta Composite Index) has increased dramatically, particularly in the second half of 2003. In addition, because of the debt moratorium associated with the tsunami disaster, the capital account surplus soared in 2005.

An unusual large amount of net errors and omissions is often viewed as an indicator of speculative capital flows. In addition to 1997, the net errors and omissions

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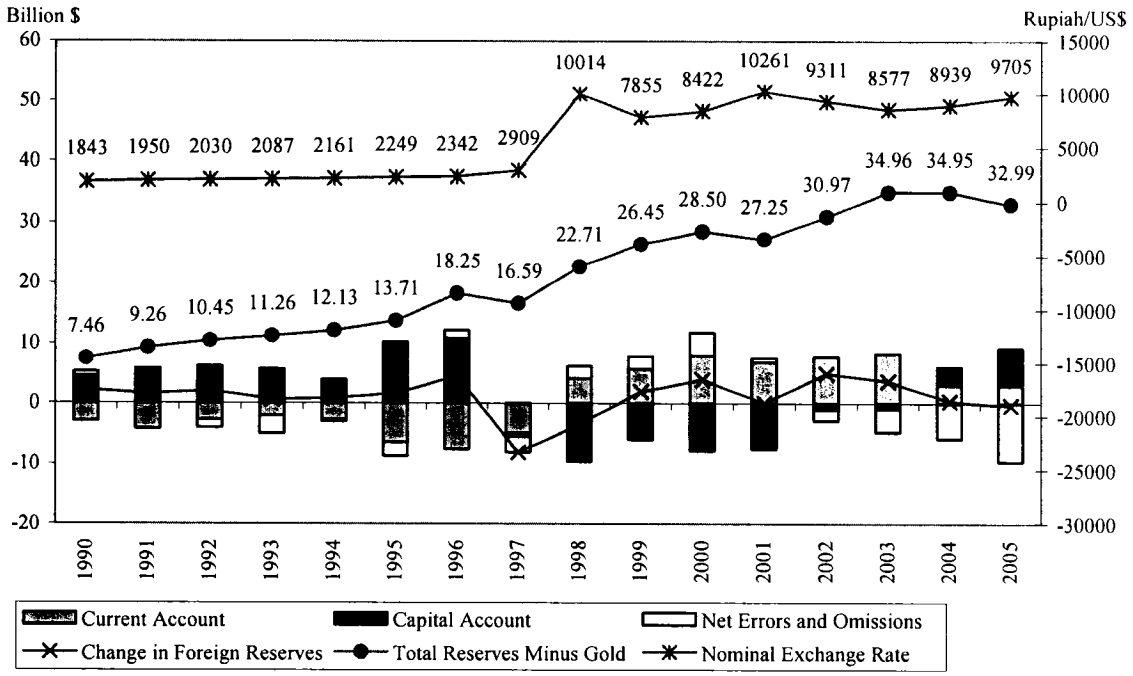
[32] Higher interest rates, remove of ceiling on foreign commercial borrowing by banks in 1989, and the introduction of a swap facility with bank Indonesia encouraged the private sectors to borrow money abroad.
[33] Foreign investors were allowed to purchase up 49 percent of the shares of domestic private and state-owed commercial banks listed on the Indonesia stock markets in March 1992. Also, the heavy sterilization policy during the early 1990s enlarged the interest rate differential between home and abroad. These policies provided foreign investors strong incentive to invest in Indonesia's stock market.

have been increased significantly in the last five years. However, the large amount of net errors and omissions in 2005 were partial contributed by the new balance of payments format. Based on the new format, resident assets in trade credit and portfolio investment abroad will be temporarily kept under the net errors and omissions item until being recorded in the capital account.

With the exception of 1997, 2001, and 2005, the reserve holdings in Indonesia have been increasing since 1990s (Figure 4-3-2a). Taking the year 1997 as the breaking point, we can easily divide the whole sample period from 1990 to 2005 into two based on the different patterns of the current account and capital account. Before 1997, the capital account surplus contributed to the reserve accumulation while the current account consistently stayed negative. After 1997, the trends of capital account and current account were completely reversed: the current account became the main contributor to reserve accumulation while the capital account was negative until 2004.

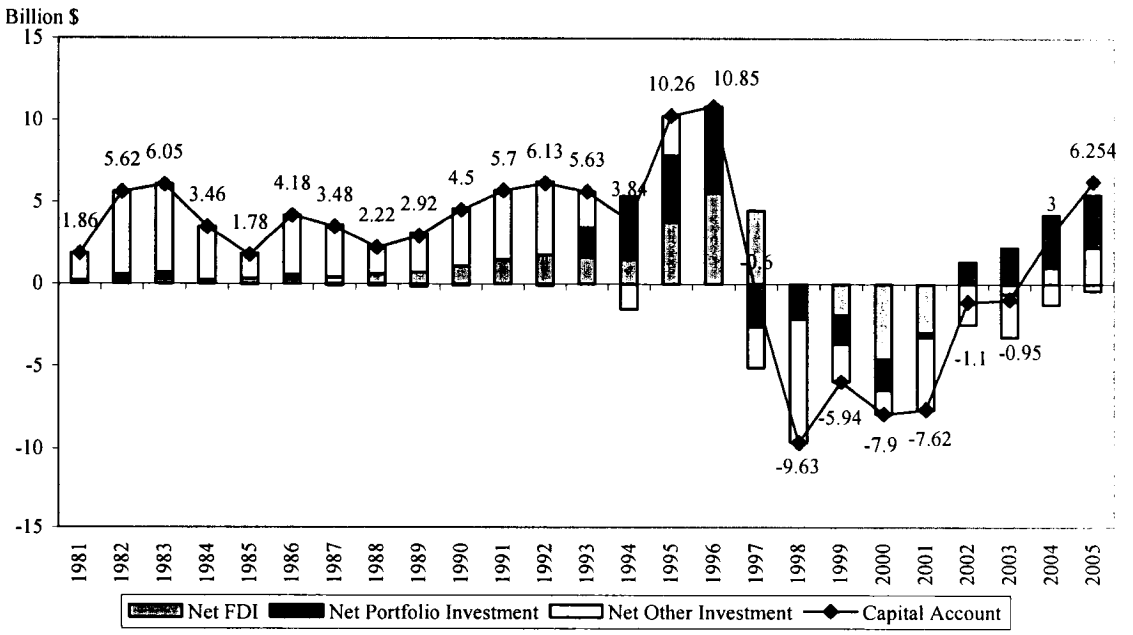
To increase export competitiveness and balance the sustained current account deficit, Indonesia has devaluated its currency three times: in November 1978, March 1983, and September 1987. However, the devaluation in 1987 did not significantly improve the current account. The current account deficits once again began to be enlarged in the early 1990s and continued to worsen until the sharp depreciation in the crises year of 1997. The exchange rate depreciated from 2909 rupiah against US dollar to 10014 rupiah against US dollar in 1997, and has hovered around 9000 rupiah against US dollar since then. The substantial depreciation successively brought the current account from deficit to surplus in 1998, while the following higher crude oil/gas prices have made the current account continuously increase until 2004.

Figure 4-3-2a: Trends in Indonesia's Balance of Payments Transactions



Source: IFS and Bank Indonesia Official Website.

Figure 4-3-2b: Capital Account Components in Indonesia (Billions of US$)



Source: IFS and Bank Indonesia Official Website.

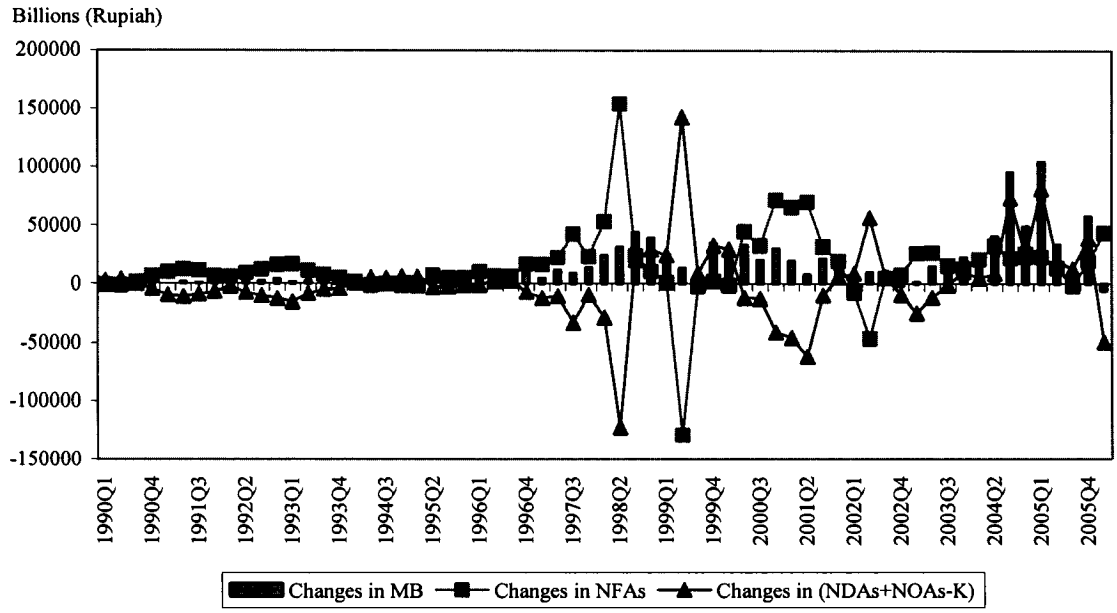
(2) Monetary Sterilization Policies in Indonesia[34]

Since the surge of capital flew into Indonesia during the early 1990s, the monetary authorities have implemented a series of policies to discourage the sustaining inflows. The sterilization policies include restricting the availability of Bank Indonesia liquidity credits, issuing more Bank Indonesia certificates (Sertifikat Bank Indonesia, SBIs), and requiring the public enterprises to convert their partial bank deposits to SBIs. Also, in late 1991, all the commercial borrowing by stated-owned enterprises had to be approved by the government with an annual ceilings restriction. However, all of these sterilization policies made the existing high interest rates go up even more. To remedy this, Bank Indonesia began to ease the sterilization policies in mid-1993. However, interest rates increased again in 1995 due to the raise of the reserve requirement from two to three percent.

In contrast to other Asian economies, Indonesia experienced excess liquidity in the money market after the currency crises since banks held government bailout bonds but are reluctant to lend (Figure 4-3-2c and Figure 4-3-2d). Hence there was serve inflation and the CPI annual growth rate reached to 40 percent by the end of 1998. Although the inflation was under control in 1999, it has raised again over 20 percent by the end of 2005 (Figure 4-3-2e) due to volatile foods inflation. Generally, Bank Indonesia mainly has four sterilization instruments: open market operations, setting discount rates, setting the legal reserve requirement, and regulating credit or financing. The monetary sterilization policies and instruments are summarized below.

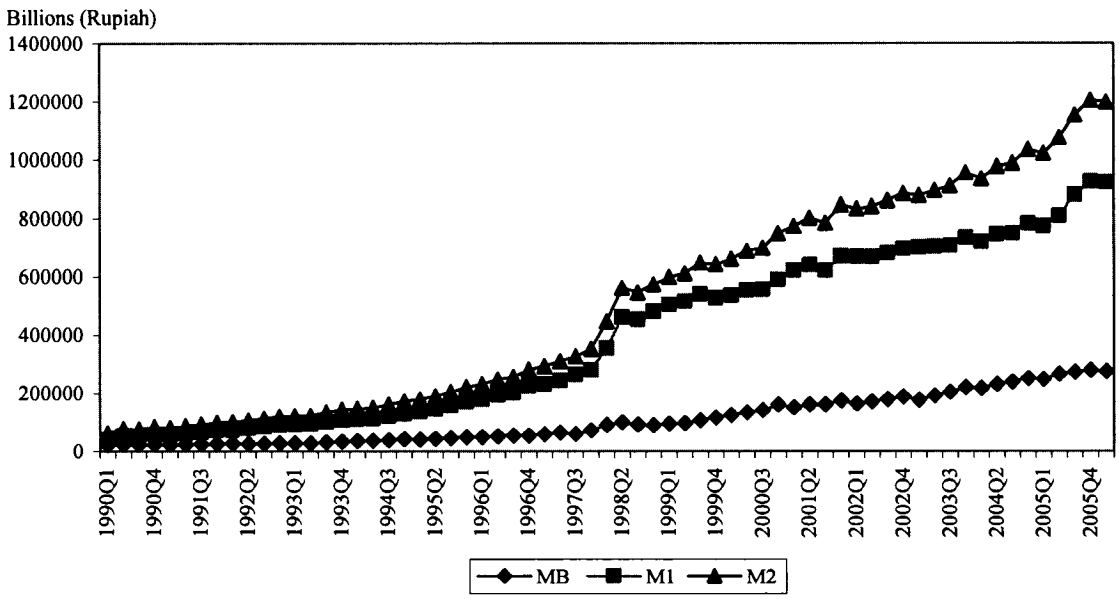
[34] The historical data and sterilization policies are refer to Dean (1996), Park and Song (1996), Rooskareni (1998), Reinhart and Reinhart (1998), and annual monetary repots in 2003, 2004, and 2005 published by Bank Indonesia.

Figure 4-3-2c: Quarterly Annual Change in NFAs, NDAs, and Reserve Money in Indonesia, 1990: Q1 – 2006: Q1



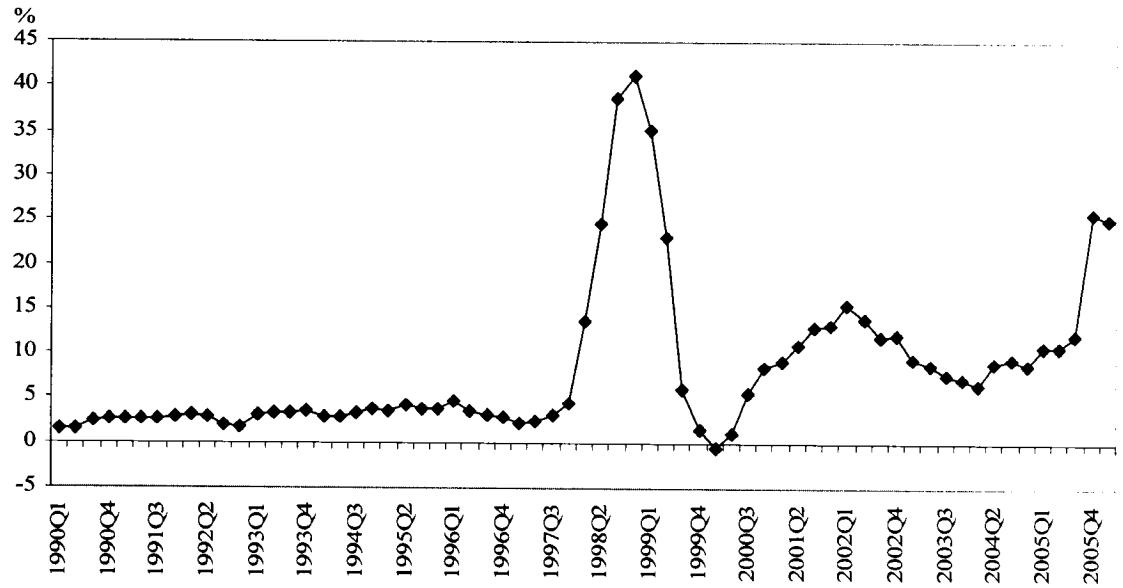
Source: IFS

Figure 4-3-2d: Reserve Money, M1, and M2 in Indonesia, 1990: Q1 – 2006: Q1



Source: IFS

Figure 4-3-2e: Inflation (CPI % Change) in Indonesia, 1990: Q1 – 2006: Q1



Source: IFS

a. Reserve Requirements

After a series of deregulation of interest rate policies in 1980s, Bank Indonesia began to move away from direct monetary control through credit ceilings to indirect control through new monetary instruments, namely open market operations and reserve requirements. To accelerate the liberalization of financial sectors, the government not only removed the restrictions on the establishment of new private banks, but also reduced the reserve requirements for commercial banks from 15 to 2 percent in 1988. This rate had been used until 1996. In order to assist the open market operations, Bank Indonesia increased the reserve requirement from 2 to 3 percent in February 1996, and raised it to 5 percent in April 1997.[35] Since June 28, 2004, the central bank has further raised the

[35] Refer to Iljas (1998).

reserve requirement in the range of 5 percent to 8 percent to deposit accounts, depending on a bank's loan-to-deposit ratio.

b. Open Market Operations (OMOs)

To absorb excess liquidity, Bank Indonesia began to issue Bank Indonesia Certificates (Sertifikat Bank Indonesia, SBIs) in February, 1984. Initially the short-term SBIs with maturity less than six months were issued, while the longer-term SBIs (7-360 days) were issued starting in February, 1991. In addition, money market securities (Sural Berharga Pasar Uang, SBPUs) were introduced in February 1985, and were used as one of the open market operation instruments.[36] Due to the surge of capital inflows in the early 1990s, Bank Indonesia issued a large amount of SBIs and SBPUs to absorb excess liquidity. The issuance of SBIs in 1991 reached to 9.4 trillion rupiahs, while in 1992, the amount increased to 9.6 trillion rupiahs. The sterilization policies begin to ease in 1993 to reduce the high domestic interest rate. However, open market operations were used heavily again during the crises period. The SBI rate had been increased from 17.38 percent in December 1997 to over 60 percent in September 1998. The volume of SBIs also rose from 7 trillion rupiahs at the end of 1997 to 43 billion rupiahs in 1998 (Figure 4-3-2f).[37]

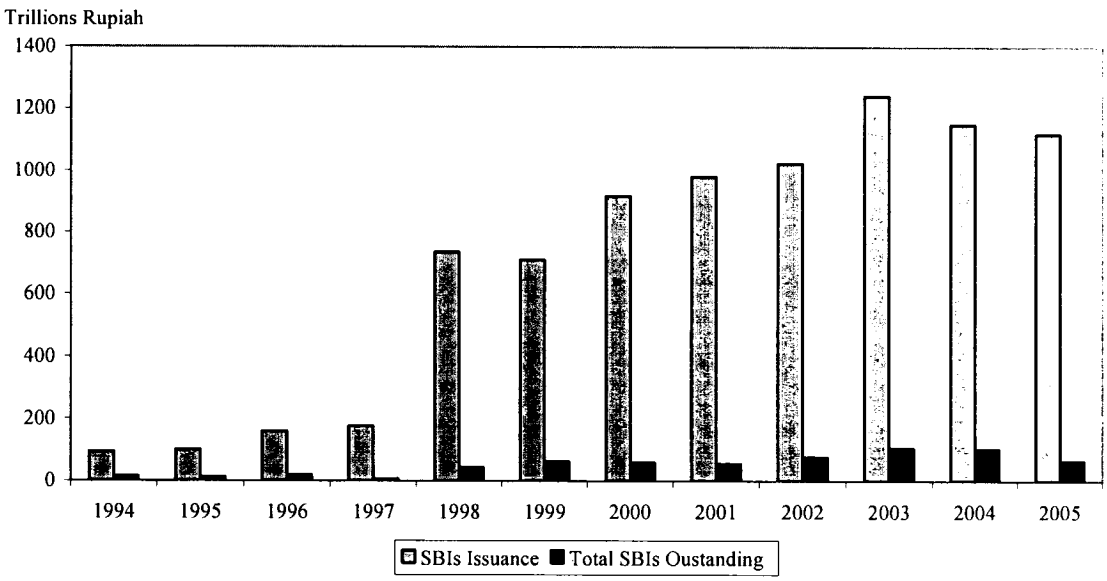
In recent years, Bank Indonesia has changed its monetary instruments slightly. SBIs are still the main instrument, but instead of using money market securities, Bank Indonesia has changed to the Fasilitas Bank Indonesia (FASBI) deposit facility, in which

[36] Refer to Park and Song (1996), SPBUs are short-term private securities traded in the money market, including promissory notes issued by banks and their customers and bills of exchange. When Bank Indonesia tends to absorb excess liquidity from the market, it sells SPBUs from its portfolio through auctions.

[37] The data refers to Rowter (2001).

banks can deposit funs with Bank Indonesia for one to 14 days and receive interest. Bank Indonesia has conducted both regular and irregular open market operations. The regular operations include one and three month SBI auctions, the FASBI deposit facility, SBI repurchase agreements (repos), and the Wadiah Certificate (SWBI), which is an SBI using sharia principals. However, the SBI repos were phased out on August 22, 2005 and they will be replaced by another expansion instrument called Fine Turn Expansion (FTE).[38] Irregular operations are Fine Tuning Operations (FTO), which are used on an "as needed" basis for both monetary contraction (FTK) and expansion (FTE) purposes. Figure 4-3-2c shows that Bank Indonesia has been issuing SBIs tremendously since 1998. In 2003, the issuance of SBIs has reached 1242 trillion rupiahs.

Figure 4-3-2f: The Issuance of SBIs and Total SBIs Outstanding in Indonesia



Source: Annual Monetary Policy Report, issued by Bank Indonesia.

[38] The data refer to the Bank Indonesia's Open Market Operations summary posted on the Economic section of US Embassy Jakarta website (http://www.usembassyjakarta.org/econ/financial_bi_open.html).

c. Lending Policy, Moral Suasion, and Net Open Position (NOP)[39]

Due to the excess liquidity in the money market in the early 1990s, Bank Indonesia has decreased the availability of Bank Indonesia liquidity credits, so that it only extends liquidity credit to Indonesia banks for activities supporting co-operatives, investment and the achievement of self-sufficiency in food. Similar to other Asian economies, the Indonesia government also exerted moral suasion on the banking sector or other relevant government agencies to manage credit expansion.

In addition to constraining the banking sector's lending, Bank Indonesia required banks to maintain NOP measures, such as the average of total NOP, both on and off balance sheet, in as week must not exceed 25 percent of the bank's capital, and the average NOP off balance sheet in a week must not exceed 25 percent of the bank's capital. This restriction had been reduced to 20 percent in 2000, but increased again to 30 percent of capital in July 2004.

d. Management of Government Deposits and of the Funds

Similar to other Asian economies such as Malaysia, Taiwan, and Thailand, Indonesia used to use the government deposits or the pension funds as one of the sterilization instruments. To absorb the excess liquidity in the market, the Bank Indonesia can shift deposits of the public sector or pension funds from the banking system to the central bank. One case is that in March 1991, the Bank Indonesia required the public enterprises to convert rupiah 10 trillion in bank deposits to SBIs.

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[39] NOP represents the difference between foreign exchange assets and liabilities both in on- and off-balance sheet.

e. Capital Controls [40]

Starting in 1992, foreign investors can hold a maximum of 49 percent of total shares issued by an individual company listed on the Indonesian stock exchange. Hence the portfolio investment began to increase sharply in 1993 and reached to 5.01 billion dollars in 1996. Furthermore, foreign investors were allowed to purchase unlimited domestic shares (except for banking shares) in September 1997. However, the portfolio investments still ran out of the country, and made the capital account turned into deficit. Due to the currency crises, forward sales foreign currency contacts offered by domestic banks to nonresidents were limited to 5 million dollars a bank and a customer, but trade- and investment-related transactions did not fit these restrictions. After the crises, the Indonesia government aggressively opened up the capital market to attract more capital inflows, particular in FDIs. In 1998, the government removed restrictions on foreign direct investment in palm oil plantations, retail trade banks, and wholesale trade. Also, the controls of nonresidents' investments in domestic listed banks were lifted. However, these policies still could not stop capitals out of the country.

Since the exchange rate began to depreciate again to a historical high point of 10,261 rupiahs against U.S. dollar, Bank Indonesia issued a series of new regulations introducing comprehensive restrictions on rupiah transactions between onshore banks and residents and limiting each bank's forward sale of foreign exchange to nonresidents. The restrictions include the lower limit on forward foreign currency contracts offered by domestic banks to nonresidents (from 5 million dollars to 3 million dollars) and the

[40] All the information is refer to "Annual report on exchange arrangements and exchange restrictions," 1995-2005, published by IMF.

prohibitions for resident banks from conducting several currency related transactions with nonresidents.[41] Finally, to reform the banking sector and lower the non-performing loans (NPLs), Bank Indonesia has restricted banks' short-term borrowings to 30 percent of bank capital in 2005. Long-term borrowings (maturities of over one year) required approval by the central bank. In addition, banks were not allowed to own assets in the form of stock or securities with an underlying reference stock.

(3) The Empirical Results for Indonesia

Table 4-3-2a shows that the estimated offset coefficient pre-crisis is around 0.3 while the estimated sterilization coefficient exceeded 1 (1.5). This suggests that Indonesia had relative low capital mobility and the Bank Indonesia over-sterilized the capital inflows before the crises. However, both the offset and sterilization coefficients become very small and insignificant in the post-crises period, indicating that the Bank Indonesia has not done much sterilization with low capital mobility. This may be due to two reasons. One, unlike the other regional economies which stabilized by mid 1998, Indonesia continued to be plagued by speculative attacks and uncertainties until late 2001 and intermittently since then. Two, there has been a general sense by observers of there being a high degree of uncertainty and ad-hocness in the operation of Indonesian monetary and exchange rate policy in the post-crisis period.

[41] Since January 2001, resident banks were prohibited from conducting the following transactions with nonresidents: (a) Lending or provision of overdrafts in rupiah or foreign currency; (b) placing funds with non residents; (c) purchase of rupiah-denominated securities issued by nonresidents; (d) interoffice transactions in rupiah; and (e) equity participation in rupiah with nonresidents.

With regard to other variables, the estimated coefficient for the change in money multiplier is negative and significant in the monetary reaction function. After the crisis the estimated coefficient for lagged inflation is statistically significant and appears to have a weak negative impact on capital inflows but a positive impact on the monetary reaction function. The exchange rate adjusted foreign interest rate is negative and significant in the monetary reaction function post-crisis, but becomes positive (i.e. incorrect sign) when static expectations is used. The lagged change in REER variable is statistically significant in the balance of payments function pre-crisis, but only significant in the monetary reaction function post-crisis. The quarterly dummies appear to be especially important for the monetary reaction function in the post-crisis period with the assumption of perfect foresight.

The results are quite similar when the current account is used. The Table 4-3-2b shows that the estimated offset coefficients are around 0.45, while the estimated sterilization coefficients are about 1.1, indicating low capital mobility and a high extent of sterilization pre-crisis. Both estimated coefficients are also insignificant post-crisis. With regard to other variables, the current account is positive and significant in the monetary reaction function post-crisis with the assumption of perfect foresight only, while the lagged volatility of the interest rate is negative and significant in the same function. In addition, the estimated sterilization coefficients pre-crises become unreasonably large after excluding the change of money multiplier variable in the functions (Table 4-3-2c and Table 4-3-2d), indicating that the change in money multiplier has significant effect in the monetary reaction function in Indonesia.

Table 4-3-2a: Indonesia - Estimated Simultaneous Equations, 1990:Q1-1997:Q2 and 1998Q3-2004:Q3

Indonesia: 2SLS	Perfect Foresight				Static expectations			
	1990:Q1-1997:Q2		1998Q3-2004:Q3		1990:Q1-1997:Q2		1998Q3-2004:Q3	
	ΔNFA_t^*	ΔNDA_t^*	ΔNFA_t^*	ΔNDA_t^*	ΔNFA_t^*	ΔNDA_t^*	ΔNFA_t^*	ΔNDA_t^*
Intercept	0.009	-0.009	0.031	**0.066***	**0.025***	0.002	0.045	-0.005
	(0.011)	(0.017)	(0.039)	(0.034)	(0.014)	(0.034)	(0.036)	(0.049)
ΔNDA_t^*	**-0.336****	-	0.033	-	**-0.294****	-	**0.019**	-
	(0.116)		(0.299)		(0.109)		(0.221)	
ΔNFA_t^*	-	**-1.537*****	-	-0.047	-	**-1.610*****	-	**-0.155**
		(0.435)		(0.403)		(0.516)		**(0.549)**
Δmm_t	-0.056	**-0.230****	0.048	**-0.818*****	-0.053	**-0.234****	0.009	**-0.701*****
	(0.055)	(0.094)	(0.287)	(0.130)	(0.046)	(0.086)	(0.211)	(0.178)
Δp_{t-1}	0.040	0.370	-0.393	**0.477***	0.074	0.397	-0.529	**1.406*****
	(0.303)	(0.569)	(0.430)	(0.265)	(0.282)	(0.570)	(0.524)	(0.385)
$Y_{c,t-1}$	1.429	-0.546	0.899	-1.417	**2.509***	0.138	1.319	-3.836
	(1.159)	(2.657)	(1.865)	(1.823)	(1.210)	(3.181)	(2.078)	(2.427)
ΔG_t	-0.152	-0.232	-0.263	1.080	-0.185	-0.247	-0.284	1.381
	(0.236)	(0.462)	(0.802)	(0.694)	(0.220)	(0.463)	(0.782)	(0.925)
$\Delta(r_t^* + E_t S_{t+1})$	0.047	0.031	0.079	**-0.583*****	-1.357	-0.741	-0.087	**0.441****
	(0.149)	(0.276)	(0.216)	(0.127)	(0.874)	(1.908)	(0.156)	(0.179)
$\Delta REER_{t-1}$	**-0.002***	-0.001	0.001	**-0.004****	**-0.003****	-0.002	0.001	**-0.004***
	(0.001)	(0.003)	(0.002)	(0.002)	(0.001)	(0.003)	(0.001)	(0.002)
$(d_2 - 1)\sigma_{s,t-1}$	0.0001	-	0.00002	-	-0.0002	-	0.00002	-
	(0.001)		(0.000)		(0.001)		(0.000)	
$(d_1 - 1)\sigma_{r,t-1}$	-	0.003	-	0.001	-	0.004	-	0.004
		(0.004)		(0.005)		(0.004)		(0.007)
Q1	0.009	0.021	0.002	**-0.100****	0.007	0.021	-0.010	-0.048
	(0.010)	(0.020)	(0.054)	(0.038)	(0.009)	(0.018)	(0.045)	(0.054)
Q2	-0.006	0.005	-0.041	-0.074	-0.012	0.001	-0.055	-0.002
	(0.010)	(0.016)	(0.051)	(0.044)	(0.009)	(0.021)	(0.046)	(0.061)
Q3	0.004	0.019	-0.002	**-0.141****	-0.005	0.014	-0.019	-0.074
	(0.010)	(0.017)	(0.075)	(0.060)	(0.011)	(0.022)	(0.066)	(0.082)
R-square	0.691	0.634	0.301	0.928	0.731	0.628	0.312	0.871
Adj. R-square	0.479	0.382	-0.290	0.867	0.545	0.373	-0.270	0.761

Table 4-3-2b: Indonesia - Robustness Check, Replace $\Delta REER_{t-1}$ with CA_t

Indonesia: 2SLS	Perfect Foresight				Static expectations			
	1990:Q1-1997:Q2		1998Q3-2004:Q3		1990:Q1-1997:Q2		1998Q3-2004:Q3	
	ΔNFA_t^*	ΔNDA_t^*	ΔNFA_t^*	ΔNDA_t^*	ΔNFA_t^*	ΔNDA_t^*	ΔNFA_t^*	ΔNDA_t^*
Intercept	-0.001	-0.014	0.078	-0.064	0.001	-0.013	0.079	-0.126
	(0.013)	(0.019)	(0.053)	(0.068)	(0.018)	(0.030)	(0.052)	(0.081)
ΔNDA_t^*	**-0.448*** **		-0.002		**-0.452*** **		0.014	
	(0.122)	-	(0.209)	-	(0.121)	-	(0.182)	-
ΔNFA_t^*		**-1.210*** **		0.705		**-1.189*** **		0.585
	-	(0.325)	-	(0.498)	-	(0.320)	-	(0.605)
Δmm_t	-0.093	**-0.242** **	-0.013	**-0.711*** **	**-0.096***	**-0.245** **	-0.009	**-0.588*** **
	(0.059)	(0.092)	(0.161)	(0.129)	(0.055)	(0.088)	(0.143)	(0.163)
Δp_{t-1}	0.134	0.411	-0.385	0.579	0.140	0.420	-0.422	**1.580*** **
	(0.352)	(0.582)	(0.378)	(0.330)	(0.348)	(0.576)	(0.441)	(0.430)
$Y_{c,t-1}$	0.595	-1.634	0.141	2.776	0.645	-1.619	0.238	-0.059
	(1.317)	(2.571)	(1.650)	(1.939)	(1.234)	(2.434)	(1.832)	(2.668)
ΔG_t	-0.170	-0.165	0.126	-0.652	-0.177	-0.157	0.106	-0.208
	(0.263)	(0.447)	(0.649)	(0.788)	(0.264)	(0.441)	(0.671)	(1.007)
$\Delta(r_t^* + E_t S_{t+1})$	0.008	0.017	0.004	**-0.617*** **	-0.212	-0.086	-0.021	**0.491** **
	(0.167)	(0.269)	(0.147)	(0.156)	(0.975)	(1.496)	(0.137)	(0.210)
CA_t	0.043	-0.065	-0.356	**0.966***	0.027	-0.072	-0.343	0.831
	(0.207)	(0.356)	(0.427)	(0.521)	(0.220)	(0.387)	(0.453)	(0.674)
$(d_2-1)\sigma_{s,t-1}$	-0.0003		0.00002		-0.0004		0.00002	
	(0.001)	-	(0.000)	-	(0.001)	-	(0.000)	-
$(d_1-1)\sigma_{r,t-1}$		0.004		**-0.009***		0.004		-0.006
	-	(0.004)	-	(0.005)	-	(0.005)	-	(0.006)
Q1	0.009	0.020	-0.011	-0.065	0.009	0.020	-0.012	-0.008
	(0.012)	(0.019)	(0.037)	(0.043)	(0.011)	(0.018)	(0.037)	(0.055)
Q2	0.0003	0.010	-0.047	-0.053	0.0001	0.010	-0.050	0.026
	(0.010)	(0.015)	(0.037)	(0.049)	(0.010)	(0.016)	(0.041)	(0.065)
Q3	0.010	0.021	-0.015	**-0.120***	0.010	0.020	-0.017	-0.047
	(0.011)	(0.020)	(0.046)	(0.058)	(0.012)	(0.020)	(0.050)	(0.075)
R-square	0.615	0.657	0.328	0.886	0.615	0.657	0.329	0.827
Adj. R-square	0.350	0.421	-0.200	0.797	0.351	0.422	-0.198	0.691

Table 4-3-2c: Indonesia - Robustness Check, Without Δmm_t

Indonesia: 2SLS	Perfect Foresight				Static Expectations			
	1990:Q1-1997:Q2		1998Q3-2004:Q3		1990:Q1-1997:Q2		1998Q3-2004:Q3	
	ΔNFA_t^*	ΔNDA_t^*	ΔNFA_t^*	ΔNDA_t^*	ΔNFA_t^*	ΔNDA_t^*	ΔNFA_t^*	ΔNDA_t^*
Intercept	0.015	0.010	0.037	**-0.087***	**0.033****	0.069	0.050	**-0.148*****
	(0.010)	(0.022)	(0.025)	(0.046)	(0.013)	(0.063)	(0.032)	(0.048)
ΔNDA_t^*	**-0.257****	-	0.013	-	**-0.194***	-	0.048	-
	(0.100)		(0.160)		(0.094)		(0.166)	
ΔNFA_t^*	-	**-2.117*****	-	-0.544	-	**-2.905****	-	-0.187
		(0.646)		(0.763)		(1.115)		(0.794)
Δp_{t-1}	0.0005	0.391	-0.347	0.336	0.040	0.495	-0.543	**1.489****
	(0.302)	(0.718)	(0.364)	(0.513)	(0.285)	(0.855)	(0.435)	(0.553)
$Y_{c,t-1}$	1.733	2.078	0.797	-2.326	**3.167****	7.281	1.380	-4.853
	(1.132)	(3.378)	(1.735)	(3.519)	(1.129)	(5.496)	(1.934)	(3.448)
ΔG_t	-0.141	-0.231	-0.188	0.022	-0.166	-0.290	-0.276	0.486
	(0.235)	(0.584)	(0.671)	(1.308)	(0.222)	(0.713)	(0.672)	(1.283)
$\Delta(r_t^* + E_t S_{t+1})$	0.112	0.334	0.067	**-0.566****	**-1.539***	-3.220	-0.107	**0.620****
	(0.133)	(0.315)	(0.151)	(0.246)	(0.878)	(3.297)	(0.149)	(0.252)
$\Delta REER_{t-1}$	**-0.003****	-0.004	0.001	-0.005	**-0.004*****	-0.009	0.001	-0.004
	(0.001)	(0.003)	(0.001)	(0.003)	(0.001)	(0.007)	(0.001)	(0.003)
$(d_2 - 1)\sigma_{s,t-1}$	0.0003	-	0.00002	-	-0.0001	-	0.00002	-
	(0.001)		(0.000)		(0.001)		(0.000)	
$(d_1 - 1)\sigma_{r,t-1}$	-	-0.0001	-	0.012	-	0.00001	-	0.008
		(0.005)		(0.009)		(0.006)		(0.010)
Q1	0.003	-0.0001	-0.007	0.060	0.003	0.006	-0.015	0.099
	(0.009)	(0.021)	(0.032)	(0.056)	(0.008)	(0.025)	(0.034)	(0.056)
Q2	-0.011	-0.014	-0.049	**0.127****	**-0.017***	-0.039	-0.062	**0.182*****
	(0.008)	(0.020)	(0.034)	(0.059)	(0.009)	(0.035)	(0.039)	(0.059)
Q3	0.001	0.009	-0.017	**0.181*****	-0.009	-0.016	-0.028	**0.205*****
	(0.009)	(0.021)	(0.038)	(0.058)	(0.010)	(0.034)	(0.043)	(0.057)
R-square	0.673	0.384	0.299	0.708	0.707	0.100	0.310	0.715
Adj. R-square	0.481	0.022	-0.202	0.500	0.535	-0.429	-0.184	0.512

Table 4-3-2d: Indonesia - Robustness Check, Without Δmm_t, Replace $\Delta REER_{t-1}$ with CA_t

Indonesia: 2SLS	Perfect Foresight				Static Expectations			
	1990:Q1-1997:Q2		1998Q3-2004:Q3		1990:Q1-1997:Q2		1998Q3-2004:Q3	
	ΔNFA_t^*	ΔNDA_t^*	ΔNFA_t^*	ΔNDA_t^*	ΔNFA_t^*	ΔNDA_t^*	ΔNFA_t^*	ΔNDA_t^*
Intercept	0.008	-0.008	0.075	-0.174	0.007	-0.024	0.076	**-0.204***
	(0.014)	(0.024)	(0.051)	(0.112)	(0.019)	(0.036)	(0.051)	(0.105)
ΔNDA_t^*	**-0.259****	-	-0.011	-	**-0.245***	-	0.001	-
	(0.120)		(0.135)		(0.121)		(0.139)	
ΔNFA_t^*	-	**-1.617****	-	-0.058	-	**-1.515****	-	0.265
		(0.561)		(0.931)		(0.563)		(0.883)
Δp_{t-1}	0.032	0.604	-0.404	0.397	0.059	0.776	-0.420	**1.540****
	(0.375)	(0.700)	(0.345)	(0.563)	(0.378)	(0.680)	(0.404)	(0.586)
$Y_{c,t-1}$	1.058	0.573	0.142	0.653	1.443	1.789	0.194	-2.569
	(1.387)	(3.055)	(1.541)	(3.262)	(1.268)	(2.741)	(1.732)	(3.442)
ΔG_t	-0.173	-0.111	0.121	-0.560	-0.145	0.059	0.111	0.071
	(0.280)	(0.547)	(0.625)	(1.349)	(0.283)	(0.529)	(0.646)	(1.343)
$\Delta(r_t^* + E_t S_{t+1})$	0.095	0.296	-0.0001	**-0.530***	0.014	0.840	-0.011	**0.643****
	(0.162)	(0.304)	(0.127)	(0.270)	(1.044)	(1.767)	(0.133)	(0.278)
CA_t	0.077	0.183	-0.348	0.760	0.105	0.355	-0.342	0.458
	(0.218)	(0.418)	(0.401)	(0.903)	(0.230)	(0.434)	(0.421)	(0.898)
$(d_2-1)\sigma_{s,t-1}$	-0.00002	-	0.00002	-	-0.0001	-	0.00002	-
	(0.001)		(0.00002)		(0.001)		(0.00002)	
$(d_1-1)\sigma_{r,t-1}$	-	-0.0002	-	0.003	-	-0.002	-	-0.001
		(0.005)		(0.008)		(0.005)		(0.008)
Q1	-0.0003	-0.007	-0.007	0.082	0.001	-0.001	-0.009	**0.118***
	(0.010)	(0.019)	(0.030)	(0.058)	(0.010)	(0.019)	(0.032)	(0.057)
Q2	-0.007	-0.007	-0.043	**0.122***	-0.007	-0.004	-0.046	**0.181****
	(0.010)	(0.018)	(0.031)	(0.064)	(0.010)	(0.019)	(0.036)	(0.064)
Q3	0.006	0.008	-0.010	**0.135****	0.005	0.005	-0.012	**0.172****
	(0.012)	(0.023)	(0.032)	(0.060)	(0.012)	(0.023)	(0.036)	(0.060)
R-square	0.538	0.464	0.327	0.644	0.521	0.461	0.328	0.669
Adj. R-square	0.266	0.148	-0.122	0.407	0.240	0.144	-0.120	0.448

4.3.3 Korea

(1) The Evolution of Balance of Payments in Korea

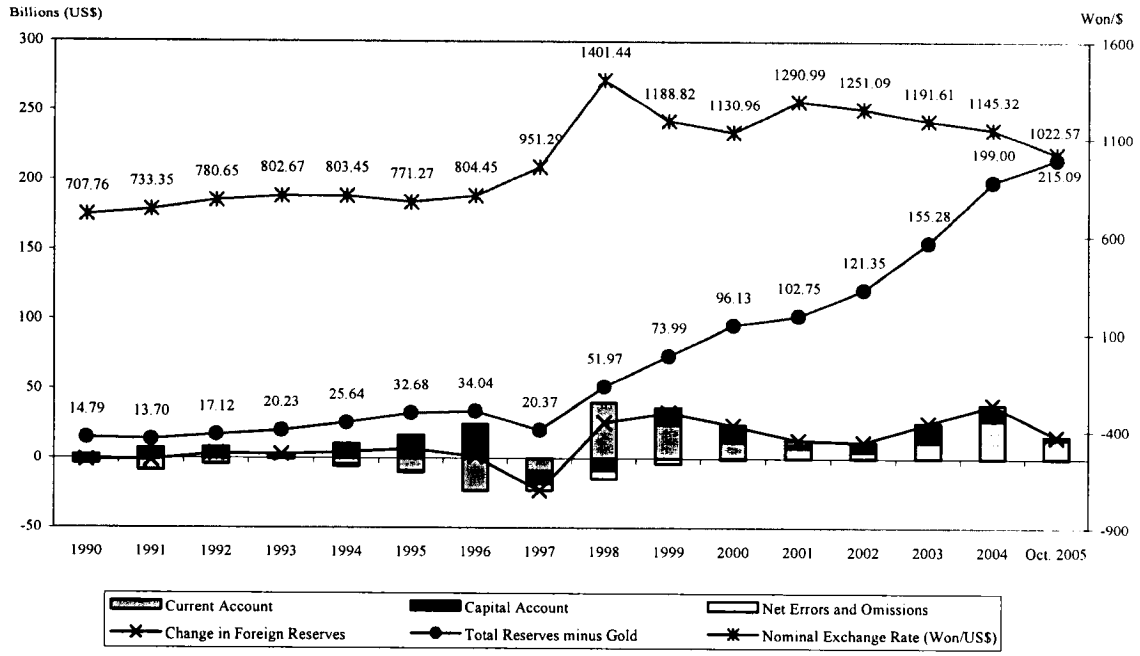
Korea's international reserves reached over $215 billion by October, 2005. Figure 4-3-3a shows that Korea's reserves remained stagnant during the early 1990s and then slowly increased until the Asian currency crises of 1997. Both current and capital account deficits dropped Korea's Balance of Payment (BOP) by $23 billion in a single year, but international reserves have been accumulated rapidly by almost $200 billion since.

In the early 1980s, Korea's monetary policy emphasized the improvement of current account, therefore, the authorities moved the exchange rate system from a peg to the US dollar to the management float, in which the exchange rates were daily set by the authorities on the basis of a basket of currencies comprising a trade-weighted basket, SDR basket, and judgments of authorities on the other economic conditions and the BOP position.[42] A continuous depreciation improved the current account in Korea, and turned it into a surplus during the late 1980s. However, the improvement of current account did not drive the reserves accumulated briskly due to the offsetting effect from the capital account (see Figure 4-3-3b).[43] Roughly speaking, the BOP remained balanced during the 1980s.

[42] Refer to Kwack (1994) and Kim (1995).

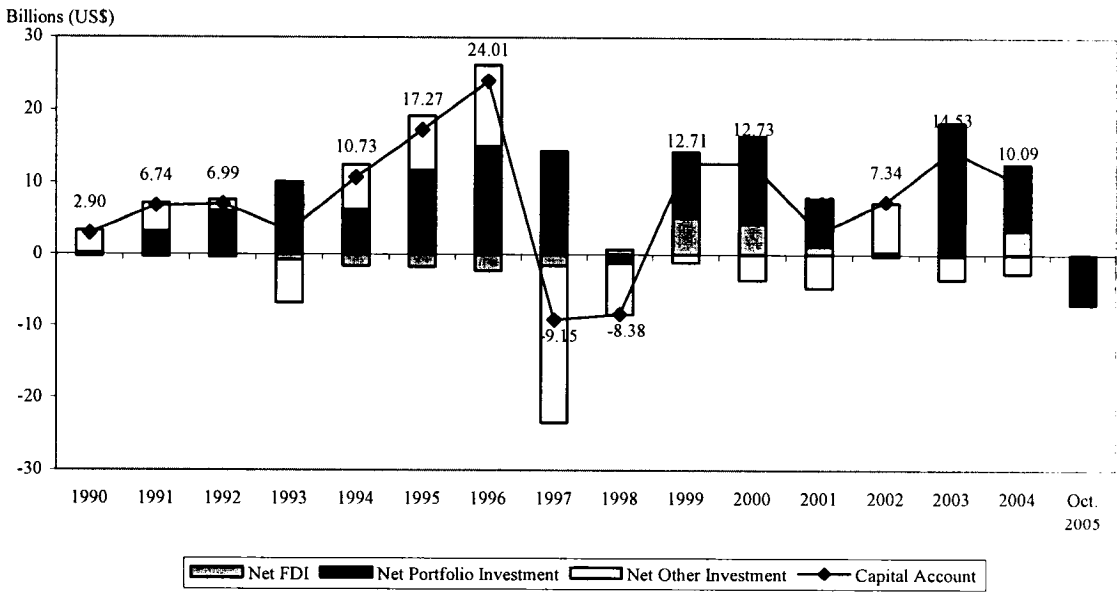
[43] Kim (1995) has similar finding that capital flows in Korea are more associated with monetary policies or current account than portfolio choice behavior. Particularly, short-term capital flows were largely motivated by monetary conditions, and trade transactions, while long-term capital transactions were largely made to offset current account imbalances. Figure 3 shows that the capital account was dominated by other investment in which the major categories are transactions in currency and deposits, loans and trade credits.

Figure 4-3-3a: Trends in Korea's Balance of Payments Transactions



Source: IFS and Bank of Korea Official Website.

Figure 4-3-3b: Capital Account Components in Korea



Source: IFS and Bank of Korea Official Website.

The process of financial liberalization and capital opening was aggressively implemented by Korean monetary authorities during the 1990s. The government conducted a series of interest rate deregulation plans since 1991 and also opened the domestic stock market to foreign investors in the following year.[44] Huge capital inflows, mainly portfolio and other investments had kept Korea's BOP being in surplus during the early 1990s, even though the current account remained continuously deficit due to strong domestic demand. However, the Asian currency crises happened in 1997 and drove tremendous capital out of the country. Although current account deficit was improved by the won depreciation in 1997, both capital account deficit and an unusual large amount of net errors and omissions, which is often viewed as an indicator of speculative capital flows, have turned the BOP into a deficit. Figure 4-3-3b also shows that huge amount of other investment flow out of Korea in 1997 and as well as portfolio investment in 1998.[45]

Due to the currency crises, the daily fluctuation of the market-average exchange rate was widened from the initial 0.4% above or below the basic rate to 10% either way on 20th November 1997, and this was further eliminated from 16th December 1997, effectively launching a floating exchange rate system. The current account turned to a tremendous surplus in 1998 due to a sharp depreciation in 1998 (from 951.3 won against US dollar to 1401.4 won against US dollar). Since then, the exchange rate has remained around 1150 won against the US dollar, and the current account has remained surplus.

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[44] The ceiling of overall foreign investment in any listed company was initially set at 10% and then gradually raised, with by far the largest increase being implemented after the outbreak of the currency crisis in November 1997. The information is referred to Kim and Kim (1999)

[45] Most of the portfolio investments were contributed by debt securities investments before the currency crisis, but changed to equity securities investment afterward. In addition, most of the other investment outflows were from bank investments and other sectors investments.

The capital account has turned to surplus as well after 1998 since portfolio investments flow back to Korea again.

(2) Monetary Sterilization Policies in Korea

Similar to most Asian countries, the Bank of Korea (BOK) takes price stability as the most important objective of its monetary policy, and has full discretionary power in terms of deciding the sterilization policies and choosing monetary instruments. A variety of inflation target policies have been set since the creation of the Financial Stabilization Program in 1957 (see Table 4-3-3a). From the earliest tools, M1, reserve money, and domestic credit, to the following M2, MCT[46], and M3, and then to the latest CPI inflation rate, they are all once used as an intermediate target, indicating that the movement of monetary aggregate is getting harder to control. In addition, the interest rate target policy has also been operated largely after the currency crises in late 1997.

To keep prices stable, reserve requirements and lending policy have been frequently used to adjust the domestic liquidity since foreign reserves began to be accumulated in the mid-1980s. But with the development of the domestic bond market, open market operations (OMOs) have played a more important role as a monetary instrument since the early 1990s.[47] Figure 4-3-3c shows that BOK has intensively sterilized its reserve accumulation since 1990s, but M2 (Figure 4-3-3d) still growth substantially during the sample period. The inflation (Figure 4-3-3e) was fairly stable and

[46] MCT includes M2, certificates of deposit (CDs) and money-in-trust.
[47] However, the relationship between the BOK and commercial banks tends to be one-sided rather than coordinative because the BOK forcefully allocated the amount of bond purchases across financial institutions. Refer to United Nation Development Research and Policy Analysis Division Report.

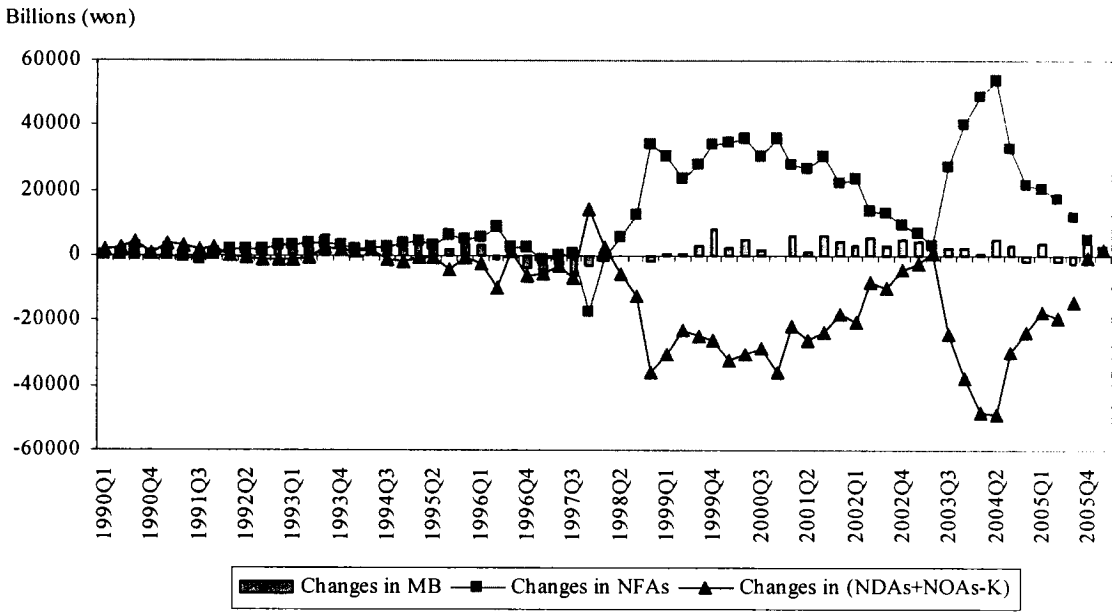
fluctuated between 3 to 7 percent, except there was a relative high inflation caused by the sharp depreciation during the crises period. The monetary sterilization policies and instruments are summarized below.

Table 4-3-3a: Inflation Target and Figures in Korea

Year	Inflation Target	Target Figures
1979	M2 Growth Rate	25
1980	M2 Growth Rate	20 (25)
1981	M2 Growth Rate	25
1982	M2 Growth Rate	20-22 (25)
1983	M2 Growth Rate	18-20 (15)
1984	M2 Growth Rate	11-13
1985	M2 Growth Rate	9.5
1986	M2 Growth Rate	12-14 (16-18)
1987	M2 Growth Rate	15-18
1988	M2 Growth Rate	15-18
1989	M2 Growth Rate	15-18
1990	M2 Growth Rate	15-19
1991	M2 Growth Rate	17-19
1992	M2 Growth Rate	18.5
1993	M2 Growth Rate	13-17
1994	M2 Growth Rate	14-17
1995	M2 Growth Rate	12-16
1996	M2 Growth Rate	11.5-15.5
1997	Double Monetary Targeting System:	14-19 (M2)
	M2 Growth Rate and MCT Growth Rate	15-20 (MCT)
1998	Inflation Rate (CPI)	9 +- 1%
1999	Inflation Rate (CPI)	3 +- 1% (inflation)
	M3 Growth Rate	13-14 (M3 growth rate)
2000	Inflation Rate (CPI)	2.5 +- 1% (Inflation)
	M3 Growth Rate	7-10 (M3)
2001	Inflation Rate (CPI)	3 +- 1% (Inflation)
	M3 Growth Rate	6-10 (M3)
2002	Inflation Rate (CPI)	3 +- 1% (Inflation)
	M3 Growth Rate	8-12 (M3)
2003	Core Inflation Rate	2.5 (core inflation)
2004-2006	Core Inflation Rate	2.5-3.5 (core inflation)

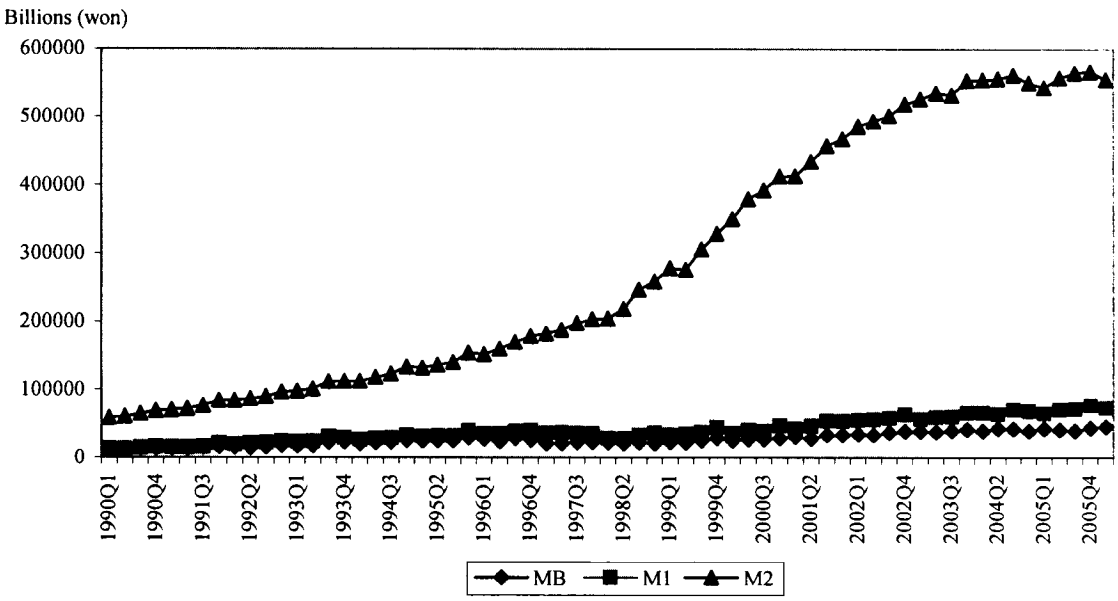
Note: 1. Figures in parentheses are revised target figures.
2. Data source: Annual Monetary Policy Report, published by the Bank of BOK.

Figure 4-3-3c: Quarterly Annual Change in NFAs, NDAs, and Reserve Money in Korea, 1990: Q1 – 2006: Q1



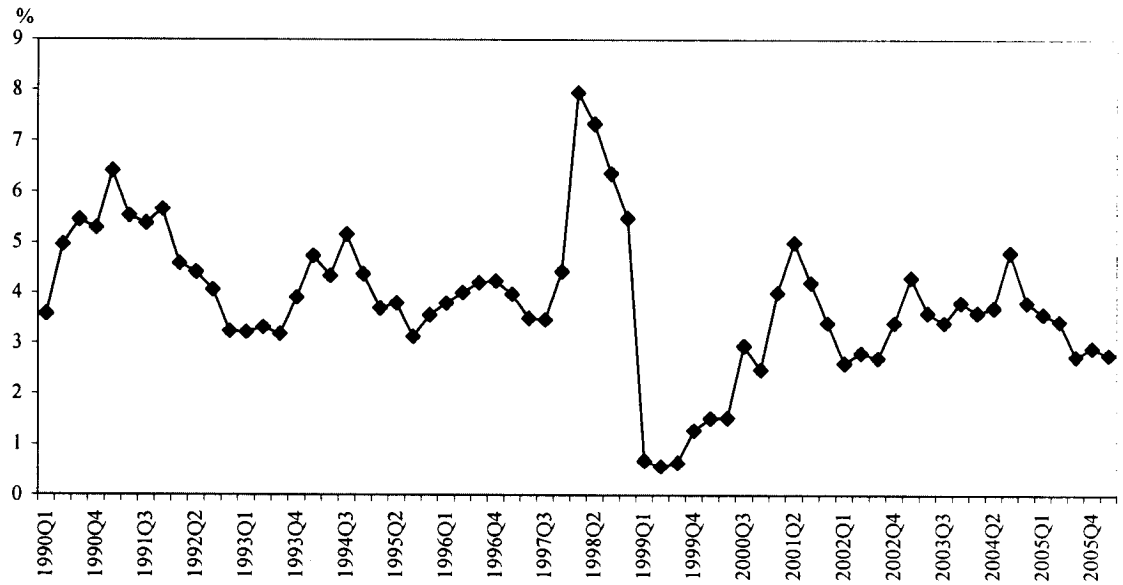
Source: IFS

Figure 4-3-3d: Reserve Money, M1, and M2 in Korea, 1990: Q1 – 2006: Q1



Source: IFS

Figure 4-3-3e: Inflation (CPI % Change) in Korea, 1990: Q1 – 2006: Q1



Source: IFS

a. Reserve Requirements

The BOK often conducted reserve requirement policies during the 1970s and 1980s. In order to ease the burden on banks' earnings, the reserve requirement ratios were lowered on several occasions since the beginning of 1980s, but continuously rose twice in November 1987 and December 1988 due to the growing monetary expansionary pressure that resulted from the large current account surplus in 1986. Although a unified reserve requirement ratio was applied to all deposits in July 1981, the marginal reserve requirements were again put in place in 1989 to control the money supply. Moving into the 1990s, the implementation of interest rate deregulation gave financial institutions a much greater degree of autonomy managing with their funds. The reserve requirement ratios were continuously reduced three times in 1996 and 1997, and have been kept by an average of 3% in order to increase the banks' competitiveness, while open market

operations becomes the main instrument of monetary management. (See Table 4-3-3b for the changes in reserve requirement ratios since the 1970s and their background.)

Table 4-3-3b: Changes in Reserve Requirement Ratios since the 1970s in Korea

Date	Reserve Requirement Ratio (%)		Background
	Demand Deposits	Time & Savings Deposits	
Jan. 1 1971	26	16	Improve financial institutions' earning and reduce banks' reliance on the BOK.
Oct. 28 1971	18	12	
Dec. 16 1972	19	14	Absorb excess liquidity consequent to monetary expansion after the August Third Emergency Economic Measures.
May 16 1973	22	18	Mop up excess liquidity following pressures for monetary expansion through the government and public sectors and the foreign sector.
Aug. 1 1974	19	15	Improve funding situations of financial institutions.
Jan. 1 1975	21	17	Defuse pressure for monetary expansion through the government sector.
Mar. 1 1975	23	16	Encourage financial institutions' efforts to increase time & saving deposits.
Jul. 1 1975	24	17	Strengthen aggregate demand management through restrictive money supply.
Feb. 23~ Apr. 23 1978	27	20	Absorb liquidity stemming from favorable devolution of balance of payments and release of grains purchase funds (raised each month on three occasions in succession).
Jan. 8 1980	20	11	Ease the burden on banks' earnings stemming from the chronic shortages of funds and narrowing deposit/lending rate spreads.
Sep. 23 1980	14	10	
Jul. 8 1981	5.5	5.5	Seek to raise financial institutions' autonomy in funds management and improve their earnings.
Nov. 23 1981	3.5	3.5	
May 23 1982	5.5	5.5	Solve the problem that financial institutions were unable to execute interbank payments and settlements smoothly across accounts held with the BOK
Sep. 8 1984	4.5	4.5	Alleviate burden on banks' earnings resulting from their support for industrial rationalization funds.
Nov. 23 1987	7.0	7.0	Counteract monetary expansion pressures through the foreign sector as a result of the widened current account surplus.
Dec. 23 1988	10.0	7.0~10.0	Offset money supply through the foreign sector.
May 8 1989	10.0 (30.2*)	14 (30.2)	Impose marginal reserve requirements to counter continuing high level of growth in money supply

			through expansion of private sector credit.
Feb. 8 1990	11.5	8.0~11.5	Discontinue marginal reserve requirements and raise basic reserve requirement ratio.
Apr. 23 1996	9.0	6.0~9.0	Enlarge banks' discretion in funds management and consolidate banks' earning basis.
Nov. 8 1996	7.0	4.0~7.0	Promote a favorable condition to the fair competition between banks and non-bank financial institutions.
Feb. 23 1997	5.0	2.0~5.0 (2.0**)	Promote a favorable condition to the fair competition between banks and non-bank financial institutions.

Trends of Foreign-Currency Deposit Reserve Requirement Ratio			
Year	Residents Account	Other Accounts***	Background
Feb 1990	4.5	1	
Mar 1990	11.5	1	
Apr. 1996	9	1	
Nov 1996	7	1	
Apr. 2000	5 (demand deposit) 2 (savings deposit)	1	

Note: * The marginal reserve requirement ratio was applied to the semi-monthly increment in the average deposit balances over the first half of April 1989.
** Reserve requirement ratio on CDs
*** Other account includes bank account, external account and overseas emigrant account, etc.

b. Open Market Operations (OMOs)

Open market operations were launched in November, 1961. The BOK conducted OMOs by requesting nationwide commercial banks to purchase the 91-day Monetary Stabilization Bonds (MSBs) that the BOK issued for a total of 3.4 billion Hwan (the Korea currency denomination at that time) at a discount rate of 8% *per annum.* However, due to the immaturity of domestic bond markets, the BOK could not effectively use OMOs to adjust the money supply, and so it established the Monetary Stabilization Account for deposit money banks in May, 1967 to manage domestic liquidity. When the BOK tried to reduce the money supply, the banks were obliged to deposit a certain

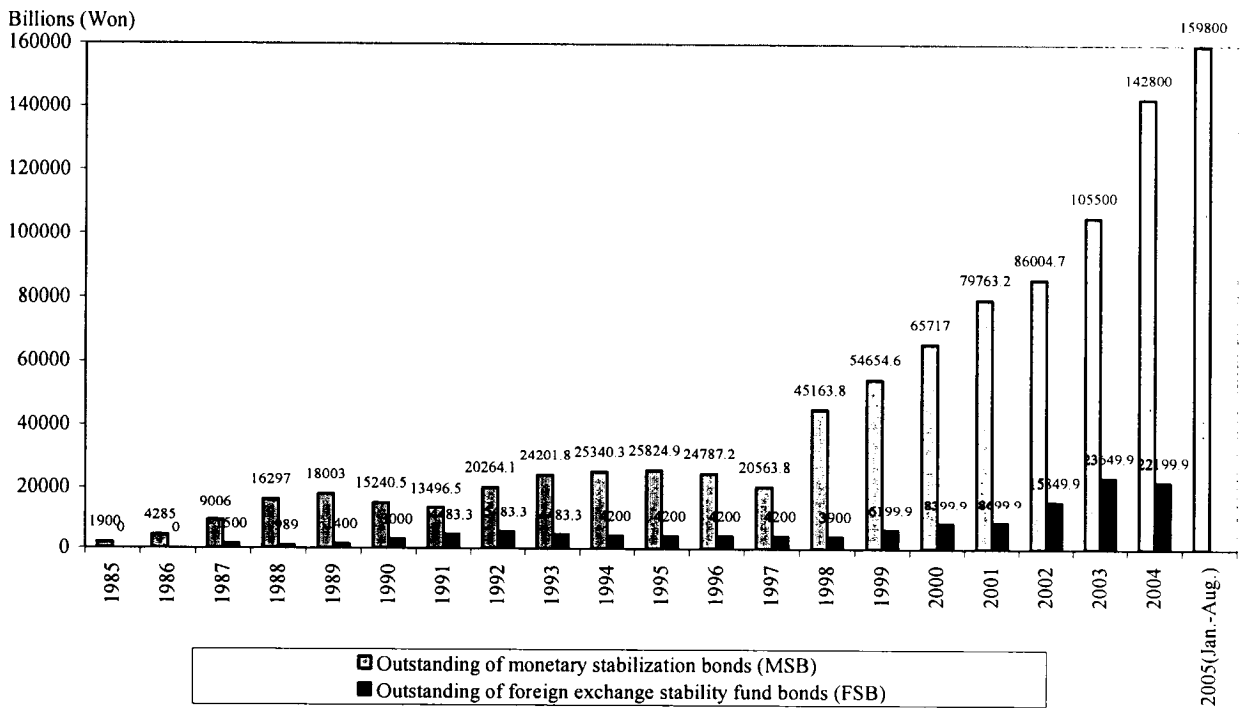
amount into this account and vice versa if the BOK tried to increase the money supply. The entire Monetary Stabilization Account was closed in May, 1989 after the BOK conducted an interest rate deregulation.

In order to deal with the growing monetary expansion, the BOK began to issue MSBs on the open market for the fist time in 1972. Then, it allowed non-bank financial institutions to bid on the MSBs in 1977 and also opened the MSBs transaction to private investors from the beginning of the 1980s. Due to the growing pressure for monetary expansion coming through the foreign sector in the late 1980s, the BOK issued a large amount of MSBs to sterilize the domestic liquidity. But the consequence is that the government had to issue another kind of medium- and long-term Foreign Exchange Stabilization Bonds (FSBs) to release the burden of the redemption payments that resulted from the expansion of MSBs.

In addition, the BOK also used OMOs to provide funds to the institutions that were short of liquidity, such as the BOK providing a total of 1.5 trillion won of liquidity to the banks during the period from June to September, 2000 enabling them to provide financial support to the Korea Deposit Insurance Corporation (KDIC). At the same year, the BOK also provided the same amount of funds to the Kookmim Bank and the Housing and Commercial Bank of Korea, which faced a temporary outflow of deposits due to strikes action at the end of last year, through repurchase agreements (RPs). Again in 2004, when a strike broke out at KorAm Bank, the BOK immediately formed a special task force to monitor the impact on the financial markets, and conducted its daily OMOs to facilitate the stricken bank's trouble-free borrowing of call funds, so as to guard against possible liquidity problems owing to large-scale withdrawals of deposits.

After the late 1980s, OMOs had become the most important instrument that the BOK used to manage the money supply. With the development of domestic bond markets, different maturity of MSBs (28, 91, 371, 392, and 546 days) were introduced into the market. In addition to government bonds and government-guaranteed bonds, the BOK added repurchased MSBs and Land Development Bonds, issued in connection with the redemption of corporate debt, to financial companies to the list of eligible OMOs securities in 1998. Therefore, MSB issuance has been built-up quickly since then, and reached 159.8 trillion won as of the end of August, 2005 (see Figure 4-3-3c). Again, accumulating issuance of MSBs brought an upward pressure on market interest rates and increased the expanses of issuance. To reduce the issuance of MSBs, the BOK introduced currency swap transactions with the National Pension Fund, absorbing Korea won in exchange for foreign reserves to be repurchased at maturity in May, 2005.

Figure 4-3-3c: MSB and FSB Issuance (Change of MSB and FSB Outstanding)



Source: Annual and Quarterly Monetary Reports, issued by BOK

c. Lending Policy

In addition to the reserve requirement and OMOs, the lending policy has often been used by the BOK as a monetary instrument since the 1950s. However, it is more like a means of policy financing rather than a tool for liquidity adjustment during the period of rapid economic growth. During the 1980s, lending policies mainly focused on financial support for export industries and small and medium-sized enterprises (SMEs). When the second oil shock happened in the mid 1980s, the BOK created industrial restructuring funds to a total amount of 1722.1 billion won to support the institutions that suffered from the shock.

Moving into the 1990s, a total of 2.9 trillion won, in the form of funds for the managerial stabilization of investment trust companies, was injected into three investment trust companies, Hanguk, Daehan and Kookmin, which were experiencing difficulties because of increased beneficiary certificate redemptions and weakening earnings. The BOK even issued a large amount of Monetary Stabilization Bonds and Foreign Exchange Stabilization Bonds to sterilize the increasing monetary expansion that resulted from these loans. Since more and more criticism put on the BOK for placing too much emphasis on policy financing, an Aggregate Credit Ceiling System was introduced in March of 1994 to strengthen its function of management of the money supply. Since then, this system has been used to provide financial supports for SMEs or some specified industries. Finally, several special loans were also introduced and extended by the BOK during the currency crises period in fulfilling of its role as the lender of last resort.

In addition to the Aggregate Credit Ceiling System, a Liquidity Adjustment Loan System and an Intraday Overdraft System were also introduced in 2000 to finance applicant banks that face temporary shortages of liquidity. To strengthen the financial support for regionally-based SMEs in the last two years, the quota under the Aggregate Credit Ceiling System allocated to the Bank's regional branches for the support of local SMEs was increased by 400 billion won. In addition, another 400 billion won was also raised on the ceiling for trade finance to counter SMEs' weakening profitability due to the increasing international raw material prices. Furthermore, a system of currency swaps linked to foreign currency loans was launched in July 2005 to make used of some part of the foreign reserve as a resource for banks' facilities investment lending. The trends of Aggregate Credit Ceiling and its interest rates can be found in Table 4-3-3c.

Table 4-3-3c: Trends of Aggregate Credit Ceiling and Its Interest Rates

	Aggregate Credit Ceiling (billions won)	Interest Rates (%)
Mar. 1994	8800	5
Apr. 1994	9300	5
Oct. 1994	9500	5
Jan. 1995	9100	5
Apr. 1995	9200	5
Nov. 1996	6400	5
Feb. 1997	3600	5
Dec 1997	4600	5
Mar 1998	5600	5
Sep 1998	7600	3
Dec 1998	7600	3
Aug 1999	7600	3
Jan 2001	9600	3
Sep 2001	11600	2.5
Oct 2002	9600	2.5
Aug 2004	9600	2.25
Nov 2004	9600	2

Data Source: Annual and Quarterly Monetary Reports, issued by BOK

d. Overnight Call Rate Target

As the effectiveness of monetary aggregates as an intermediate target continued to weaken, the operating target which was used to achieve the inflation targets moved from reserves to the overnight call rate target after the 1997 currency crises. The BOK used interest rates as its official operating target for the first time by reducing the interest rate for OMOs from 8.1% to 7% in September 1998 when the foreign exchange market recovered from the currency crises, for expansionary monetary policies intended to be conducted.

Given the fact that the overnight call rate moves closely with the rate applied in OMOs, this policy change has made the overnight call rate consolidate its position as the operating target of monetary policy. The overnight call target has been continuously reduced from its first set of 4.75% in May 1999 to 3.25% at present. Normally, the overnight call rate target will be raised if the price growth exceeds the inflation target, which may be caused by a greatly increase of international oil prices or huge exchange rate depreciation from a currency crises. The trend of changes in the overnight call rate target can be found in Table 4-3-3d.

Table 4-3-3d: Trends of Changes in Overnight Call Rate Target

	Overnight Call Rate Target (%)
May 1, 1999	4.75
Feb 10, 2000	5.00
Oct 5, 2000	5.25
Feb 8, 2001	5.00
July 5, 2001	4.75
Aug 9, 2001	4.50
Sep 19, 2001	4.00
May 7, 2002	4.25
May 13, 2003	4.00
July 10, 2003	3.75
Aug. 12, 2004	3.50
Nov. 11, 2004	3.25

Data Source: Annual and Quarterly Monetary Reports, issued by BOK

e. Capital Controls

Since the capital market, particularly portfolio transactions, did not open until Korea allowed FDI to invest in its stock market in 1992, and completely opened its stock market in 1998, the capital flows were more associated with borrowing and repaying by firms or non-bank financial institutions, like other investments, rather than interest-sensitive capital flows like portfolio investment.[48] During the early periods, foreign investors were only allowed to participate in the Korea stock market through investment trust funds, such as the Korea Fund in 1984, the Korea Europe Fund in 1987, and the Korea Asia Fund in 1991. Meanwhile, the Korean government also abolished its restrictions on payments and transfers for current account transactions, and contributed to the current surplus during the late 1980s.

[48] Refer to Oh (2005) and Kim (1995)

The capital market liberalization before the currency crises included opening the stock market to foreign investors, increasing the investment ceilings and borrowing limits from overseas, and increasing the limit on won that can be carried in and out of Korea when traveling abroad. Therefore, a large amount of portfolio investments flew into Korea during the early 1990s until 1998. Due to the currency crises, the BOK began to allow the exchange rate of the won to float freely in December, 1997. Instead of setting any restrictions to stop the capital outflows, the Korean government further opened the capital market to attract foreign capital back into the country. In 1998, the Korean stock market was totally opened to foreign investors. They were allowed to engage in securities dealings, insurance, property-related business and even issue foreign currency-denominated securities in Korea. Moreover, the revised foreign exchange law switched the capital control system from a positive to a negative list in 1999, indicating that Korea was opening up its capital market gradually.

(3) The Empirical Results for Korea

Korea's empirical results can be found in Table 4-3-3e and Table 4-3-3f. When the change in the lagged REER is used (Table 4-3-3e), the estimated offset coefficient pre-crisis ranges from 0.66 to 0.8, while the estimated sterilization coefficient is around 1. This suggests that Korea had a fairly high degree of capital mobility pre-crisis, and the Bank of Korea (BOK) also undertook fairly aggressive sterilization operations. Post-crisis, while the estimated offset coefficient declined slightly to 0.55, the estimated

sterilization coefficient has also declined marginally to 0.76 with the assumption of perfect foresight.[49]

The estimated coefficients for the change in the money multiplier are consistently significant pre-crisis, while it is only significant in the monetary reaction function post-crisis. The other variables are statistically insignificant in both periods with inconsistent signs, except that the exchange rate adjusted foreign interest rate is positive (i.e. incorrect sign) and significant in the monetary reaction function with the assumption of static expectations. The lagged change in the REER, the government expenditure, and the lagged inflation terms are statistically insignificant both periods with inconsistent signs. The volatility term is the correct sign for exchange rate only, but is not statistically significant. The quarterly dummies appear to become important post-crisis.

The empirical results were similar when the current account is used (Table 4-3-3f). Also, the estimated offset coefficients declined marginally when the change in money multiplier variable was excluded from both estimating functions.

To sum up, Korea has relatively high degree of capital mobility in the pre-crises period, but declined marginally afterward. This is inconsistent with the impression that Korea is gradually opening up its capital market in recent years. But it might be because that Korea's *de facto* capital mobility has not recovered to the level as high as before the currency crises. In addition, the empirical results show that Korea has aggressively sterilized the capital inflows in the pre-crises period, but now it tends to decrease the extent of sterilization, and uses exchange rate policies more.

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[49] Both estimated offset and sterilization coefficients also drop substantially after the crises with the assumption of static expectations. Due to the insignificant estimation, the result is not discussed here.

Table 4-3-3e: Korea - Estimated Simultaneous Equations, 1990:Q1-1997:Q2 and 1998Q3-2004:Q3

Korea: 2SLS	Perfect Foresight				Static expectations			
	1990:Q2-1997:Q1		1998Q3-2004:Q3		1990:Q2-1997:Q1		1998Q3-2004:Q3	
	ΔNFA_t^*	ΔNDA_t^*	ΔNFA_t^*	ΔNDA_t^*	ΔNFA_t^*	ΔNDA_t^*	ΔNFA_t^*	ΔNDA_t^*
Intercept	0.020	0.022	-0.027	**-0.057***	0.018	0.014	-0.022	**-0.057***
	(0.017)	(0.020)	(0.033)	(0.027)	(0.016)	(0.020)	(0.034)	(0.026)
ΔNDA_t^*	**-0.804*****	-	**-0.552****	-	**-0.660*****	-	-0.473	-
	(0.122)		(0.235)		(0.133)		(0.354)	
ΔNFA_t^*	-	**-1.096*****	-	**-0.768****	-	**-1.098*****	-	-0.212
		(0.156)		(0.337)		(0.187)		(0.351)
Δmm_t	**-0.255*****	**-0.312*****	-0.167	**-0.302****	**-0.203*****	**-0.296*****	-0.148	**-0.261***
	(0.045)	(0.036)	(0.135)	(0.134)	(0.044)	(0.033)	(0.141)	(0.136)
Δp_{t-1}	0.075	0.158	0.222	1.254	0.044	0.267	-0.026	0.801
	(0.328)	(0.389)	(1.984)	(2.462)	(0.321)	(0.391)	(1.992)	(2.398)
$Y_{c,t-1}$	-0.166	-0.209	-1.586	-0.027	0.105	0.138	-1.688	1.095
	(0.573)	(0.717)	(1.315)	(2.206)	(0.500)	(0.660)	(1.248)	(2.180)
ΔG_t	0.125	0.132	-0.086	0.092	0.142	0.126	-0.110	0.042
	(0.098)	(0.120)	(0.231)	(0.318)	(0.097)	(0.125)	(0.240)	(0.319)
$\Delta(r_t^* + E_t S_{t+1})$	0.167	0.230	-0.059	-0.221	-0.078	0.093	-0.064	**0.689***
	(0.165)	(0.192)	(0.259)	(0.296)	(0.148)	(0.178)	(0.380)	(0.342)
$\Delta REER_{t-1}$	0.0004	0.0004	-0.001	0.000	0.001	0.001	-0.001	-0.0001
	(0.001)	(0.001)	(0.003)	(0.005)	(0.001)	(0.001)	(0.003)	(0.005)
$(d_2 - 1)\sigma_{s,t-1}$	-0.00003	-	-0.0001	-	0.0003	-	-0.0001	-
	(0.000)		(0.001)		(0.000)		(0.001)	
$(d_1 - 1)\sigma_{r,t-1}$	-	0.0004	-	0.012	-	0.0003	-	0.033
		(0.003)		(0.031)		(0.003)		(0.032)
Q1	-0.018	-0.023	0.058	0.082	-0.012	-0.012	0.054	0.076
	(0.020)	(0.026)	(0.045)	(0.055)	(0.018)	(0.025)	(0.046)	(0.056)
Q2	-0.008	-0.009	0.045	0.025	-0.003	-0.001	0.046	0.007
	(0.015)	(0.020)	(0.034)	(0.043)	(0.014)	(0.019)	(0.034)	(0.043)
Q3	-0.017	-0.018	**0.061***	0.044	-0.014	-0.009	**0.062***	0.003
	(0.021)	(0.025)	(0.031)	(0.039)	(0.019)	(0.025)	(0.032)	(0.041)
R-square	0.835	0.937	0.746	0.698	0.840	0.933	0.743	0.692
Adj. R-square	0.722	0.893	0.531	0.442	0.731	0.886	0.525	0.431

Table 4-3-3f: Korea - Robustness Check, Replace $\Delta REER_{t-1}$ with CA_t

Korea: 2SLS	Perfect Foresight				Static expectations			
	1990:Q2-1997:Q2		1998Q3-2004:Q3		1990:Q2-1997:Q2		1998Q3-2004:Q3	
	ΔNFA_t^*	ΔNDA_t^*	ΔNFA_t^*	ΔNDA_t^*	ΔNFA_t^*	ΔNDA_t^*	ΔNFA_t^*	ΔNDA_t^*
Intercept	0.017	0.023	0.007	-0.016	0.012	0.016	0.015	-0.024
	(0.016)	(0.020)	(0.036)	(0.035)	(0.016)	(0.020)	(0.040)	(0.035)
ΔNDA_t^*	**-0.715*** **	-	**-0.405***	-	**-0.475****	-	-0.370	-
	(0.155)		(0.195)		(0.181)		(0.283)	
ΔNFA_t^*	-	**-1.110*** **	-	**-0.778****	-	**-1.127*** **	-	**-0.345**
		(0.200)		(0.309)		(0.255)		(0.395)
Δmm_t	**-0.228*** **	**-0.315*** **	-0.146	**-0.363****	**-0.142****	**-0.302*** **	-0.155	**-0.308****
	(0.054)	(0.036)	(0.120)	(0.127)	(0.061)	(0.035)	(0.120)	(0.128)
Δp_{t-1}	0.117	0.113	0.702	1.282	0.148	0.181	0.543	1.020
	(0.328)	(0.424)	(1.580)	(1.671)	(0.329)	(0.438)	(1.570)	(1.660)
$Y_{c,t-1}$	0.195	-0.271	**-3.322***	-1.983	0.911	0.019	**-3.457***	-0.820
	(0.735)	(0.906)	(1.786)	(2.221)	(0.737)	(0.970)	(1.777)	(2.351)
ΔG_t	0.099	0.142	-0.033	0.157	0.093	0.146	-0.012	0.095
	(0.101)	(0.125)	(0.232)	(0.237)	(0.101)	(0.130)	(0.233)	(0.239)
$\Delta(r_t^* + E_t S_{t+1})$	0.177	0.228	-0.149	-0.241	-0.156	0.064	-0.238	0.568
	(0.158)	(0.198)	(0.225)	(0.236)	(0.153)	(0.186)	(0.310)	(0.323)
CA_t	0.151	-0.020	-0.605	-1.000	0.300	-0.049	-0.616	-0.806
	(0.210)	(0.258)	(0.484)	(0.677)	(0.214)	(0.270)	(0.487)	(0.681)
$(d_2 - 1)\sigma_{s,t-1}$	0.00003	-	-0.0001	-	0.0005	-	-0.000002	-
	(0.000)		(0.001)		(0.000)		(0.001)	
$(d_1 - 1)\sigma_{r,t-1}$	-	0.001	-	0.032	-	0.001	-	**0.045***
		(0.003)		(0.022)		(0.003)		(0.023)
Q1	-0.009	-0.024	0.024	0.062	0.007	-0.015	0.018	0.060
	(0.022)	(0.028)	(0.043)	(0.039)	(0.021)	(0.029)	(0.045)	(0.039)
Q2	-0.003	-0.011	0.035	0.014	0.008	-0.004	0.029	0.003
	(0.016)	(0.021)	(0.028)	(0.031)	(0.016)	(0.021)	(0.028)	(0.031)
Q3	-0.013	-0.020	**0.059****	0.036	-0.005	-0.012	**0.056***	0.008
	(0.020)	(0.026)	(0.027)	(0.032)	(0.020)	(0.026)	(0.027)	(0.035)
R-square	0.849	0.936	0.761	0.749	0.846	0.931	0.762	0.750
Adj. R-square	0.745	0.892	0.573	0.552	0.741	0.884	0.576	0.553

Table 4-3-3g: Korea - Robustness Check, Without Δmm_t

Korea: 2SLS	Perfect Foresight				Static expectations			
	1990:Q2-1997:Q1		1998Q3-2004:Q3		1990:Q2-1997:Q1		1998Q3-2004:Q3	
	ΔNFA_t^*	ΔNDA_t^*	ΔNFA_t^*	ΔNDA_t^*	ΔNFA_t^*	ΔNDA_t^*	ΔNFA_t^*	ΔNDA_t^*
Intercept	-0.0003	-0.024	-0.038	**-0.065****	0.019	-0.008	-0.012	**-0.066***
	(0.030)	(0.046)	(0.034)	(0.030)	(0.026)	(0.046)	(0.041)	(0.031)
ΔNDA_t^*	**-0.512****	-	**-0.471***	-	**-0.351****	-	-0.118	-
	(0.182)		(0.236)		(0.165)		(0.402)	
ΔNFA_t^*	-	**-1.013****	-	**-0.704***	-	**-0.998****	-	0.038
		(0.364)		(0.391)		(0.440)		(0.455)
Δp_{t-1}	0.272	0.910	-0.547	0.691	-0.057	0.704	-1.010	0.408
	(0.605)	(0.886)	(1.908)	(2.781)	(0.520)	(0.918)	(2.089)	(2.855)
$Y_{c,t-1}$	-0.051	-0.093	-1.023	0.610	-0.423	-1.166	-1.407	2.148
	(1.026)	(1.680)	(1.327)	(2.506)	(0.804)	(1.524)	(1.328)	(2.638)
ΔG_t	0.064	-0.047	-0.108	0.194	0.111	-0.059	-0.218	0.136
	(0.179)	(0.276)	(0.237)	(0.358)	(0.160)	(0.291)	(0.271)	(0.379)
$\Delta(r_t^* + E_t S_{t+1})$	-0.382	-0.517	-0.008	-0.189	**-0.377***	-0.099	-0.313	**0.851***
	(0.256)	(0.407)	(0.261)	(0.335)	(0.204)	(0.422)	(0.447)	(0.414)
$\Delta REER_{t-1}$	0.002	0.002	-0.002	0.0001	0.001	0.002	-0.003	0.0004
	(0.001)	(0.002)	(0.003)	(0.005)	(0.001)	(0.003)	(0.003)	(0.006)
$(d_2 - 1)\sigma_{s,t-1}$	0.001	-	-0.0004	-	0.001	-	-0.0002	-
	(0.001)		(0.001)		(0.001)		(0.001)	
$(d_1 - 1)\sigma_{r,t-1}$	-	0.002	-	-0.0004	-	0.002	-	0.027
		(0.007)		(0.035)		(0.007)		(0.038)
Q1	-0.001	0.005	0.078	0.093	-0.017	-0.021	0.053	0.083
	(0.036)	(0.060)	(0.045)	(0.062)	(0.030)	(0.059)	(0.052)	(0.066)
Q2	0.022	0.046	**0.069****	0.046	0.007	0.030	**0.066***	0.018
	(0.028)	(0.044)	(0.029)	(0.047)	(0.023)	(0.044)	(0.031)	(0.051)
Q3	0.010	0.037	**0.077****	0.053	-0.011	0.018	**0.079****	-0.002
	(0.037)	(0.057)	(0.029)	(0.044)	(0.032)	(0.058)	(0.031)	(0.050)
R-square	0.439	0.631	0.713	0.580	0.559	0.597	0.654	0.526
Adj. R-square	0.109	0.414	0.508	0.281	0.299	0.360	0.406	0.187

Table 4-3-3h: Korea - Robustness Check, Without Δmm_t, Replace $\Delta REER_{t-1}$ with CA_t

Korea: 2SLS	Perfect Foresight				Static expectations			
	1990:Q2-1997:Q2		1998Q3-2004:Q3		1990:Q2-1997:Q2		1998Q3-2004:Q3	
	ΔNFA_t^*	ΔNDA_t^*	ΔNFA_t^*	ΔNDA_t^*	ΔNFA_t^*	ΔNDA_t^*	ΔNFA_t^*	ΔNDA_t^*
Intercept	-0.006	-0.026	0.003	-0.051	0.004	-0.016	0.019	-0.061
	(0.024)	(0.046)	(0.039)	(0.040)	(0.020)	(0.047)	(0.045)	(0.043)
ΔNDA_t^*	**-0.345****	-	-0.285	-	**-0.226***	-	-0.147	-
	(0.159)		(0.202)		(0.128)		(0.313)	
ΔNFA_t^*	-	**-1.243****	-	-0.708	-	**-1.487****	-	0.013
		(0.492)		(0.412)		(0.615)		(0.591)
Δp_{t-1}	0.474	1.153	0.377	0.434	0.310	1.154	0.177	0.331
	(0.494)	(0.967)	(1.670)	(2.007)	(0.419)	(1.008)	(1.722)	(2.113)
$Y_{c,t-1}$	1.385	0.860	-2.953	-0.034	**1.502***	0.921	-3.161	1.849
	(0.983)	(2.148)	(1.877)	(2.663)	(0.826)	(2.313)	(1.937)	(3.039)
ΔG_t	-0.033	-0.096	-0.061	0.214	0.010	-0.120	-0.059	0.137
	(0.147)	(0.289)	(0.249)	(0.289)	(0.126)	(0.299)	(0.259)	(0.308)
$\Delta(r_t^* + E_t S_{t+1})$	-0.123	-0.398	-0.097	-0.157	**-0.319***	-0.220	-0.337	**0.818***
	(0.229)	(0.435)	(0.237)	(0.285)	(0.158)	(0.441)	(0.352)	(0.438)
CA_t	**0.623****	0.490	-0.599	-0.352	**0.622*****	0.775	-0.654	-0.187
	(0.243)	(0.613)	(0.519)	(0.781)	(0.187)	(0.621)	(0.541)	(0.830)
$(d_2 - 1)\sigma_{s,t-1}$	0.001	-	-0.0002	-	0.001	-	-0.0001	-
	(0.001)		(0.001)		(0.001)		(0.001)	
$(d_1 - 1)\sigma_{r,t-1}$	-	0.004	-	0.007	-	0.004	-	0.032
		(0.006)		(0.025)		(0.006)		(0.029)
Q1	0.029	0.022	0.029	**0.089***	0.025	0.018	0.016	0.083
	(0.030)	(0.066)	(0.045)	(0.046)	(0.025)	(0.068)	(0.051)	(0.048)
Q2	0.033	0.054	**0.050***	0.045	0.027	0.053	0.043	0.020
	(0.022)	(0.046)	(0.027)	(0.035)	(0.018)	(0.049)	(0.028)	(0.039)
Q3	0.018	0.041	**0.068****	0.050	0.008	0.033	**0.066****	0.001
	(0.030)	(0.059)	(0.027)	(0.040)	(0.025)	(0.060)	(0.028)	(0.049)
R-square	0.641	0.622	0.706	0.600	0.742	0.589	0.687	0.553
Adj. R-square	0.430	0.399	0.510	0.334	0.590	0.347	0.478	0.255

4.3.4 Malaysia

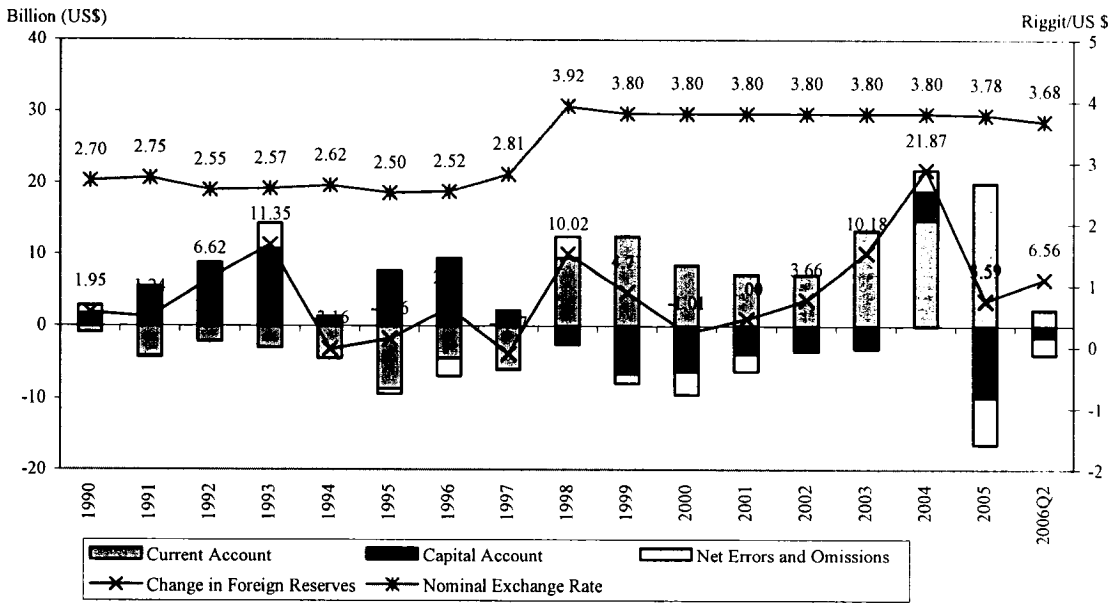
(1) The Evolution of Balance of Payments in Malaysia

Malaysia's BOPs evolution exhibits a clear contrast before and after the currency crises in 1997 (Figure 4-3-4a). In the early 1990's until 1997, the capital account enjoyed a consistent surplus while the current account had been in deficit. This pattern was completely turned around after 1997. Right after 1997, there has been a huge current account surplus. But capital account has been in deficit except year 2004 (Figure 4-3-4b). The 1997 crises had a huge impact on the BOPs behavior as well as the nominal exchange rates. The bilateral nominal exchange rates of Ringgit with respect to US$ devalued from 2.82 in 1997 to 3.92 in 1998. It was maintained at 3.80 afterwards. The devaluation in 1998 helped Malaysia gain competitiveness in export sector and depressed the import sector, which directly contributed to the turnaround of current account performance.

The large deficit in current account before the crises was not mainly due to the trade deficit but the services account deficit. The boom in foreign direct investment in the last several years caused a lot of repatriation of profits. For instances, the current account's $ 7.1 billion deficit was comprised of only $ 0.2 billion deficit in goods balances, but an almost $7.1 billion in services account. Furthermore, the outflows of foreign investments may exceed the inflows. This is called "the decapitalization trap" in Malaysia.

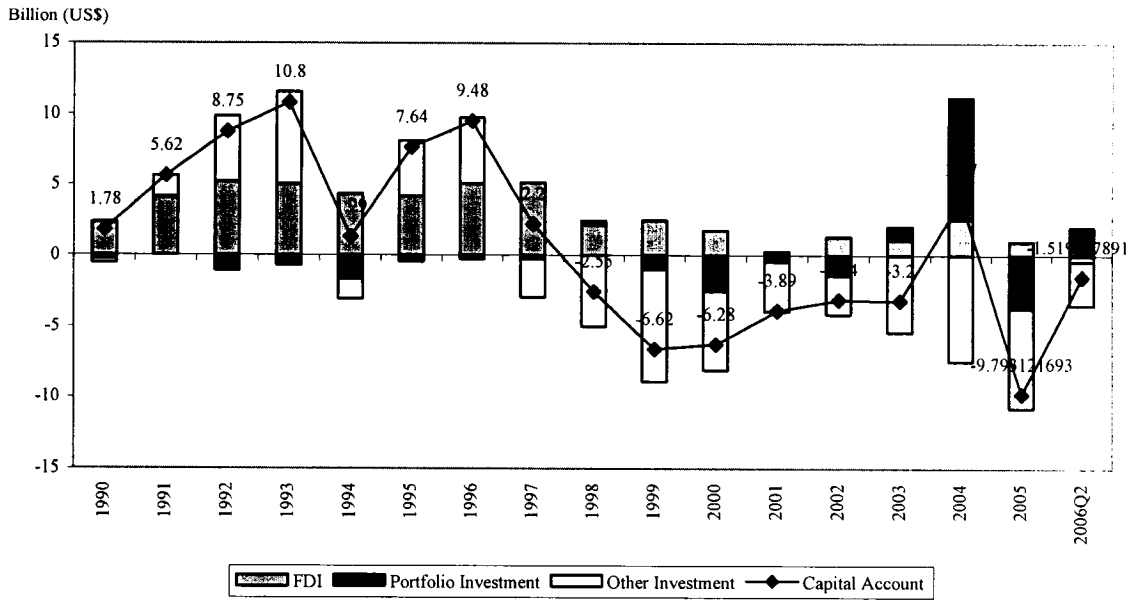
Malaysia's international reserves reached a record high level of over $ 78.76 billion in the second quarter of 2006. The reserve accumulation has been very consistent from 1990 to today, even though there were some decreases in year 1994, 1995 and 1997. After 2002, the reserve stockpiling speeded up. Within three years from 2002, the reserve levels increased from $ 34.22 billion to $ 70.17 billion, which was more than doubled. This pattern has no signs of waning. The reserve gain in the first two quarters of 2006 is more than 8 billions, which is more than the whole year gain in 2005.

Figure 4-3-4a: Trends in Malaysia's Balance of Payments Transactions



Source: IFS and the Bank Negara Malaysia (BNM) official website.

Figure 4-3-4b: Capital Account Components in Malaysia



Source: IFS and the Bank Negara Malaysia (BNM) official website.

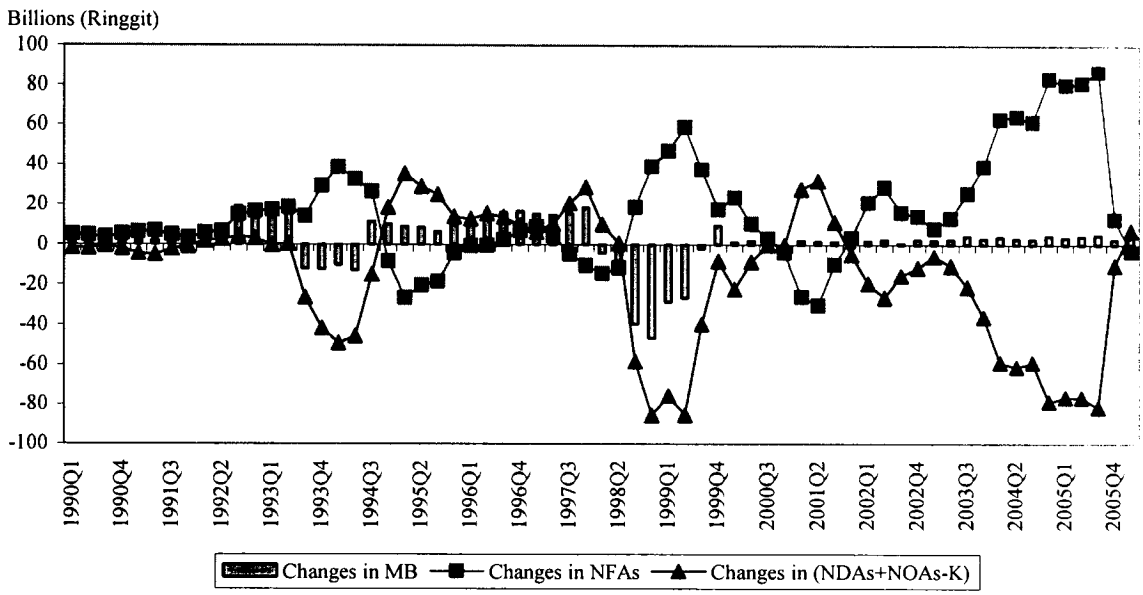
(2) Monetary Sterilization Policies in Malaysia

Malaysia originally pegged its exchange rate to a composite basket of currency before the currency crises occurred in 1998. However, the Bank Negara Malaysia (BNM) announced that the Ringgit would be pegged against the U.S. dollar at RM3.80 per US dollar after the crises to stabilize the volatility of exchange rate. But since July 2005, Malaysia has decided to adopt a managed float exchange rate regime, and determined its exchange rate based on economic fundamentals.

To maintain the domestic liquidity situation, The BNM usually set up the 3-months intervention rate as the operating target, and uses different monetary instruments to achieve its policy goal, including open market operations, the adjustment of statutory reserve requirement (SRR), and capital controls. Figure 4-3-4c shows that dynamic

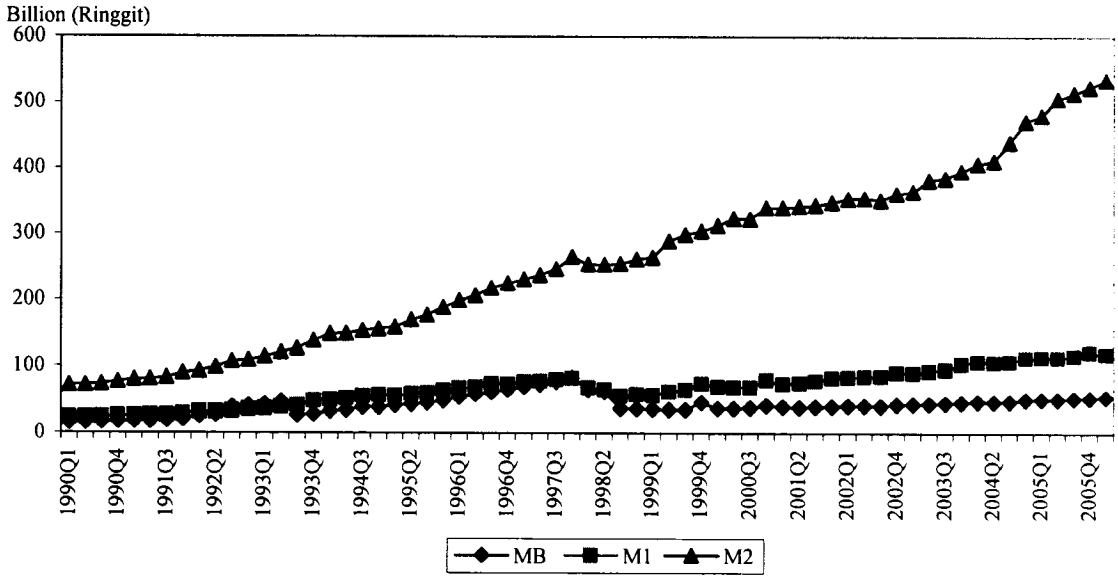
change in foreign and domestic components of monetary base in Malaysia. It is quite obvious to see that most of the change in NFAs has been sterilized by the NDAs, particular after 2000. Hence the change in monetary base was fairly constant in recent five years (Figure 4-3-4d). Moreover, the BNM had over-sterilized the capital inflows within the two years after the crises to mitigate the rising inflation pressure (Figure 4-3-4e) caused by the sharp depreciation in early 1998. The evidence could be found by a substantial decrease in the change of monetary base.

Figure 4-3-4c: Quarterly Annual Change in NFAs, NDAs, and Reserve Money in Malaysia, 1990: Q1 – 2006: Q1



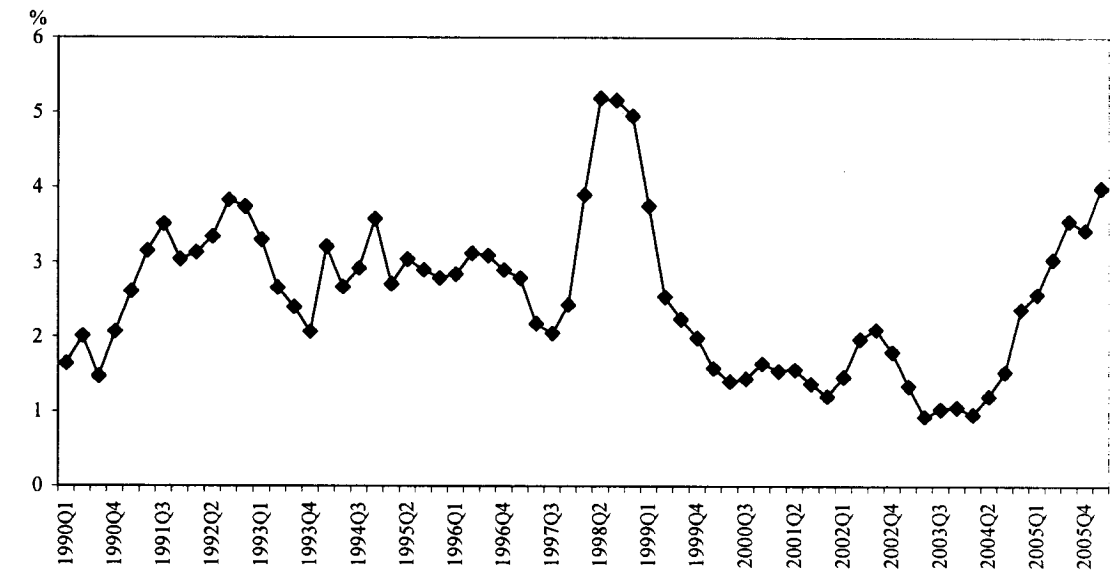
Source: IFS

Figure 4-3-4d: Reserve Money, M1, and M2 in Malaysia, 1990: Q1 – 2006: Q1



Source: IFS

Figure 4-3-4e: Inflation (CPI % Change) in Malaysia, 1990: Q1 – 2006: Q1

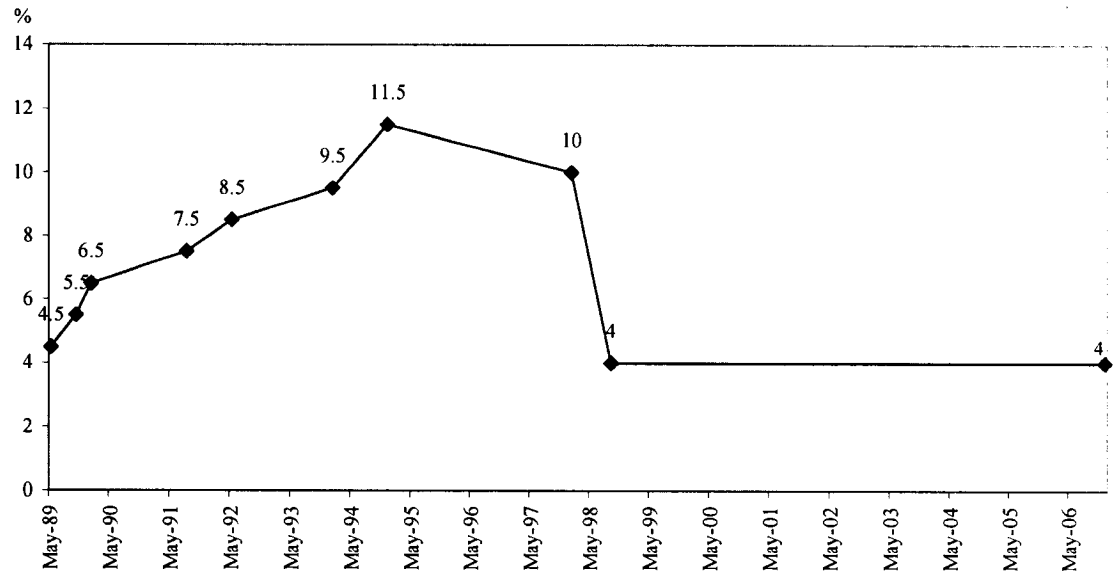


Source: IFS

a. Reserve Requirements

Reserve requirement has been used fairly frequently during the pre-crises and late crises period, particular in 1998 (Figure 4-3-4f). At the beginning of the year, the BNM reduced the SRR to 10% to ease banking sectors' burden caused by the crises. To stimulate domestic economy, the Bank wide the band of variation of the reserve requirement from 0.5% to 2%, reduced the SRR by 2% twice in both July and the beginning of September, and further decreased another 2% at late September. Therefore, the SRR had been reduced from 10% to 4% by the end of 1998 to increase the domestic liquidity. Meanwhile, the reserve requirements for commercial banks' liquidity assets had also been reduced from 17% to 15%, while the requirements for finance companies and merchant banks were remained at 10%.

Figure 4-3-4f: Reserve Requirement Ratio (%) in Malaysia, 1989 – 2006



Source: Dean (1996) and Annual Monetary Report Issued by BNM.

b. Open Market Operations (OMOs)

In order to manage the inflationary pressure caused by a large amount of reserve accumulation during the 1990s, the BNM has often conducted open market operations to mop up the extra liquidity in the domestic money market. However, due to the limited amount of government bonds, such as TBs, and MGSs[50], the BNM issued RM 7.16 billion of Bank Negara Bills (BNBs) to do OMOs in 1993. Since then, BNBs has been used frequently to adjust domestic liquidity.

c. Lending Policy

Many monetary measures and special lending policies have been implemented in Malaysia to provide funds for the priority sectors. For example, the BNM introduced the Enterprise Programme for Small and medium-sized enterprises (SMEs) to solve their non-performing loan (NPL) problems due to the crises, while the Fund for Small and Medium Industries 2 was also established in 2000 for export-oriented industries.

d. Capital Controls

When the currency crises occurred in 1997, Malaysia required banks to limit outstanding noncommercial-related ringgit offer side swap transactions to $2 million per foreign customer. The government even imposed a series of restrictive capital controls on international capital flows after the crises, but has gradually opened up recently. For example, in 1998, the government required nonresidents had to purchase and sell their Malaysian securities through authorized depository institutions, and hold on their

[50] To sterilize the capital inflows during the early 1990s, the outstanding amount of public bonds held by BNM reduced sharply from RM2.68 billion in 1990 to RM 0.45 billion in 1993. Refer to Umezaki (2006)

transaction profits for at least one year. In 1999, nonresidents could repatriate proceeds from sales of securities after paying exit taxes on capital gains. But now, the policy has been changed again, and nonresident can repatriate profits free of levy if the profits have been held for more than 12 months.

e. Management of Government Funds

The Money Market Operations (MMO) account was activated again in April 1990. To manage the domestic liquidity, the BNM moved a total amount of about RM3.7 billion government deposits from the banking system to the MMO account. In the following years, the BNM also moved some public sector funds, such as Employee Provident Fund (EPF) and government deposits to the central bank to do sterilization.

(3) The Empirical Results for Malaysia

The empirical results for Malaysia are reported in Table 4-3-4a and Table 4-3-4b. The results are fairly consistent no matter which variables and which assumptions of expectations are used. The estimated offset coefficient pre-crisis is around 0.72 to 0.79, while the estimated sterilization coefficient is about 0.6. This suggests that Malaysia had a fairly high degree of capital mobility pre-crisis and the Bank Negara Malaysia (BNM) also sterilized about 60 percent of the inflows. The offset coefficient has increased post-crisis, as has the estimated sterilization coefficient, suggesting that the BNM continued to heavily sterilize its reserve accretion under the pegged exchange rate policy. The slight increase in *de facto* openness in Malaysia post-crisis despite the imposition of capital controls appears somewhat counter-intuitive. The discussed further in the chapter 6.

The estimated coefficients for the change in money multiplier are negative and significant both pre and post-crisis in the monetary reaction function, but are only significant in the balance of payments function post-crisis. While the exchange rate adjusted foreign interest rate variable is statistically insignificant and the correct sign pre-crisis, it increased in statistical and economic significance with the wrong sign post-crisis with the assumption of perfect foresight. But with static expectations, the estimated coefficient is negative (i.e. correct sign) and significant in the monetary reaction function post-crisis. This further fuels some suspicion that the model may not be appropriate for Malaysia in view of the country's US dollar peg from September 1998 to July 2005, a period which encompasses the post-crisis sub-period in the sample.

The lagged inflation is negative and significant in the balance of payments function post-crisis with static expectations, indicating that a high inflation rate would drive the capitals out of the country. The cyclical income and change in REER terms remain statistically insignificant with wrong or inconsistent signs. The exchange rate volatility term is negative and significant pre-crisis, but turns to be positive post-crisis. The interest rate volatility term is correct sign (negative), but only statistically significant in the post-crisis period. In addition, the estimated offset coefficients decline marginally when the change in money multiplier is excluded (Table 4-3-4c and Table 4-3-4d).

Table 4-3-4a: Malaysia - Estimated Simultaneous Equations, 1990:Q1-1997:Q2 and 1998Q3-2004:Q4

Malaysia: 2SLS	Perfect Foresight				Static expectations			
	1990:Q1-1997:Q2		1998Q3-2004:Q4		1990:Q1-1997:Q2		1998Q3-2004:Q4	
	ΔNFA_t^*	ΔNDA_t^*	ΔNFA_t^*	ΔNDA_t^*	ΔNFA_t^*	ΔNDA_t^*	ΔNFA_t^*	ΔNDA_t^*
Intercept	0.140	-0.009	0.014	0.009	0.166	-0.002	**0.064****	0.013
	(0.099)	(0.079)	(0.012)	(0.013)	(0.105)	(0.086)	(0.028)	(0.022)
ΔNDA_t^*	**-0.798*****	-	**-0.957*****	-	**-0.733*****	-	**-0.914*****	-
	(0.210)		(0.051)		(0.219)		(0.101)	
ΔNFA_t^*	-	**-0.613*****	-	**-1.011*****	-	**-0.620*****	-	**-0.917*****
		(0.135)		(0.054)		(0.150)		(0.068)
Δmm_t	-0.294	**-0.577*****	**-0.415*****	**-0.448*****	-0.284	**-0.631*****	**-0.625*****	**-0.601*****
	(0.214)	(0.133)	(0.067)	(0.057)	(0.232)	(0.147)	(0.140)	(0.085)
Δp_{t-1}	2.735	4.587	-0.562	-0.296	3.527	5.934	**-7.271***	-1.174
	(5.198)	(4.277)	(1.744)	(1.831)	(5.532)	(4.496)	(4.020)	(3.226)
$Y_{c,t-1}$	0.064	-0.006	0.006	0.003	0.022	-0.036	**0.035***	0.007
	(0.296)	(0.292)	(0.008)	(0.008)	(0.324)	(0.307)	(0.017)	(0.014)
ΔG_t	0.855	0.289	0.053	-0.029	0.990	0.391	0.032	-0.128
	(0.551)	(0.464)	(0.100)	(0.089)	(0.577)	(0.486)	(0.238)	(0.180)
$\Delta(r_t^* + E_t S_{t+1})$	-1.092	-0.991	**5.074*****	**4.346*****	0.579	0.929	3.014	**-2.264****
	(0.736)	(0.612)	(0.614)	(0.591)	(1.100)	(0.959)	(7.176)	(0.807)
$\Delta REER_{t-1}$	0.013	0.007	0.0001	0.001	0.007	-0.0005	-0.001	0.002
	(0.008)	(0.007)	(0.002)	(0.002)	(0.009)	(0.008)	(0.004)	(0.003)
$(d_2 - 1)\sigma_{s,t-1}$	**-2.083***	-	**0.338****	-	**-2.214***	-	-1.292	-
	(1.054)		(0.140)		(1.119)		(2.731)	
$(d_1 - 1)\sigma_{r,t-1}$	-	-0.085	-	**-0.032****	-	-0.114	-	**-0.121*****
		(0.091)		(0.014)		(0.101)		(0.033)
Q1	-0.187	-0.047	0.014	0.016	-0.222	-0.062	0.014	0.014
	(0.132)	(0.111)	(0.010)	(0.010)	(0.142)	(0.120)	(0.024)	(0.018)
Q2	-0.117	0.006	-0.005	0.001	-0.145	-0.002	-0.053	-0.004
	(0.126)	(0.103)	(0.013)	(0.014)	(0.136)	(0.111)	(0.031)	(0.025)
Q3	-0.237	-0.064	0.008	0.010	**-0.291***	-0.105	**-0.056***	-0.011
	(0.153)	(0.129)	(0.013)	(0.014)	(0.157)	(0.134)	(0.027)	(0.023)
R-square	0.753	0.828	0.986	0.993	0.721	0.811	0.922	0.980
Adj. R-square	0.582	0.710	0.976	0.988	0.529	0.680	0.869	0.967

Table 4-3-4b: Malaysia - Robustness Check, Replace $\Delta REER_{t-1}$ with CA_t

Malaysia: 2SLS	Perfect Foresight				Static expectations			
	1990:Q1-1997:Q2		1998Q3-2004:Q4		1990:Q1-1997:Q2		1998Q3-2004:Q4	
	ΔNFA_t^*	ΔNDA_t^*	ΔNFA_t^*	ΔNDA_t^*	ΔNFA_t^*	ΔNDA_t^*	ΔNFA_t^*	ΔNDA_t^*
Intercept	0.153	-0.002	-0.008	-0.022	0.158	0.009	0.046	-0.046
	(0.107)	(0.082)	(0.016)	(0.017)	(0.106)	(0.087)	(0.048)	(0.030)
ΔNDA_t^*	**-0.792*** **	-	**-0.959*** **	-	**-0.723*** **	-	**-0.918*** **	-
	(0.227)		(0.041)		(0.223)		(0.101)	
ΔNFA_t^*	-	**-0.607*** **	-	**-1.017*** **	-	**-0.669*** **	-	**-0.945*** **
		(0.139)		(0.043)		(0.155)		(0.055)
Δmm_t	-0.332	**-0.600*** **	**-0.423*** **	**-0.456*** **	-0.312	**-0.615*** **	**-0.632*** **	**-0.580*** **
	(0.231)	(0.133)	(0.059)	(0.050)	(0.232)	(0.141)	(0.141)	(0.072)
Δp_{t-1}	3.629	5.124	-1.507	-1.089	3.890	5.963	**-8.064***	-1.960
	(5.634)	(4.394)	(1.628)	(1.638)	(5.625)	(4.555)	(3.904)	(2.727)
$Y_{c,t-1}$	-0.120	-0.059	0.008	0.006	-0.088	-0.045	**0.036***	0.010
	(0.300)	(0.298)	(0.007)	(0.007)	(0.298)	(0.309)	(0.017)	(0.012)
ΔG_t	**1.054***	0.409	0.061	-0.022	**1.042***	0.433	0.035	-0.145
	(0.594)	(0.474)	(0.091)	(0.079)	(0.596)	(0.498)	(0.236)	(0.152)
$\Delta(r_t^* + E_t S_{t+1})$	-0.628	-0.767	**5.077*** **	**4.081*** **	0.981	0.904	1.836	**-2.329*** **
	(0.749)	(0.586)	(0.549)	(0.533)	(1.010)	(0.843)	(7.924)	(0.683)
CA_t	-0.104	-0.133	**0.146***	**0.196** **	0.009	0.023	0.124	**0.352** **
	(0.572)	(0.450)	(0.081)	(0.086)	(0.566)	(0.465)	(0.230)	(0.138)
$(d_2 - 1)\sigma_{s,t-1}$	-1.963	-	**0.407*** **	-	**-2.194***	-	-0.809	-
	(1.158)		(0.132)		(1.157)		(3.057)	
$(d_1 - 1)\sigma_{r,t-1}$	-	-0.106	-	**-0.046*** **	-	-0.102	-	**-0.145*** **
		(0.091)		(0.014)		(0.096)		(0.030)
Q1	-0.205	-0.063	**0.016***	**0.018***	-0.203	-0.072	0.017	0.018
	(0.145)	(0.115)	(0.009)	(0.009)	(0.146)	(0.121)	(0.024)	(0.015)
Q2	-0.122	0.00004	-0.007	0.0003	-0.127	-0.010	**-0.056***	0.001
	(0.138)	(0.107)	(0.012)	(0.012)	(0.137)	(0.111)	(0.029)	(0.021)
Q3	**-0.288***	-0.093	0.003	0.004	**-0.299***	-0.119	**-0.060** **	-0.014
	(0.163)	(0.132)	(0.012)	(0.012)	(0.161)	(0.137)	(0.027)	(0.020)
R-square	0.707	0.818	0.988	0.995	0.708	0.804	0.923	0.986
Adj. R-square	0.505	0.692	0.980	0.991	0.508	0.669	0.871	0.976

Table 4-3-4c: Malaysia - Robustness Check, Without Δmm_t

Malaysia: 2SLS	Perfect Foresight				Static expectations			
	1990:Q1-1997:Q2		1998Q3-2004:Q4		1990:Q1-1997:Q2		1998Q3-2004:Q4	
	ΔNFA_t^*	ΔNDA_t^*	ΔNFA_t^*	ΔNDA_t^*	ΔNFA_t^*	ΔNDA_t^*	ΔNFA_t^*	ΔNDA_t^*
Intercept	**0.211****	0.046	0.012	0.006	**0.229****	0.098	**0.100****	0.021
	(0.098)	(0.117)	(0.025)	(0.028)	(0.099)	(0.120)	(0.041)	(0.045)
ΔNDA_t^*	**-0.454***	-	**-0.903*****	-	**-0.452***	-	**-0.576*****	-
	(0.241)		(0.106)		(0.230)		(0.118)	
ΔNFA_t^*	-	**-0.549****	-	**-1.037*****	-	**-0.615****	-	**-1.058*****
		(0.233)		(0.129)		(0.237)		(0.147)
Δp_{t-1}	1.252	7.637	-3.122	-3.648	2.263	8.414	**-12.860****	-6.165
	(5.855)	(6.413)	(3.706)	(4.070)	(6.020)	(6.636)	(5.851)	(6.243)
$Y_{c,t-1}$	0.211	-0.045	0.005	0.002	0.166	-0.073	**0.057****	0.017
	(0.316)	(0.442)	(0.017)	(0.019)	(0.330)	(0.455)	(0.025)	(0.028)
ΔG_t	**1.068***	0.614	-0.086	-0.195	**1.176***	0.817	-0.100	-0.511
	(0.572)	(0.687)	(0.206)	(0.198)	(0.584)	(0.698)	(0.361)	(0.340)
$\Delta(r_t^* + E_t S_{t+1})$	-0.874	-1.216	**7.307*****	**7.280*****	0.337	-0.336	10.928	**-5.220*****
	(0.812)	(0.922)	(1.368)	(0.998)	(1.135)	(1.351)	(10.765)	(1.370)
$\Delta REER_{t-1}$	0.014	0.013	-0.00005	0.001	0.009	0.010	-0.006	-0.0002
	(0.008)	(0.010)	(0.004)	(0.005)	(0.009)	(0.011)	(0.007)	(0.007)
$(d_2 - 1)\sigma_{s,t-1}$	**-2.916****	-	0.293	-	**-2.890****	-	-4.718	-
	(1.146)		(0.290)		(1.181)		(4.058)	
$(d_1 - 1)\sigma_{r,t-1}$	-	-0.043	-	-0.030	-	-0.026	-	**-0.217*****
		(0.137)		(0.032)		(0.145)		(0.060)
Q1	**-0.254***	-0.142	0.024	0.031	**-0.285***	-0.220	0.013	0.027
	(0.134)	(0.163)	(0.022)	(0.024)	(0.138)	(0.166)	(0.037)	(0.035)
Q2	-0.187	-0.117	0.005	0.012	-0.211	-0.176	-0.066	0.012
	(0.125)	(0.149)	(0.027)	(0.030)	(0.129)	(0.151)	(0.047)	(0.050)
Q3	**-0.305***	-0.161	0.037	0.044	**-0.349****	-0.243	-0.050	0.023
	(0.157)	(0.190)	(0.027)	(0.030)	(0.157)	(0.189)	(0.042)	(0.045)
R-square	0.693	0.581	0.936	0.963	0.672	0.556	0.807	0.917
Adj. R-square	0.513	0.334	0.898	0.942	0.479	0.294	0.694	0.869

Table 4-3-4d: Malaysia - Robustness Check, Without Δmm_t, Replace $\Delta REER_{t-1}$ with CA_t

Malaysia: 2SLS	Perfect Foresight				Static expectations			
	1990:Q1-1997:Q2		1998Q3-2004:Q4		1990:Q1-1997:Q2		1998Q3-2004:Q4	
	ΔNFA_t^*	ΔNDA_t^*	ΔNFA_t^*	ΔNDA_t^*	ΔNFA_t^*	ΔNDA_t^*	ΔNFA_t^*	ΔNDA_t^*
Intercept	**0.216***	0.068	-0.003	-0.017	**0.224****	0.091	0.123	-0.057
	(0.102)	(0.119)	(0.036)	(0.043)	(0.102)	(0.123)	(0.070)	(0.065)
ΔNDA_t^*	**-0.597****	-	**-0.898*****	-	**-0.446***	-	**-0.585*****	-
	(0.233)		(0.091)		(0.239)		(0.117)	
ΔNFA_t^*	-	**-0.575****	-	**-1.034*****	-	**-0.600****	-	**-1.070*****
		(0.222)		(0.111)		(0.251)		(0.127)
Δp_{t-1}	3.865	8.927	-3.784	-4.109	3.006	9.533	**-14.271****	-7.416
	(6.105)	(6.488)	(3.676)	(4.072)	(6.225)	(6.647)	(5.730)	(5.804)
$Y_{c,t-1}$	-0.040	-0.145	0.007	0.004	0.025	-0.137	**0.056****	0.019
	(0.314)	(0.446)	(0.016)	(0.019)	(0.316)	(0.457)	(0.026)	(0.026)
ΔG_t	**1.331****	0.915	-0.079	-0.199	**1.285****	0.975	-0.085	-0.515
	(0.590)	(0.682)	(0.203)	(0.197)	(0.601)	(0.701)	(0.368)	(0.319)
$\Delta(r_t^* + E_t S_{t+1})$	-0.530	-0.861	**7.290*****	**7.096*****	0.809	0.182	13.605	**-5.236*****
	(0.789)	(0.881)	(1.263)	(1.011)	(1.065)	(1.234)	(11.878)	(1.276)
CA_t	-0.214	-0.556	0.102	0.133	-0.056	-0.448	-0.074	0.466
	(0.605)	(0.673)	(0.182)	(0.217)	(0.604)	(0.686)	(0.354)	(0.301)
$(d_2-1)\sigma_{s,t-1}$	**-2.474***	-	0.332	-	**-2.870****	-	-5.821	-
	(1.186)		(0.297)		(1.221)		(4.522)	
$(d_1-1)\sigma_{r,t-1}$	-	-0.073	-	-0.041	-	-0.064	-	**-0.246*****
		(0.136)		(0.035)		(0.140)		(0.060)
Q1	**-0.284***	-0.193	0.025	0.032	-0.273*	-0.227	0.016	0.033
	(0.141)	(0.165)	(0.021)	(0.023)	(0.144)	(0.169)	(0.037)	(0.032)
Q2	-0.204	-0.141	0.003	0.014	-0.199	-0.171	**-0.080***	0.014
	(0.131)	(0.152)	(0.027)	(0.030)	(0.133)	(0.154)	(0.045)	(0.046)
Q3	**-0.369****	-0.229	0.034	0.041	**-0.369****	-0.267	-0.053	0.017
	(0.161)	(0.189)	(0.027)	(0.030)	(0.161)	(0.192)	(0.043)	(0.042)
R-square	0.660	0.562	0.938	0.964	0.650	0.542	0.800	0.927
Adj. R-square	0.459	0.304	0.901	0.942	0.444	0.272	0.683	0.884

4.3.5 The Philippines

(1) The Evolution of Balance of Payments in the Philippines

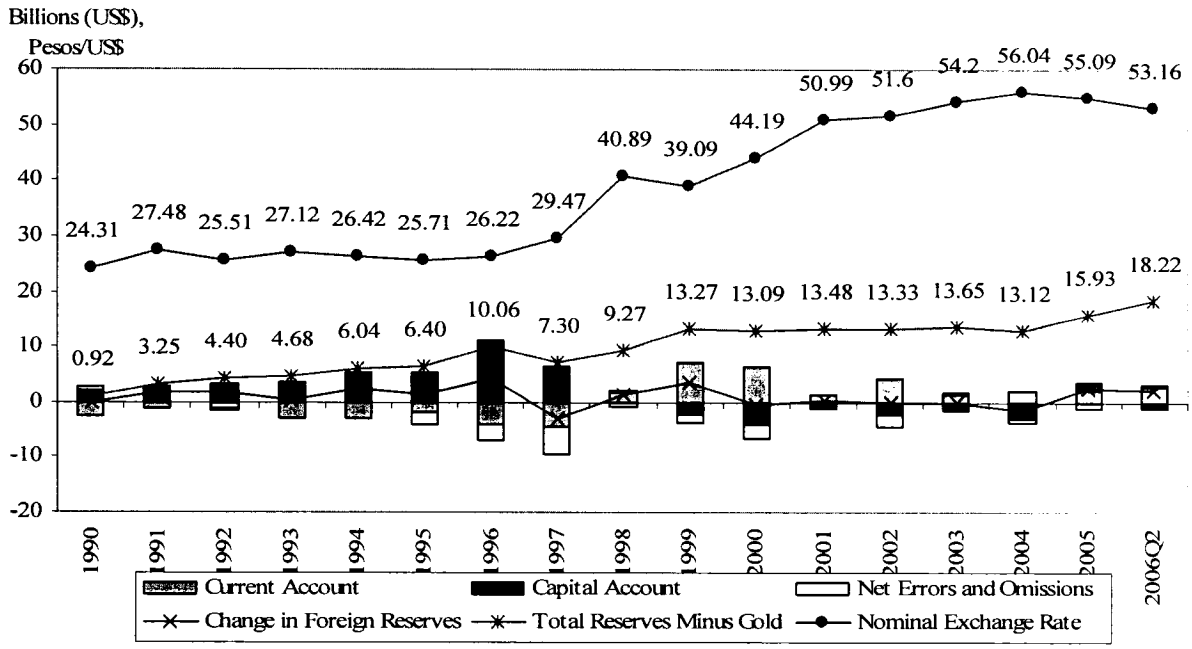
The Philippines' international reserves have accumulated to $22.64 billion by the end of 2006 (Figure 4-3-5a). Its reserves accumulation grew rapidly until the Asian currency crises occurred in 1997. During this period, the Philippines had consistently growing capital account surplus (Figure 4-3-5b), while the current account had remained in deficit. Its capital account surplus was mainly contributed by the other investment and FDI, but since 1995, the portfolio investment had begun to dominant capital account, and contributed $5.32 billion in 1996, resulting in a total capital account surplus of $11.28 billion at that year. Philippines peso had remained fairly stable and fluctuated around P24 to P25 against one U.S. dollar during this period though the government announced a floating exchange rate regime since 1984. In addition, a large amount of net errors and omissions began to flow out of the country since 1995 and reached to the highest point of $5.24 billion in 1997, reflecting that there were huge speculative short-term capitals escaping out of the regime because of the crises.

Due to a huge amount of current account deficit and negative net errors and omissions, there was a $3.09 billion of BOPs deficit in 1997. The Bangko Sentral ng Pilipinas (BSP), which was established in July 2003, decided to depreciate Philippine peso to P40.89 per U.S. dollar from P29.47 per U.S. dollar, and since then, Philippines peso has gradually depreciated to P49.46 per US dollar by the end of 2006. The consistently depreciation has made the current account turned into and remained in surplus from since 1998. Contrary to the current account, its capital account had turned

into deficit since 1999, except in 2005. The capital account deficit was mainly resulted from a large amount of other investment flowing out the country. For example, while a historical high record of portfolio investment flew into the country in 1999 ($6.87 billion), an even larger amount of other investment deficit ($10.88 billion) occurred, and caused a $2.25 billion capital account deficit at the year.

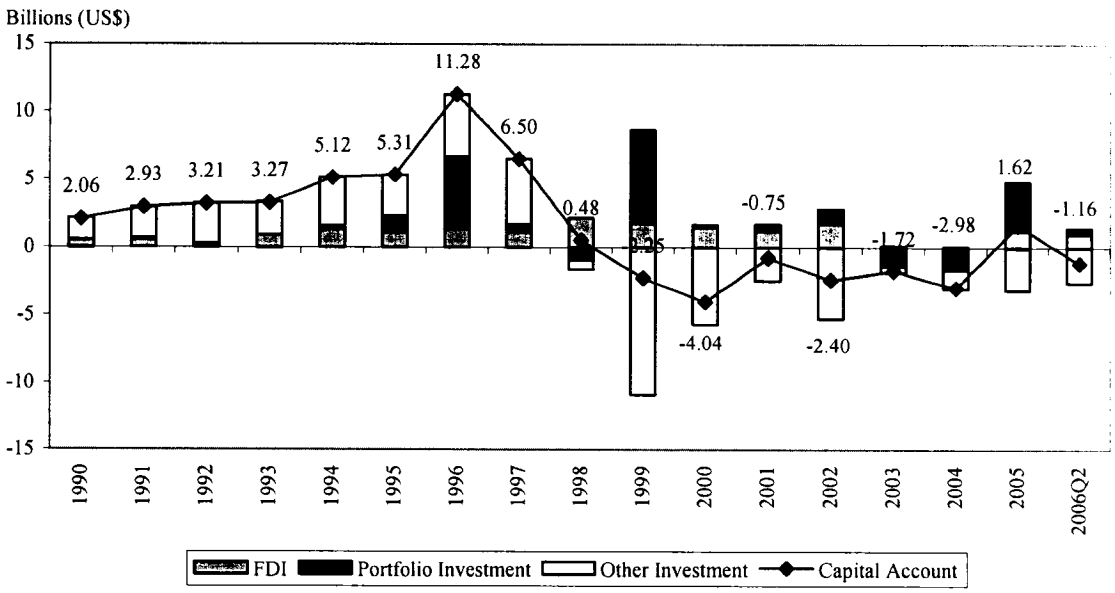
Since most of the current account surplus has been offset by the capital account deficit, the Philippines' BOPs had kept balance and did not accumulate many reserves until there was an improvement in capital account in 2005.

Figure 4-3-5a: Trends in the Philippines's Balance of Payments Transactions



Source: IFS

Figure 4-3-5b: Capital Account Components in the Philippines



Source: IFS

(2) Monetary Sterilization Policies in the Philippines

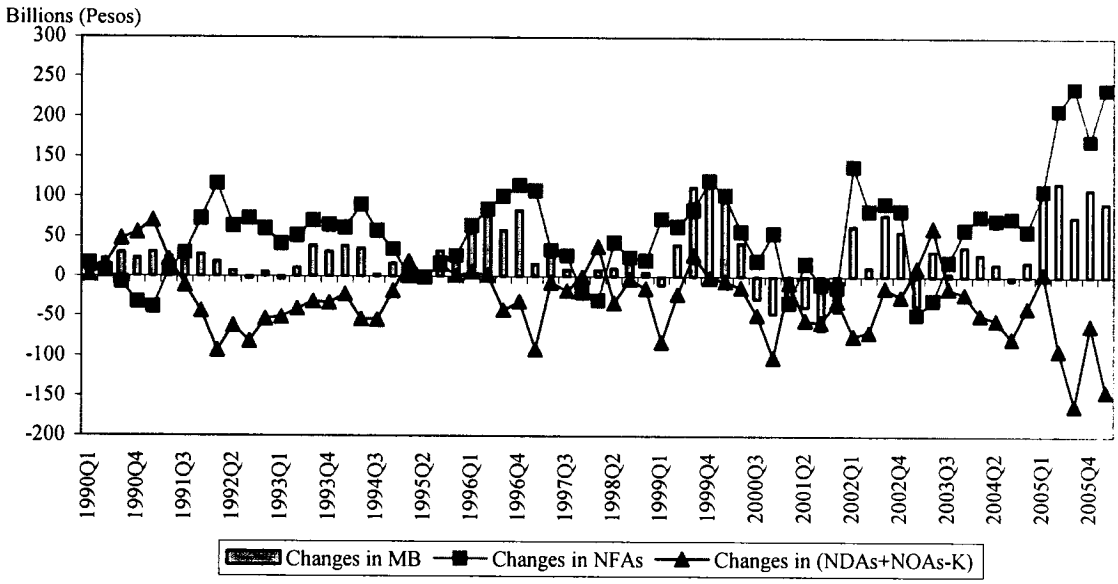
To maintain price stability, the BSP's has built up an inflation targeting framework as its monetary policy since January 2002. The BSP uses the average year-on-year change in the consumer price index (CPI) as its inflation target and set up a target every year. To achieve the target, the BSP has conducted various monetary instruments, such as its overnight reverse repurchases (RRP) rate and overnight repurchase (RR) rate.[51] In addition, the BSP also conducts open market operations, changes reserve and liquidity reserve[52] requirement, and adjusts lending policies to manage domestic liquidity. Figure 4-3-5c and Figure 4-3-5d show that BSP has intensively sterilized the reserve

[51] Repurchase (RP) rate is the policy interest rate as which the BSP lends to banks with government securities as collateral, while reverse repurchase (RRP) rate is the interest rate at which the BSP borrows from banks with government securities as collateral. (The definition is published by the BSP).

[52] The liquidity reserve indicates the proportion of deposits and deposit substitute liabilities that may be held in the form of market-yielding government securities purchased directly from the BSP.

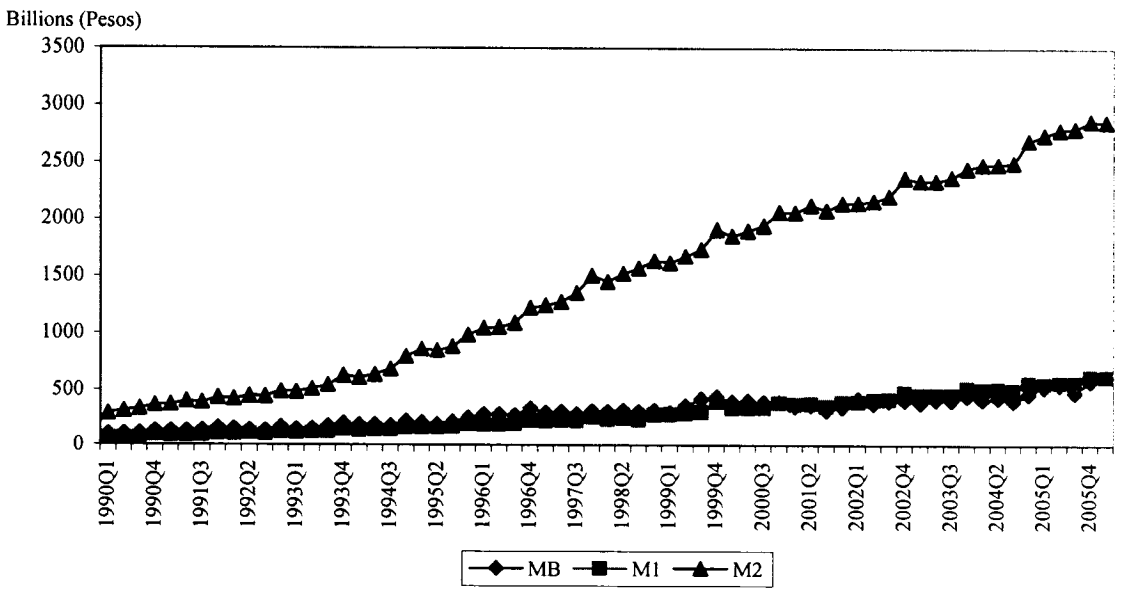
accumulation since early 1990s. The inflation fluctuated stably around 4-10 percent, except there was a deflation in 2002 (Figure 4-3-5e).

Figure 4-3-5c: Quarterly Annual Change in NFAs, NDAs, and Reserve Money in the Philippines, 1990: Q1 – 2006: Q1



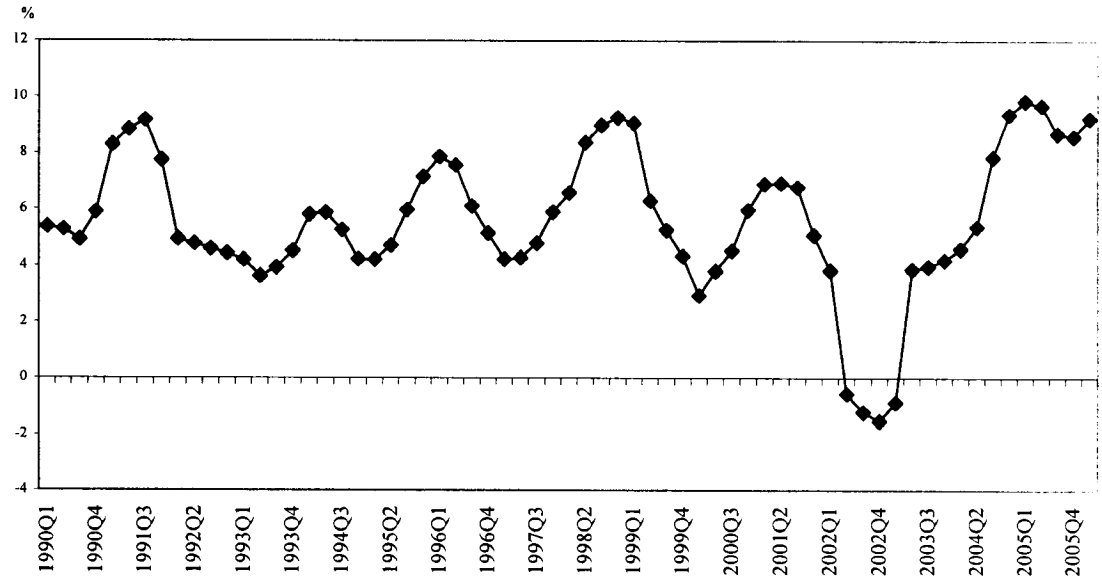
Source: IFS

Figure 4-3-5d: Reserve Money, M1, and M2 in the Philippines, 1990: Q1 – 2006: Q1



Source: IFS

Figure 4-3-5e: Inflation (CPI % Change) in the Philippines, 1990: Q1 – 2006: Q1

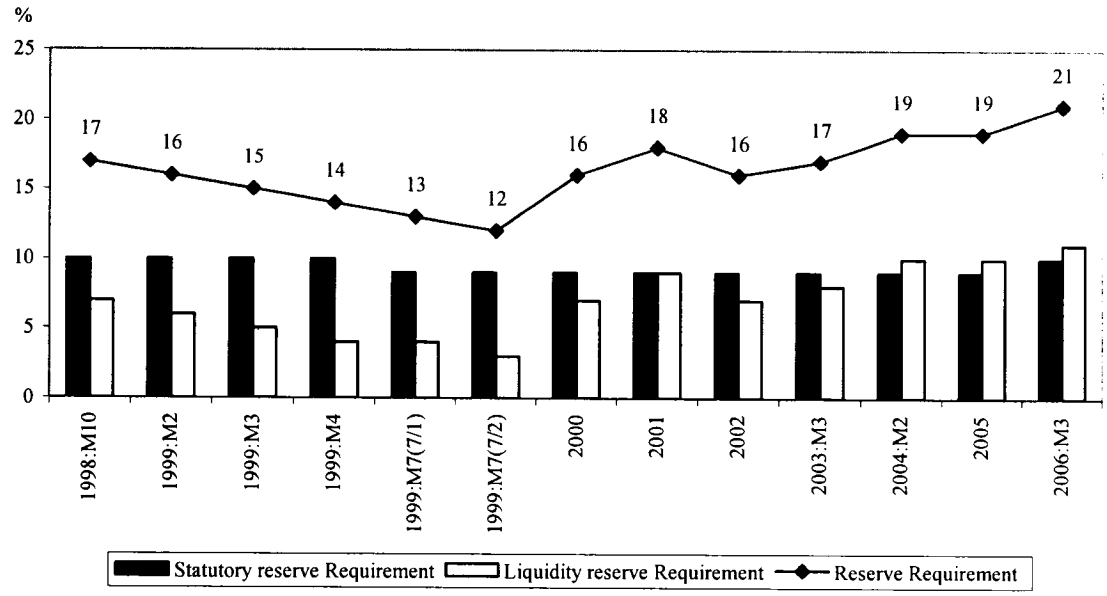


Source: IFS

a. Reserve Requirements

The BSP has frequently adjusted statutory reserve and liquidity reserve requirements as one of the main sterilization instruments. During the early 1990s, the reserve requirement was raised twice, going from 21% to 25%, to defend the increasing inflation. Also, a 5% gross tax on bank receipts and a 20% tax on deposit earnings were levied by the government to mop up the excess domestic liquidity. But since the BSP was established in 1993, the reserve requirements had declined gradually from 25% to 17% in 1994 and further reduced to 12% in 1999 to help banking sectors overcame the difficulties resulted from the crises. The reserve requirements have again been increased since 2000 to 16%, and going up gradually to 21% in 2006 to absorb the excess money supply.

Figure 4-3-5f: The Movement of Reserve Requirements in the Philippines



Source: Annual Monetary Report issued by BSP.
Note: Reserve requirement is the sum of statutory reserve requirement and liquidity reserve requirement.

b. Open Market Operations (OMOs) and Government Funds

During the early 1990s, the Central Bank Certificates of Indebtedness (CBCIs) had been issued intensively to do OMOs. But since 1993, more adjustment has been made through the adjustment of nominal exchange rate. Currently the BSP has conducted OMOs through issuance of BSP's holdings of T-bills as well as lending and borrowing under the BSP's reverse repurchase and repurchase facilities. To achieve the policy target, the BSP often conducts OMOs to adjust the fluctuation of domestic liquidity caused by the reserve requirements change. In addition, the Philippines government can mop up the excess liquidity by issuing securities and make deposits at the central bank (Dean, 1996 and Takagi and Esaka, 1999)

c. Lending Policy

The BSP provides grants or funds to banking institutions under the financial difficulties, and help them to meet the liquidity requirement through the Philippine Deposit Insurance Corporation (PDIC). There are other regular and special credit windows provided by the BSP to support domestic productive sectors. The total loan portfolio of the BSP has reached to P122.6 billion in 2004 and P114.7 billion in 2005, respectively.

d. Capital Controls

During the crises period, all forward transactions made by nonresidents had to get prior approval by the BSP, as well as the issuance of peso-denominated instruments in the international capital markets. In April 1998, the BSP lifted the band of 6% around the exchange rate and depreciated Philippine peso. Next month, the BSP announced to reduce the amount of foreign exchange that authorized agent banks may sell to residents for any non-trade purpose, without need of appropriate documentation, from $25,000 to $10,000. In addition, offshore banking units (OBUs) were allowed to hold peso-denominated assets, including bonds and stocks, in 2003. But these assets have to be sold or disposal within five years.

(3) The Empirical Results for the Philippines

Based on the empirical results for the Philippines in Table 4-3-5a and Table 4-3-5b, the estimated offset coefficient pre-crisis is around 0.74 to 0.8, while the estimated

sterilization coefficient is around 1.1. This suggests that the Philippines had a fairly high degree of capital mobility pre-crisis and the Bangko Sentral ng Pilipinas (BSP) also undertook fairly aggressive sterilization operations. The offset coefficient has declined substantially post-crisis, while the estimated sterilization coefficient remained around 1, suggesting that the BSP continued to sterilize all the reserve accretion.

The estimated coefficients for the change in the money multiplier are consistently significant and negative both pre and post-crisis with the similar economic significance (i.e. coefficient values). The exchange rate adjusted foreign interest rate term is the correct sign post-crisis in balance of payments function in Table 4-3-5b, but is statistically insignificant and with inconsistent signs elsewhere. The lagged inflation term and the lagged volatility of interest are the wrong sign both pre and post-crisis for both functions. The former is significant with wrong sign in the balance of payments function post-crisis, while the latter is significant in the monetary reaction function at the same period. In addition, the current account variable is positive and significant in both functions post-crisis with the assumption of perfect foresight.

Without considering the change in money multiplier variable (Table 4-3-5c and Table 4-3-5d), both estimated offset and sterilization coefficients have reduced their significance and magnitude in the post-crises period, indicating that change of money multiplier have significant effect on monetary authorities' decision and the capital market.

Table 4-3-5a: The Philippines - Estimated Simultaneous Equations, 1990:Q1-1997:Q2 and 1998Q3-2005:Q1

Philippines: 2SLS	Perfect Foresight				Static expectations			
	1990:Q1-1997:Q2		1998Q3-2005:Q2		1990:Q1-1997:Q2		1998Q3-2005:Q2	
	ΔNFA_t^*	ΔNDA_t^*	ΔNFA_t^*	ΔNDA_t^*	ΔNFA_t^*	ΔNDA_t^*	ΔNFA_t^*	ΔNDA_t^*
Intercept	0.011	-0.004	0.009	0.005	0.009	-0.005	0.005	-0.002
	(0.034)	(0.034)	(0.028)	(0.034)	(0.034)	(0.034)	(0.028)	(0.032)
ΔNDA_t^*	**-0.791*** **	-	**-0.428** **	-	**-0.805*** **	-	**-0.478*** **	-
	(0.142)		(0.161)		(0.131)		(0.151)	
ΔNFA_t^*	-	**-1.150*** **	-	**-1.220*** **	-	**-1.148*** **	-	**-0.975*** **
		(0.162)		(0.325)		(0.155)		**(0.268)**
Δmm_t	**-0.349*** **	**-0.390*** **	**-0.235*** **	**-0.432*** **	**-0.350*** **	**-0.410*** **	**-0.229*** **	**-0.418*** **
	(0.108)	(0.106)	(0.078)	(0.076)	(0.107)	(0.101)	(0.078)	(0.067)
Δp_{t-1}	0.424	0.707	0.664	0.675	0.406	0.581	**0.780***	0.461
	(0.434)	(0.530)	(0.419)	(0.550)	(0.428)	(0.519)	(0.402)	(0.527)
$Y_{c,t-1}$	-0.099	0.224	0.049	-0.276	-0.050	0.272	0.099	-0.216
	(0.519)	(0.530)	(0.682)	(0.819)	(0.510)	(0.528)	(0.687)	(0.763)
ΔG_t	-0.162	-0.158	0.072	-0.028	-0.095	-0.139	0.089	-0.025
	(0.312)	(0.310)	(0.228)	(0.266)	(0.293)	(0.314)	(0.226)	(0.248)
$\Delta(r_t^* + E_t S_{t+1})$	-0.054	0.064	-0.198	-0.173	-0.141	-0.073	-0.132	0.232
	(0.157)	(0.163)	(0.160)	(0.235)	(0.183)	(0.190)	(0.177)	(0.216)
$\Delta REER_{t-1}$	0.0003	-0.0004	0.002	0.0001	-0.0003	-0.001	0.003	-0.0002
	(0.001)	(0.001)	(0.002)	(0.003)	(0.001)	(0.002)	(0.002)	(0.003)
$(d_2 - 1)\sigma_{s,t-1}$	-0.006	-	-0.003	-	-0.004	-	0.001	-
	(0.015)		(0.007)		(0.015)		(0.008)	
$(d_1 - 1)\sigma_{r,t-1}$	-	0.003	-	0.011	-	0.002	-	**0.026***
		(0.002)		(0.013)		(0.002)		(0.013)
Q1	-0.011	0.003	-0.015	-0.022	-0.006	0.011	-0.019	-0.015
	(0.048)	(0.048)	(0.044)	(0.053)	(0.047)	(0.048)	(0.044)	(0.050)
Q2	0.003	0.013	-0.016	-0.008	0.003	0.018	-0.013	-0.005
	(0.043)	(0.043)	(0.033)	(0.040)	(0.043)	(0.042)	(0.033)	(0.037)
Q3	0.013	0.037	0.014	0.013	0.019	0.043	0.021	0.014
	(0.052)	(0.050)	(0.040)	(0.049)	(0.050)	(0.049)	(0.040)	(0.046)
R-square	0.868	0.911	0.843	0.839	0.873	0.911	0.846	0.855
Adj. R-square	0.778	0.849	0.741	0.735	0.786	0.849	0.746	0.761

Table 4-3-5b: The Philippines - Robustness Check, Replace $\Delta REER_{t-1}$ with CA_t

Philippines: 2SLS	Perfect Foresight				Static expectations			
	1990:Q1-1997:Q2		1998Q3-2005:Q1		1990:Q1-1997:Q2		1998Q3-2005:Q1	
	ΔNFA_t^*	ΔNDA_t^*	ΔNFA_t^*	ΔNDA_t^*	ΔNFA_t^*	ΔNDA_t^*	ΔNFA_t^*	ΔNDA_t^*
Intercept	-0.007	-0.028	0.005	-0.007	-0.001	-0.020	0.011	-0.006
	(0.042)	(0.039)	(0.021)	(0.028)	(0.037)	(0.041)	(0.026)	(0.030)
ΔNDA_t^*	**-0.833*** **	-	**-0.623*** **	-	**-0.742*** **	-	**-0.599*** **	-
	(0.185)		(0.113)		(0.140)		(0.120)	
ΔNFA_t^*	-	**-1.111*** **	-	**-1.109*** **	-	**-1.230*** **	-	**-1.057*** **
		(0.184)		(0.219)		(0.188)		(0.205)
Δmm_t	**-0.351*** **	**-0.376*** **	**-0.304*** **	**-0.411*** **	**-0.318** **	**-0.405*** **	**-0.296*** **	**-0.419*** **
	(0.114)	(0.103)	(0.044)	(0.064)	(0.109)	(0.104)	(0.054)	(0.063)
Δp_{t-1}	0.471	0.805	0.363	0.269	0.647	0.909	**0.865** **	0.495
	(0.492)	(0.605)	(0.339)	(0.468)	(0.478)	(0.641)	(0.373)	(0.504)
$Y_{c,t-1}$	-0.099	0.218	-0.032	0.100	-0.229	0.107	-0.278	-0.038
	(0.559)	(0.538)	(0.459)	(0.610)	(0.525)	(0.575)	(0.563)	(0.643)
ΔG_t	-0.102	-0.174	0.057	0.073	-0.164	-0.234	0.045	0.055
	(0.319)	(0.300)	(0.169)	(0.222)	(0.289)	(0.320)	(0.210)	(0.232)
$\Delta(r_t^* + E_t S_{t+1})$	-0.004	0.093	**-0.408*** **	-0.300	-0.143	-0.054	-0.134	0.115
	(0.172)	(0.158)	(0.133)	(0.218)	(0.149)	(0.177)	(0.170)	(0.215)
CA_t	-0.108	-0.142	**0.142** **	**0.150** **	-0.135	-0.158	0.069	0.094
	(0.167)	(0.185)	(0.054)	(0.066)	(0.163)	(0.195)	(0.060)	(0.066)
$(d_2 - 1)\sigma_{s,t-1}$	-0.010	-	-0.008	-	-0.002	-	-0.003	-
	(0.016)		(0.006)		(0.014)		(0.008)	
$(d_1 - 1)\sigma_{r,t-1}$	-	0.003	-	0.015	-	0.003	-	**0.025***
		(0.002)		(0.011)		(0.002)		(0.013)
Q1	-0.012	-0.0003	0.007	0.018	-0.027	-0.012	-0.028	-0.001
	(0.054)	(0.051)	(0.035)	(0.045)	(0.050)	(0.055)	(0.040)	(0.047)
Q2	0.004	0.015	-0.0004	0.012	-0.009	0.007	-0.014	0.003
	(0.045)	(0.042)	(0.026)	(0.034)	(0.042)	(0.045)	(0.032)	(0.036)
Q3	0.018	0.041	0.011	0.028	0.001	0.027	-0.001	0.021
	(0.058)	(0.051)	(0.027)	(0.035)	(0.052)	(0.054)	(0.033)	(0.037)
R-square	0.872	0.917	0.908	0.883	0.875	0.905	0.859	0.869
Adj. R-square	0.784	0.859	0.849	0.807	0.788	0.840	0.769	0.784

Table 4-3-5c: The Philippines - Robustness Check, Without Δmm_t

Philippines: 2SLS	Perfect Foresight				Static expectations			
	1990:Q1-1997:Q2		1998Q3-2005:Q2		1990:Q1-1997:Q2		1998Q3-2005:Q2	
	ΔNFA_t^*	ΔNDA_t^*	ΔNFA_t^*	ΔNDA_t^*	ΔNFA_t^*	ΔNDA_t^*	ΔNFA_t^*	ΔNDA_t^*
Intercept	-0.001	-0.034	-0.0005	-0.027	0.014	-0.030	-0.007	-0.022
	(0.049)	(0.044)	(0.039)	(0.056)	(0.045)	(0.048)	(0.036)	(0.056)
ΔNDA_t^*	**-0.750*** **	-	-0.198	-	**-0.659*** **	-	-0.291	-
	(0.211)		(0.184)		(0.165)		(0.174)	
ΔNFA_t^*	-	**-1.105*** **	-	-0.791	-	**-1.207*** **	-	-0.719
		(0.233)		(0.525)		(0.244)		(0.467)
Δp_{t-1}	0.871	1.172	0.400	-0.436	**0.926***	1.121	0.469	-0.600
	(0.523)	(0.699)	(0.588)	(0.839)	(0.502)	(0.749)	(0.530)	(0.876)
$Y_{c,t-1}$	-0.363	0.177	0.684	0.593	-0.465	0.147	0.774	0.434
	(0.675)	(0.702)	(0.909)	(1.368)	(0.634)	(0.758)	(0.849)	(1.350)
ΔG_t	-0.532	-0.457	0.229	0.097	-0.511	-0.628	0.241	0.055
	(0.368)	(0.395)	(0.312)	(0.448)	(0.337)	(0.416)	(0.289)	(0.442)
$\Delta(r_t^* + E_t S_{t+1})$	0.036	0.262	-0.112	0.192	-0.191	0.024	-0.303	0.034
	(0.222)	(0.200)	(0.223)	(0.373)	(0.235)	(0.266)	(0.220)	(0.384)
$\Delta REER_{t-1}$	-0.0001	-0.001	**0.007*** **	0.005	-0.001	-0.001	**0.007*** **	0.004
	(0.001)	(0.002)	(0.002)	(0.005)	(0.002)	(0.002)	(0.002)	(0.005)
$(d_2 - 1)\sigma_{s,t-1}$	0.002	-	-0.005	-	0.011	-	0.004	-
	(0.019)		(0.010)		(0.018)		(0.011)	
$(d_1 - 1)\sigma_{r,t-1}$	-	0.004	-	0.025	-	0.003	-	0.020
		(0.002)		(0.021)		(0.003)		(0.024)
Q1	-0.032	-0.002	0.012	0.039	-0.043	-0.001	0.016	0.040
	(0.063)	(0.064)	(0.061)	(0.087)	(0.059)	(0.069)	(0.056)	(0.088)
Q2	0.003	0.029	-0.017	0.014	-0.013	0.034	-0.005	0.013
	(0.059)	(0.056)	(0.046)	(0.067)	(0.056)	(0.060)	(0.043)	(0.066)
Q3	0.022	0.070	0.051	0.085	0.004	0.068	0.061	0.074
	(0.074)	(0.065)	(0.054)	(0.081)	(0.067)	(0.070)	(0.050)	(0.080)
R-square	0.766	0.839	0.668	0.523	0.781	0.812	0.715	0.513
Adj. R-square	0.629	0.744	0.483	0.258	0.652	0.701	0.557	0.243

Table 4-3-5d: The Philippines - Robustness Check, Without Δmm_t, Replace $\Delta REER_{t-1}$ with CA_t

Philippines: 2SLS	Perfect Foresight				Static expectations			
	1990:Q1-1997:Q2		1998Q3-2005:Q1		1990:Q1-1997:Q2		1998Q3-2005:Q1	
	ΔNFA_t^*	ΔNDA_t^*	ΔNFA_t^*	ΔNDA_t^*	ΔNFA_t^*	ΔNDA_t^*	ΔNFA_t^*	ΔNDA_t^*
Intercept	0.072	-0.066	0.015	-0.027	0.035	-0.056	0.012	-0.017
	(0.101)	(0.053)	(0.043)	(0.059)	(0.069)	(0.058)	(0.044)	(0.056)
ΔNDA_t^*	-0.143	-	**-0.399**	-	-0.302	-	**-0.509****	-
	(0.516)		(0.247)		(0.337)		(0.219)	
ΔNFA_t^*	-	**-1.213****	-	-0.283	-	**-1.310****	-	**-0.552**
		(0.426)		(0.360)		(0.506)		(0.349)
Δp_{t-1}	**1.583***	1.659	0.177	-0.871	**1.654****	1.592	0.643	-0.586
	(0.811)	(1.075)	(0.713)	(0.904)	(0.755)	(1.334)	(0.651)	(0.888)
$Y_{c,t-1}$	-1.472	-0.057	-0.145	0.169	-1.245	-0.082	-0.259	0.037
	(1.136)	(0.870)	(0.941)	(1.282)	(0.937)	(1.017)	(0.957)	(1.218)
ΔG_t	-0.831	-0.613	0.151	0.00005	-0.645	-0.755	0.150	0.046
	(0.508)	(0.458)	(0.346)	(0.465)	(0.377)	(0.490)	(0.355)	(0.440)
$\Delta(r_t^* + E_t S_{t+1})$	-0.348	0.250	**-0.478***	0.083	-0.246	0.052	-0.402	-0.082
	(0.418)	(0.218)	(0.272)	(0.437)	(0.242)	(0.244)	(0.277)	(0.407)
CA_t	-0.168	-0.296	0.157	0.103	-0.252	-0.263	0.103	0.118
	(0.280)	(0.271)	(0.111)	(0.139)	(0.247)	(0.313)	(0.102)	(0.125)
$(d_2-1)\sigma_{s,t-1}$	0.030	-	-0.014	-	0.022	-	-0.0004	-
	(0.033)		(0.011)		(0.023)		(0.014)	
$(d_1-1)\sigma_{r,t-1}$	-	0.004	-	0.024	-	0.004	-	0.017
		(0.002)		(0.022)		(0.003)		(0.024)
Q1	-0.153	-0.034	0.010	0.048	-0.132	-0.033	-0.016	0.036
	(0.113)	(0.090)	(0.071)	(0.095)	(0.093)	(0.110)	(0.069)	(0.089)
Q2	-0.103	0.016	-0.018	0.029	-0.083	0.019	-0.016	0.016
	(0.104)	(0.068)	(0.052)	(0.071)	(0.084)	(0.081)	(0.054)	(0.068)
Q3	-0.138	0.050	0.001	0.054	-0.099	0.046	0.004	0.044
	(0.146)	(0.086)	(0.055)	(0.073)	(0.110)	(0.104)	(0.057)	(0.070)
R-square	0.611	0.834	0.592	0.452	0.696	0.803	0.570	0.502
Adj. R-square	0.382	0.736	0.366	0.148	0.518	0.687	0.332	0.226

4.3.6 Singapore

(1) The Evolution of Balance of Payments in Singapore

Singapore's foreign reserves researched US$129.4 billion by the third quarter of 2006. Figure 4-3-6a shows the dynamic change of reserves accumulation since 1990. Singapore's reserves increased rapidly during the early 1990s, but remained stagnant after 1997 due to the currency crises. However, its reserves accumulation has begun to accumulate significantly again since 2001 because of the increasing current account surplus.

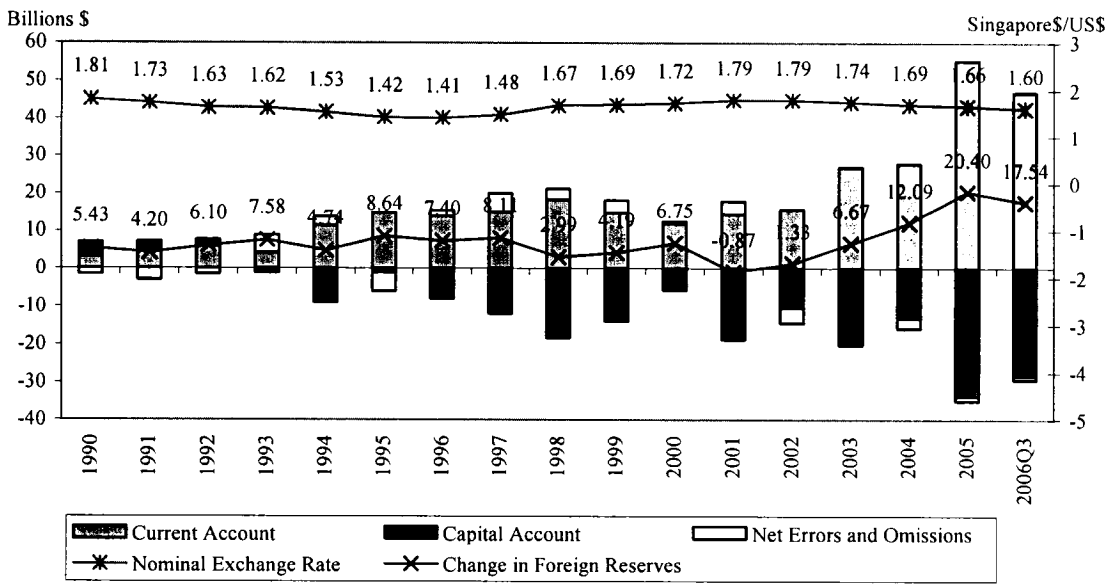
Before the currency crises, Singapore's current account surplus was mainly contributed by services, while the trade balance remained in deficit until 1994. But since then, trade surplus has became the mainly source of the current account surplus in Singapore, except it was slowed down slightly by the Asian crises in 1997, the global electronics recession in 2001, and the SARS outbreak in 2003. Generally speaking, the Singapore dollar has remained steady, while some other Asian countries depreciated substantially during the crises period. The Singapore dollar depreciated from 1.48 per US dollar in 1997 to 1.67 per US dollar in 1998 only.

Singapore's current account surplus has been offset mostly by the capital account deficit. Figure 4-3-6b shows that the capital account was dominated by huge outflows of portfolio investment, and turned into deficit since 1993. The portfolio investment outflow was mainly contributed by an increasing amount of private investment on overseas equities and debt securities. Singapore's FDI has remained in surplus except in 2001 since there was a number of large-scale of merger and acquisition (M&A) going on in

Singapore.[53] Therefore, both FDI and portfolio investment outflows contributed a large amount of capital account deficit, and denominated the current account surplus in that year, making the balance of payments turn in deficit in 2001. This was the only year that balance of payments was in deficit since 1990.

In addition to FDI and portfolio investments, other investments outflow has sharply increased and begun to influence the capital account substantially since 2003. This component can be very volatile, such as a large amount of capital flew out of the country through other investments during the crises period, as well as in recent two years. Other investment category includes loans, currency and deposits, and inter-company debts. These mainly reflect the flows between the banking sectors as well as other non-bank sectors and their foreign counterparts (including the Asian Dollar Market).

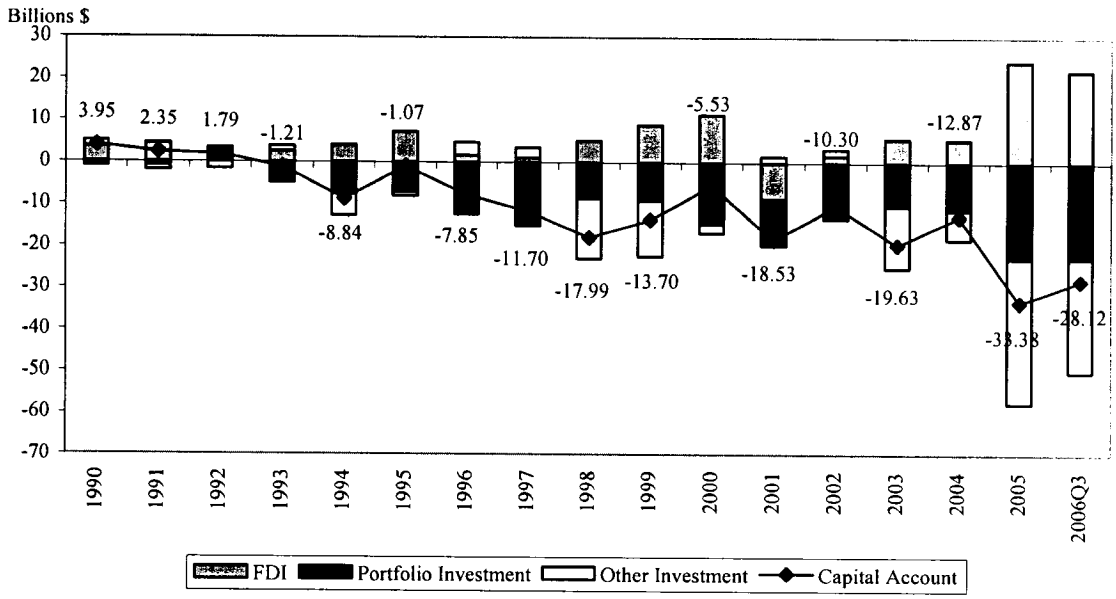
Figure 4-3-6a: Trends in Singapore's Balance of Payments Transactions



Source: IFS and Monetary Authority of Singapore (MAS)

[53] In 2001, Singtel's acquisition of Optus is the largest acquisition abroad by a local company, amounting to US$9.7 billion. The second largest deal was DBS's acquisition of Dao Heng bank , amounting to US$5.3 billion. In contrast, Solectron Corp's acquisition of Natsteel Electronics was the largest foreign acquisition of a Singapore company, amounting to US$2 billion.

Figure 4-3-6b: Capital Account Components in Singapore



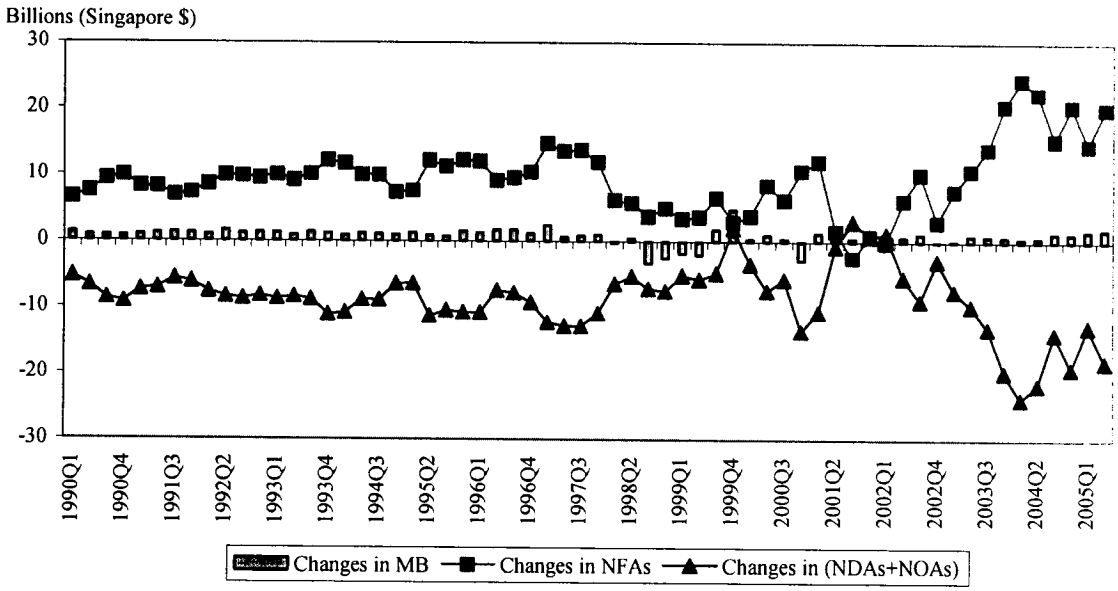
Source: IFS and Monetary Authority of Singapore (MAS)

(2) Monetary Sterilization Policies in Singapore

The main objective of monetary policy in Singapore has been focused on low inflation as well as sustained economy growth. To achieve this goal, the Monetary Authority of Singapore (MAS) has been using the trade-weighted exchange rate index (TWI) as an intermediate target, and restricted it to fluctuate within an undisclosed band. The wideness of the band has been adjusted by the MAS frequently based on different economic situations. The MAS has used several monetary instruments to maintain the stability of exchange rate, including foreign exchange swaps, inter-bank lending and borrowing, open market operations, and repurchase agreements. However, the unique part is that Singapore has largely used the public pension fund to purchase/sale government securities rather than selling to private financial institutions. Figure 4-3-6c and Figure 4-3-6d show that most of the reserve accumulation has been sterilized by the

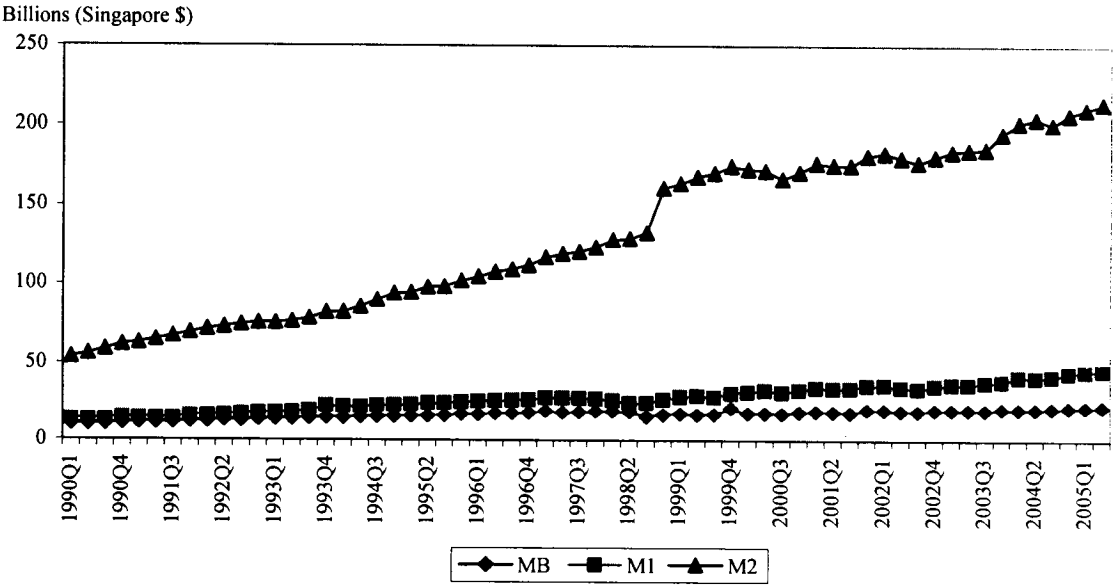
MAS so that the monetary base remains fairly stable. The inflation is also well controlled below 3 percent (Figure 4-3-6e).

Figure 4-3-6c: Quarterly Annual Change in NFAs, NDAs, and Reserve Money in Singapore, 1990: Q1 – 2005: Q2



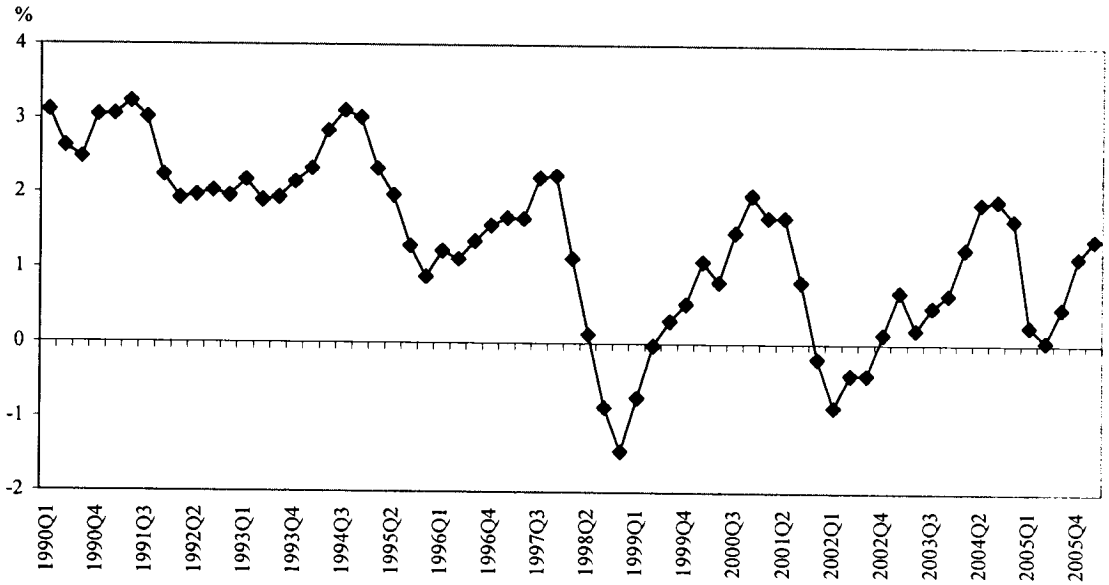
Source: IFS

Figure 4-3-6d: Reserve Money, M1, and M2 in Singapore, 1990: Q1 – 2005: Q2



Source: IFS

Figure 4-3-6e: Inflation (CPI % Change) in Korea, 1990: Q1 – 2006: Q1



Source: IFS

a. Public Sector Operations

The Central Provident Fund (CPF) has played an important role in Singapore's monetary sterilization policy. The CPF is mainly contributed by both employees and employers. Employees and their belonging companies contribute partial of employees' salary to the CPF, while the CPF will finance members' housing, health, investment, and retirement in the future. Due to the special property of the funds, 95 percent of the funds were invested in government securities market.[54] Therefore, the CPF is in fact a financial intermediate institution between its members and the government. Since the CPF holds a large portion of national savings, it is a significant participant in the banking system involving transferring fund between its agent banks and the MAS. In addition,

[54] The CPF Board places the net proceeds as Advance Deposits with MAS for subsequent subscription to Special Issues of Singapore Government Securities. These Special Issues of SGS has original maturities of 20 years and are non-marketable. They are issued specifically to the CPF Board to meet its investment requirements under the CPF Act and pay an interest equivalent to the interest the CPF Board pays to CPF members. (Refer to Monetary Policy Operations in Singapore, 2003)

Accountant-General's Department (AGD) is an organization that manages the cash flows of the government. Similar to the CPF, the AGD also informs the MAS in advance about its fund flows, and cooperates with the MAS to meet policy goals.

There are two advantages of using pension or government funds to do sterilization. Because most of the pension funds are invested in the government securities, these pension funds' demand of government securities is more inelastic, indicating that the interest rates will not be affected as much as selling government securities to commercial banks. Second, the CPF and AGD can operate transactions in coordination with the MAS when the MAS conducts specific monetary operations. (Wu and Wang, 2003; Monetary Policy Operations in Singapore, 2003).

b. Reserve Requirements

All banks in Singapore have to maintain interest-free cash balances with the MAS (Minimum Cash Balance, MCB) to 3 % of their liabilities base. While banks' MCB is allowed to fluctuate between 2-4% on a day-to-day basis, they must ensure that the average MCB ratio for the two-week maintenance period is not less than 3%.

c. Open Market Operations and Other Instruments

The MAS also issues Singapore Government Securities (SGS) regularly to maintain domestic liquidity. Even though Singapore has fiscal surplus over years, the government and the MAS have been actively developing the SGS markets since the Singapore government intends to develop the country as an international financial centre.

In addition to the SGS market, the MAS may use some other short-term monetary instruments, such as SGS repos/ reverse repos, FX swaps/ reverse swaps, and direct lending/borrowing, to manage domestic liquidity.

(3) The Empirical Results for Singapore

Table 4-3-6a and Table 4-3-6b report the empirical results for Singapore. The results show that the estimation is very sensitive to the different assumptions of exchange rate expectations. With perfect foresight, the estimated offset coefficient pre-crisis is around 0.5, while the estimated sterilization coefficient is around 1. This suggests that Singapore had a moderate degree of capital mobility pre-crisis, and the Monetary Authority of Singapore (MAS) undertook significant sterilization operations. During the post-crisis, the offset coefficient has increased substantially to 1, while the estimated sterilization coefficient decreased slightly to around 0.91. It indicates that the capital mobility in Singapore has significantly increased after the crisis, and remains heavy sterilization policy.

However, the estimation varies substantially if the static expectations are adopted. The estimated offset coefficients pre and post-crisis are around 0.8 to 1, while the estimated sterilization coefficients are around 0.15 to 0.3. The estimated sterilization coefficients are insignificant during both periods. The results driven from the static expectations suggest that Singapore had very high capital mobility and had not done much sterilization during both pre and post-crisis period. The results also indicate that the MAS did not fully sterilize the reserves accumulation due to high level of openness. It

could be argued that since there is a high degree of openness the MAS does not attempt to sterilize aggressively as they understand it will be rather ineffective.[55]

While the money multiplier consistently has the correct sign, it is significant in the balance of payments function post-crisis, and in the monetary reaction function post-crisis with static expectations. Neither the lagged cyclical output nor the lagged government expenditure variables are statistically significant. The lagged inflation has the inconsistent sign in both functions, but is only statistically significant with the correct sign (negative) in the case of the balance of payments function pre-crisis under the assumption of static expectations. With perfect foresight, the exchange rate adjusted foreign interest rate variable is negative and significant in both functions, except the monetary reaction function pre-crisis. But with static expectations, the sign changes to incorrect sign (positive) and significant in the monetary reaction function pre and post-crisis. The lagged change in the REER variable has the incorrect sign in the balance of payments function pre-crisis. The interest rate volatility term has inconsistent sign while the exchange rate volatility term is the wrong sign (positive) and significant in the balance of payments function post crisis. Table 4-3-6c and Table 4-3-6d show that the estimated offset coefficients with static expectations decline significantly in the post-crises period after excluding the change in money multiplier variable from the functions.

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[55] Referring to monetary sterilization in Singapore, the MAS has noted:

> Sterilisation of the FX intervention as defined above may require MAS to sell SGS (Singapore Government securities) outright to exactly offset the liquidity impact of the intervention operations. However...in conducting its money market operations, MAS takes into account the net liquidity impact of such FX intervention operations in conjunction with the various autonomous and other money market factors. Depending on the magnitude and direction of these factors, MAS may be required to withdraw liquidity, or even inject additional liquidity into the banking system in the same direction as the effect of the FX intervention (MAS, 2003, p.22).

Table 4-3-6a: Singapore - Estimated Simultaneous Equations, 1990:Q1-1997:Q2 and 1998Q3-2005:Q2

Singapore: 2SLS	Perfect Foresight				Static expectations			
	1990:Q1-1997:Q2		1998Q3-2005:Q2		1990:Q1-1997:Q2		1998Q3-2005:Q2	
	ΔNFA_t^*	ΔNDA_t^*	ΔNFA_t^*	ΔNDA_t^*	ΔNFA_t^*	ΔNDA_t^*	ΔNFA_t^*	ΔNDA_t^*
Intercept	0.042	-0.019	-0.006	**-0.053***	-0.034	**-0.106*****	-0.012	**-0.062***
	(0.032)	(0.050)	(0.022)	(0.029)	(0.063)	(0.031)	(0.032)	(0.035)
ΔNDA_t^*	**-0.534*****	-	**-1.054*****	-	**-1.125****	-	**-1.192*****	-
	(0.178)		(0.134)		(0.407)		(0.324)	
ΔNFA_t^*	-	**-1.024*****	-	**-0.918*****	-	-0.283	-	-0.370
		(0.307)		(0.164)		(0.173)		(0.280)
Δmm_t	-0.181	-0.480	**-0.630*****	-0.346	-0.693	-0.136	**-0.738****	**-0.550***
	(0.363)	(0.481)	(0.178)	(0.198)	(0.436)	(0.327)	(0.316)	(0.267)
Δp_{t-1}	-4.386	-1.683	-5.628	-2.773	0.481	3.024	-6.367	-3.485
	(2.823)	(4.388)	(3.277)	(4.424)	(4.384)	(2.577)	(4.311)	(5.423)
$Y_{c,t-1}$	0.563	-0.024	-0.128	-0.285	0.071	-0.482	0.088	-0.324
	(0.389)	(0.599)	(0.256)	(0.342)	(0.552)	(0.347)	(0.330)	(0.415)
ΔG_t	-0.138	-0.017	0.139	0.119	-0.071	-0.059	0.003	-0.038
	(0.126)	(0.178)	(0.139)	(0.178)	(0.169)	(0.111)	(0.165)	(0.205)
$\Delta(r_t^* + E_t S_{t+1})$	**-1.879*****	-1.173	**-2.048****	**-2.802*****	0.997	**2.654*****	1.325	**3.837****
	(0.570)	(1.004)	(0.713)	(0.902)	(1.759)	(0.560)	(1.407)	(1.374)
$\Delta REER_{t-1}$	**0.018***	0.016	-0.009	-0.009	**0.028****	0.001	-0.008	-0.015
	(0.010)	(0.016)	(0.008)	(0.012)	(0.013)	(0.011)	(0.013)	(0.015)
$(d_2 - 1)\sigma_{s,t-1}$	0.389	-	**2.971*****	-	1.457	-	**3.596****	-
	(0.935)		(0.888)		(1.353)		(1.247)	
$(d_1 - 1)\sigma_{r,t-1}$	-	-0.001	-	0.026	-	0.048	-	-0.049
		(0.060)		(0.063)		(0.042)		(0.088)
Q1	0.039	0.053	0.052	**0.092***	0.047	0.033	0.027	0.024
	(0.025)	(0.036)	(0.034)	(0.044)	(0.033)	(0.024)	(0.043)	(0.058)
Q2	**0.051***	0.037	0.034	0.058	0.056	-0.001	0.043	0.065
	(0.025)	(0.039)	(0.027)	(0.037)	(0.035)	(0.026)	(0.037)	(0.045)
Q3	0.033	0.016	**0.059***	0.057	0.041	0.031	**0.095****	0.055
	(0.024)	(0.033)	(0.033)	(0.050)	(0.032)	(0.021)	(0.040)	(0.061)
R-square	0.892	0.748	0.923	0.865	0.807	0.891	0.870	0.797
Adj. R-square	0.818	0.575	0.870	0.771	0.674	0.816	0.780	0.658

Table 4-3-6b: Singapore - Robustness Check, Replace $\Delta REER_{t-1}$ with CA_t

Singapore: 2SLS	Perfect Foresight				Static expectations			
	1990:Q1-1997:Q2		1998Q3-2005:Q2		1990:Q1-1997:Q2		1998Q3-2005:Q2	
	ΔNFA_t^*	ΔNDA_t^*	ΔNFA_t^*	ΔNDA_t^*	ΔNFA_t^*	ΔNDA_t^*	ΔNFA_t^*	ΔNDA_t^*
Intercept	0.057	-0.028	-0.002	-0.004	0.006	**-0.099*** **	-0.017	-0.009
	(0.035)	(0.054)	(0.028)	(0.040)	(0.073)	(0.032)	(0.030)	(0.055)
ΔNDA_t^*	-0.349	-	**-0.975*** **	-	-0.961	-	**-0.873** **	-
	(0.207)		(0.156)		(0.570)		(0.304)	
ΔNFA_t^*	-	**-0.931*** **	-	**-0.814*** **	-	-0.157	-	-0.172
		(0.311)		(0.186)		(0.145)		(0.402)
Δmm_t	0.294	-0.243	**-0.522*** **	-0.321	-0.366	-0.237	**-0.501***	**-0.503***
	(0.411)	(0.508)	(0.175)	(0.184)	(0.534)	(0.300)	(0.251)	(0.285)
Δp_{t-1}	**-7.114***	-2.648	-5.629	-5.073	-1.457	**5.155***	-4.995	-6.741
	(3.434)	(5.227)	(3.302)	(4.185)	(6.379)	(2.908)	(3.999)	(6.139)
$Y_{c,t-1}$	0.298	-0.336	0.060	-0.288	-0.352	-0.346	0.276	-0.281
	(0.419)	(0.530)	(0.243)	(0.320)	(0.562)	(0.305)	(0.250)	(0.449)
ΔG_t	-0.222	-0.044	0.129	0.220	-0.143	-0.047	-0.011	0.098
	(0.134)	(0.189)	(0.144)	(0.172)	(0.187)	(0.109)	(0.144)	(0.220)
$\Delta(r_t^* + E_t S_{t+1})$	**-2.447*** **	-1.201	**-1.619***	**-3.201*** **	0.285	**2.983*** **	0.062	**4.147** **
	(0.600)	(1.104)	(0.828)	(0.951)	(2.333)	(0.557)	(1.145)	(1.665)
CA_t	-0.177	-0.043	0.014	-0.379	-0.074	0.184	0.222	-0.380
	(0.162)	(0.206)	(0.210)	(0.272)	(0.260)	(0.132)	(0.215)	(0.383)
$(d_2 - 1)\sigma_{s,t-1}$	-0.663	-	**2.665*** **	-	1.150	-	**2.988** **	-
	(1.033)		(0.901)		(1.503)		(1.117)	
$(d_1 - 1)\sigma_{r,t-1}$	-	0.031	-	-0.006	-	0.048	-	-0.088
		(0.054)		(0.063)		(0.034)		(0.108)
Q1	**0.052***	0.062	0.049	**0.091***	0.058	0.016	0.030	0.020
	(0.029)	(0.041)	(0.035)	(0.043)	(0.040)	(0.026)	(0.038)	(0.067)
Q2	0.039	0.020	0.030	0.048	0.030	-0.017	0.033	0.052
	(0.026)	(0.036)	(0.028)	(0.036)	(0.040)	(0.022)	(0.032)	(0.051)
Q3	0.012	0.007	**0.065***	0.036	0.003	0.034	**0.089** **	0.023
	(0.023)	(0.032)	(0.034)	(0.051)	(0.035)	(0.021)	(0.035)	(0.073)
R-square	0.869	0.737	0.920	0.870	0.751	0.893	0.897	0.734
Adj. R-square	0.779	0.557	0.866	0.781	0.581	0.819	0.826	0.552

Table 4-3-6c: Singapore - Robustness Check, Without Δmm_t

Singapore: 2SLS	Perfect Foresight				Static expectations			
	1990:Q1-1997:Q2		1998Q3-2005:Q2		1990:Q1-1997:Q2		1998Q3-2005:Q2	
	ΔNFA_t^*	ΔNDA_t^*	ΔNFA_t^*	ΔNDA_t^*	ΔNFA_t^*	ΔNDA_t^*	ΔNFA_t^*	ΔNDA_t^*
Intercept	0.047	-0.014	-0.029	**-0.066****	-0.026	**-0.108*****	0.028	-0.085
	(0.030)	(0.051)	(0.027)	(0.031)	(0.066)	(0.030)	(0.055)	(0.050)
ΔNDA_t^*	**-0.502*****	-	**-0.760*****	-	**-1.085****	-	-0.128	-
	(0.161)		(0.180)		(0.429)		(0.481)	
ΔNFA_t^*	-	**-1.073*****	-	**-0.826*****	-	-0.267	-	0.019
		(0.317)		(0.209)		(0.164)		(0.573)
Δp_{t-1}	**-4.729***	-3.057	-1.372	-1.932	-0.146	2.890	-1.018	-2.652
	(2.677)	(4.285)	(4.119)	(4.750)	(4.570)	(2.521)	(6.448)	(7.776)
$Y_{c,t-1}$	0.567	-0.039	0.168	-0.253	-0.013	-0.517	0.704	-0.538
	(0.381)	(0.604)	(0.326)	(0.375)	(0.571)	(0.325)	(0.485)	(0.663)
ΔG_t	-0.137	-0.020	0.061	0.233	-0.046	-0.055	-0.192	0.275
	(0.123)	(0.180)	(0.196)	(0.191)	(0.174)	(0.109)	(0.289)	(0.312)
$\Delta(r_t^* + E_t S_{t+1})$	**-1.999*****	-1.545	-1.380	**-2.437****	1.025	**2.703*****	-2.693	**4.235***
	(0.502)	(0.994)	(0.923)	(0.947)	(1.844)	(0.530)	(2.042)	(2.183)
$\Delta REER_{t-1}$	**0.017***	0.011	-0.001	-0.002	**0.023***	-0.001	0.010	-0.006
	(0.009)	(0.015)	(0.010)	(0.012)	(0.013)	(0.010)	(0.017)	(0.020)
$(d_2 - 1)\sigma_{s,t-1}$	0.267	-	1.013	-	1.305	-	1.048	-
	(0.881)		(0.979)		(1.402)		(1.519)	
$(d_1 - 1)\sigma_{r,t-1}$	-	0.016	-	0.054	-	0.054	-	-0.013
		(0.057)		(0.067)		(0.038)		(0.121)
Q1	0.039	0.058	0.062	**0.109****	0.048	0.034	0.021	0.054
	(0.024)	(0.036)	(0.045)	(0.047)	(0.035)	(0.023)	(0.069)	(0.079)
Q2	**0.048***	0.033	0.047	0.062	0.048	-0.004	0.011	0.065
	(0.024)	(0.039)	(0.035)	(0.040)	(0.036)	(0.024)	(0.061)	(0.065)
Q3	0.033	0.022	**0.102****	0.054	0.041	0.032	**0.111***	0.006
	(0.023)	(0.033)	(0.042)	(0.057)	(0.034)	(0.021)	(0.062)	(0.101)
R-square	0.890	0.729	0.862	0.832	0.779	0.889	0.659	0.550
Adj. R-square	0.825	0.570	0.781	0.733	0.649	0.823	0.459	0.285

Table 4-3-6d: Singapore - Robustness Check, Without Δmm_t, Replace $\Delta REER_{t-1}$ with CA_t

Singapore: 2SLS	Perfect Foresight				Static expectations			
	1990:Q1-1997:Q2		1998Q3-2005:Q2		1990:Q1-1997:Q2		1998Q3-2005:Q2	
	ΔNFA_t^*	ΔNDA_t^*	ΔNFA_t^*	ΔNDA_t^*	ΔNFA_t^*	ΔNDA_t^*	ΔNFA_t^*	ΔNDA_t^*
Intercept	0.056	-0.030	-0.037	-0.025	0.010	**-0.105*** **	-0.028	-0.033
	(0.034)	(0.053)	(0.034)	(0.040)	(0.071)	(0.030)	(0.046)	(0.061)
ΔNDA_t^*	**-0.420****	-	**-0.677*****	-	-0.855	-	-0.189	-
	(0.181)		(0.183)		(0.538)		(0.371)	
ΔNFA_t^*	-	**-0.975*****	-	**-0.804*****	-	-0.158	-	-0.059
		(0.287)		(0.214)		(0.148)		(0.562)
Δp_{t-1}	**-6.180***	-3.640	-0.837	-3.070	-2.797	4.620	0.403	-4.105
	(3.094)	(4.650)	(3.932)	(4.270)	(5.942)	(2.826)	(5.380)	(6.744)
$Y_{c,t-1}$	0.284	-0.338	0.262	-0.273	-0.377	-0.389	0.534	-0.388
	(0.406)	(0.520)	(0.319)	(0.347)	(0.552)	(0.297)	(0.387)	(0.560)
ΔG_t	-0.226	-0.044	0.008	0.270	-0.123	-0.035	-0.183	0.249
	(0.130)	(0.185)	(0.191)	(0.183)	(0.181)	(0.107)	(0.226)	(0.275)
$\Delta(r_t^* + E_t S_{t+1})$	**-2.274*****	-1.389	-0.959	**-2.904****	-0.003	**3.022*****	-2.174	**3.910***
	(0.537)	(0.993)	(1.095)	(0.996)	(2.259)	(0.553)	(1.568)	(2.032)
CA_t	-0.128	-0.085	0.142	-0.345	-0.149	0.148	0.432	-0.426
	(0.142)	(0.182)	(0.280)	(0.293)	(0.229)	(0.124)	(0.339)	(0.470)
$(d_2-1)\sigma_{s,t-1}$	-0.437	-	0.969	-	1.136	-	1.210	-
	(0.960)		(0.960)		(1.481)		(1.309)	
$(d_1-1)\sigma_{r,t-1}$	-	0.038	-	0.025	-	0.054	-	-0.034
		(0.051)		(0.065)		(0.033)		(0.116)
Q1	**0.051***	0.067	0.053	**0.105****	0.061	0.019	0.027	0.048
	(0.028)	(0.039)	(0.047)	(0.045)	(0.039)	(0.025)	(0.061)	(0.074)
Q2	0.037	0.023	0.045	0.057	0.034	-0.015	0.023	0.060
	(0.025)	(0.035)	(0.036)	(0.038)	(0.039)	(0.022)	(0.052)	(0.059)
Q3	0.009	0.012	**0.107****	0.050	0.004	**0.038***	**0.111***	0.022
	(0.022)	(0.030)	(0.042)	(0.055)	(0.034)	(0.020)	(0.053)	(0.090)
R-square	0.870	0.731	0.851	0.845	0.744	0.889	0.720	0.624
Adj. R-square	0.793	0.573	0.764	0.753	0.594	0.823	0.555	0.404

4.3.7 Taiwan

(1) The Evolution of Balance of Payments in Taiwan

Taiwan is the third largest international reserves holder in the world. In the third quarter of 2006, its current reserves reached US$261.55 billion. Taiwan's reserves remained stagnant before the 1997 currency crises, and gradually increased after that. But since 2001, Taiwan's international reserves have been increased sharply mainly due to its large amount of current account surplus.

Figure 4-3-7a shows the dynamic change of components of balance of payments in Taiwan. Before the currency crises, the balance of payments was about break even, except there was a larger amount of surplus in 1991. During this period, Taiwan had consistent current account surplus, but most of it had been offset by a similar capital account deficit. The capital account components in Figure 4-3-7b also show that both FDI and other investments had consistently remained in deficit. Because of the military exercises of Mainland China, there was a large amount of capital outflows in 1995. Besides, Taiwan's international reserves remained stable.

The Central Bank of China (CBC) has been adopting a managed floating foreign exchange rate regime since 1989. The exchange rate moved stable around NT$26~27 per US dollar before the crises. However, huge amount of FDI and portfolio investments fled out of Taiwan in 1997 because of the currency crises. The CBC defended its currency for a while, but quickly decided to depreciate its currency to remain export advantage. The exchange rate reached NT$33.45 per US dollar in 1998, but it did not significantly

improve the current account at the same period. The balance of payments remained even until international capitals have begun to flow back to Asia since 1998.

Post-crises, both current account and capital account surplus have made Taiwan's reserves accumulation increase rapidly, particular in 1999, portfolio investments flew in substantially due to the government gradually opened the equity market to foreign investors[56]. But since then, Taiwan's current account surplus has increased substantially. The balance of payments surplus reached to a record-high of US$37 billion in the single year of 2003. The current account surplus was mainly attributed to the persistently steady growth in global economy and the economic boom in most of Asian economies. However, even though there was a significant improvement in current account surplus, all the components in capital account turned to deficit in 2000, which was mainly because of the widening interest rate spread between deposits denominated in US dollars and NT dollars. The capital account has gradually increased and stayed in surplus after 2001. Both FDI and portfolio investments remained in deficit, while a large amount of other investments began to flow into Taiwan and kept capital account in surplus. The deficit in portfolio investments was mainly due to the low interest rate policy in Taiwan[57], while the surplus

[56] The open policy includes the increase of the limit of foreign ownership in any listed company and the increase of the maximum amount of investment in Taiwan's stock market. Meanwhile, Morgan Stanley Capital International Incorporation (MSCI) also raised the weight ratio of Taiwanese equities value to 100 percent.

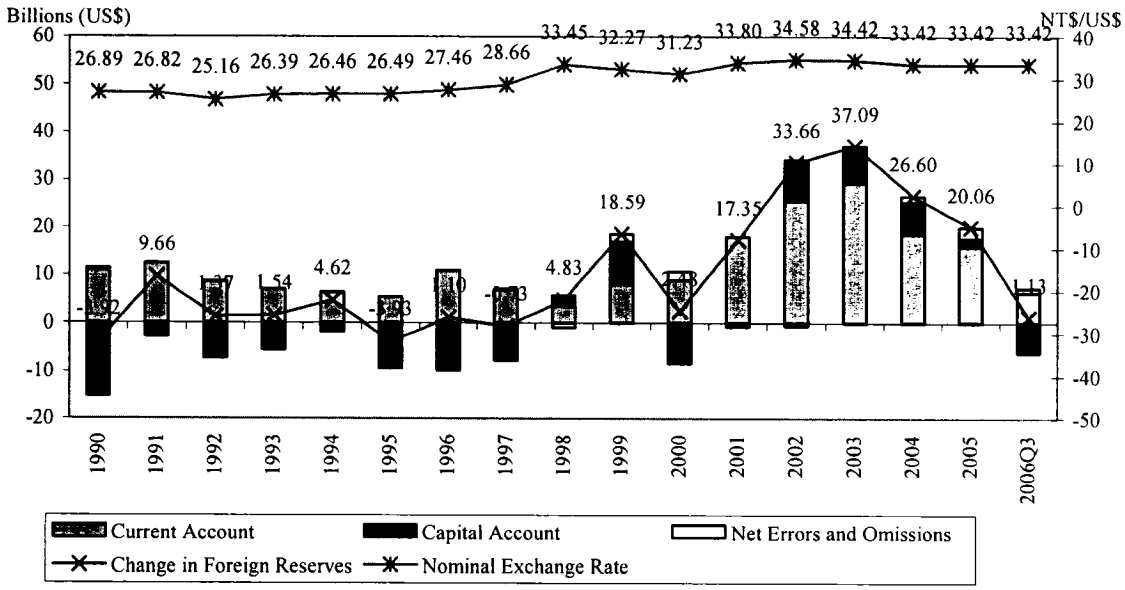
[57] Since the September 11 terrorist attacks happened in the U.S., the CBC has adopted a low interest rate policy to stimulate the economy. The Bank has cut the discount rate twelve times in 2001, and kept reducing the discount rate until 2003, which was mainly due to globally declining market interest rates, the US-Iraq War, and the Sever Acute Respiratory Syndrome (SARs).

in other investments was resulted in an expectation for the appreciation of the NT dollar against the US dollar.[58]

Taiwan's balance of payments began to decline after 2004 and almost turned into deficit in the third quarter of 2006. The decline of balance of payments was mainly due to the decrease in both current account and capital account surplus. The decline in current account surplus was resulted from the increase in imports, which was led by the recovery of domestic economy. Taiwan's capital account has been decreasing since 2002, and turn into deficit in the third quarter of 2006. The decline in capital account was attributed to the decrease of other investments inflows and the increase of portfolio investment outflows. The capital mainly flows to Mainland China due to an expectation of an appreciation of the Renminbi, and the boom in China's stock market. The political disturbance resulted from the President (Chen Shui-Bian)'s corruption scandal also decreases investors (both foreigner and domestic investors)' confidence and willingness to invest in Taiwan.

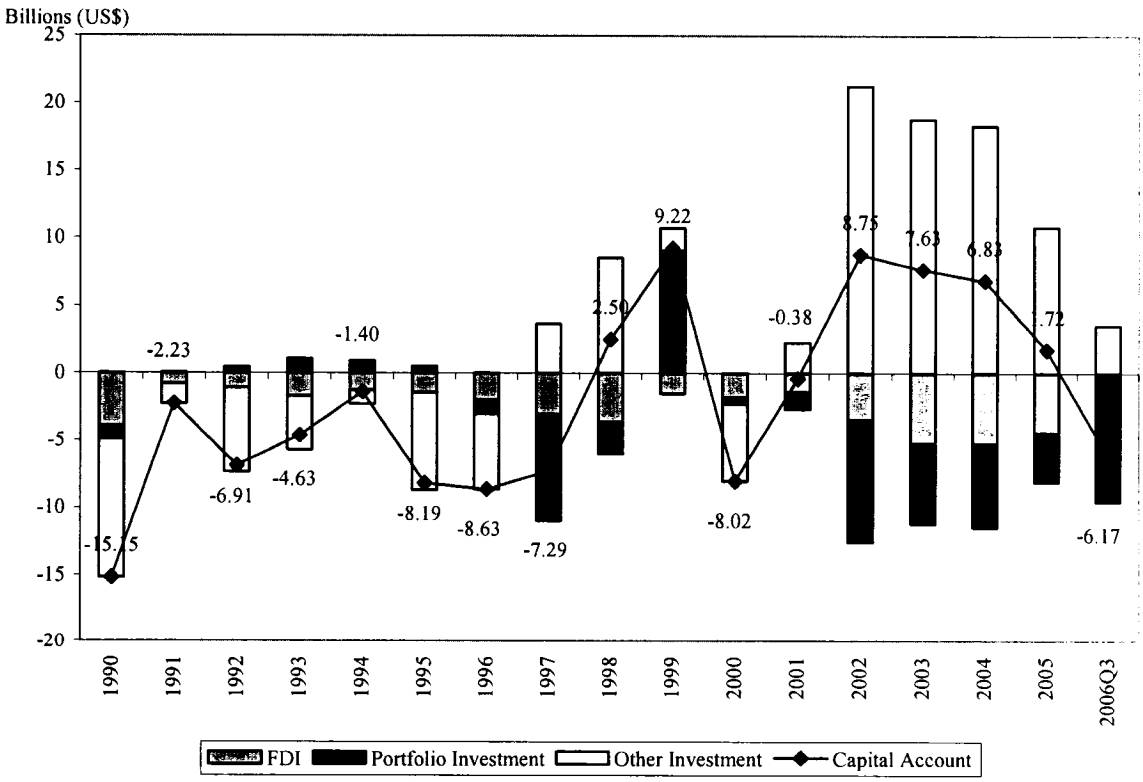
[58] Both of the weakening of the US dollar and a substantial current account surplus attributed to the expectation for the appreciation of the NT dollar against the US dollar.

Figure 4-3-7a: Trends in Taiwan's Balance of Payments Transactions



Source: Central Bank of China website and AREMOS Economic Statistical Database.

Figure 4-3-7b: Capital Account Components in Taiwan



Source: Central Bank of China website and AREMOS Economic Statistical Database.

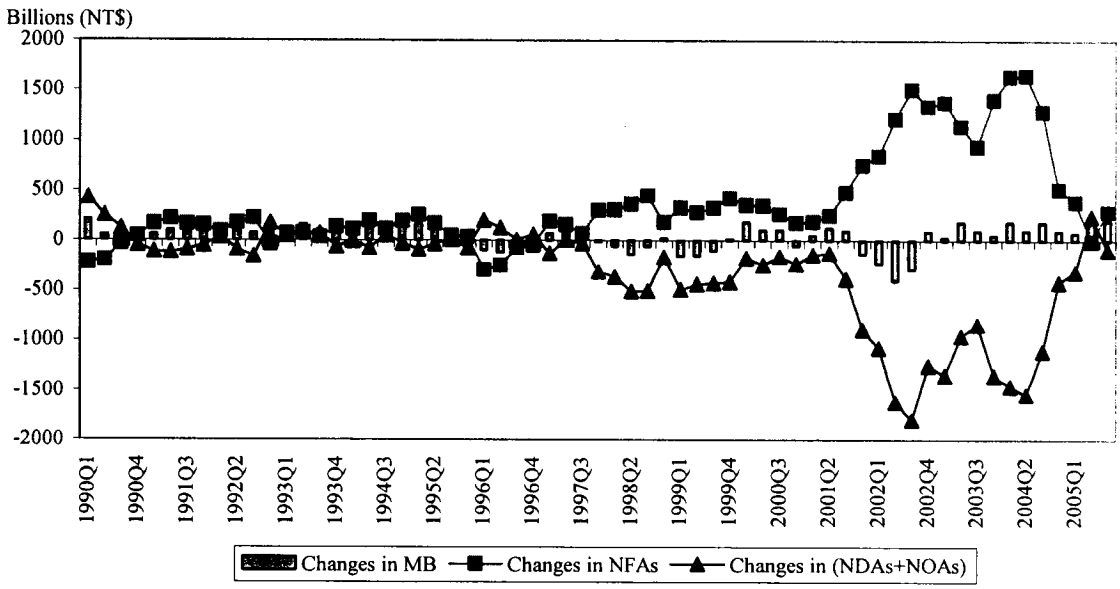
(2) Monetary Sterilization Policies in Taiwan

The broad monetary aggregate M2 has been used as the intermediate target since early 1990s. But because of the diversification of financial assets, the CBC has added M2 plus bond funds as one of the intermediate targets for monetary policy. Figure 4-3-7c shows the CBC's movement in NFAs and NDAs of the monetary base. Pre-crises, the change in monetary base was constantly stable, while it has been declining after the crises. The annual change in monetary base was almost zero after 2002. The dynamic change in NFAs and NDAs also suggests that the CBC has been consistently sterilizing the capital inflows to keep the price stable. Figure 4-3-7e also shows that the inflation has been successively controlled below 3 percent after the crises, and even turned to deflation around 2002. But after late 2003, the price level has been rising to around 2.8 percent again. Figure 4-3-7d shows Taiwan's monetary base, M1B, and M2.[59] The graph indicates that there has been no significantly change in Taiwan's monetary aggregates. Monetary base and M1B are relative stable, while the M2 has been growth gradually. Therefore, we can conclude that domestic liquidity has been consistently and well managed by the CBC.

The CBC has been frequently using open market operations, reserve requirement adjustment, and discount rate to sterilize reserve accumulations. Capital control and window guidance are also two common tools to manage domestic liquidity. The monetary sterilization policies and instruments are summarized as below.

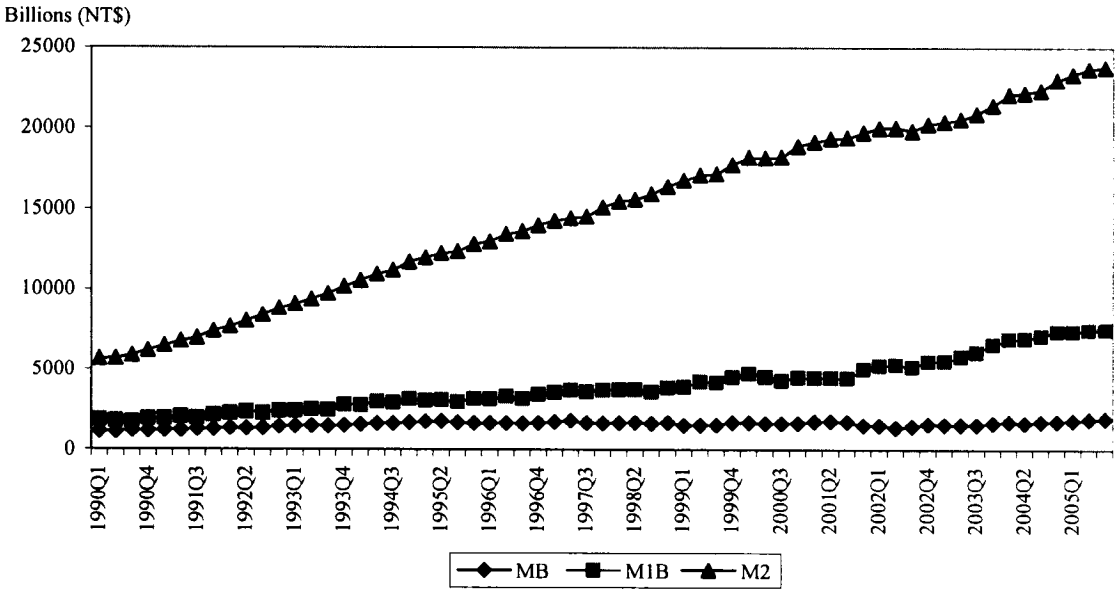
[59] M1B = Currency Held by the Public + Deposit Money, while M2=M1B+Quasi-Money.

Figure 4-3-7c: Quarterly Annual Change in NFAs, NDAs, and Reserve Money in Taiwan, 1990: Q1 – 2005: Q3



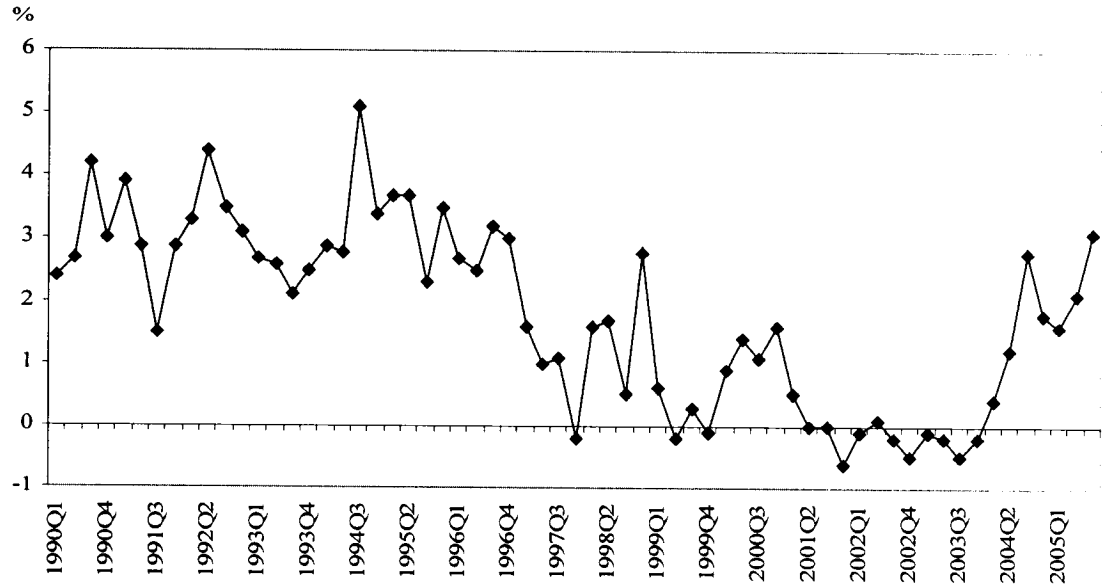
Source: Central Bank of China website and AREMOS Economic Statistical Database.

Figure 4-3-7d: Reserve Money, M1, and M2 in Taiwan, 1990: Q1 – 2005: Q3



Source: Central Bank of China website and AREMOS Economic Statistical Database.

Figure 4-3-7e: Inflation (CPI % Change) in Taiwan, 1990: Q1 – 2005: Q3



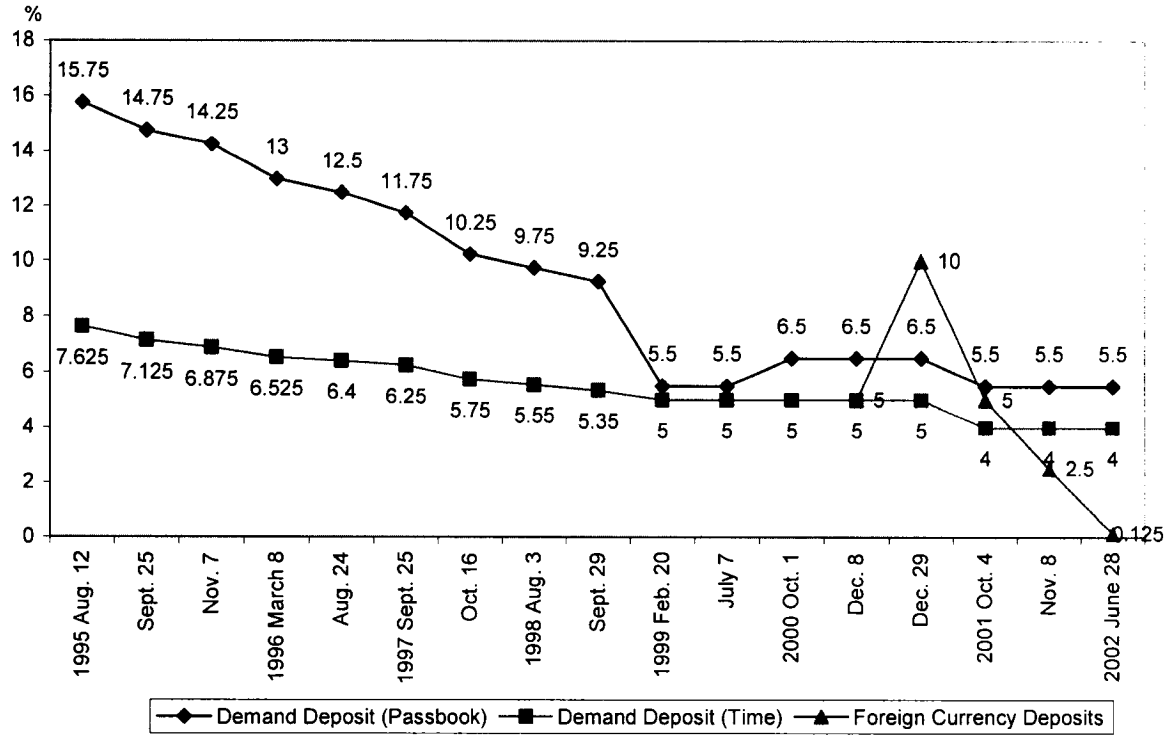
Source: Central Bank of China website and AREMOS Economic Statistical Database.

a. Reserve Requirements

The CBC has frequently adjusted the reserve requirement ratio on different deposits to manage domestic liquidity. Figure 4-3-7f shows the reserve requirement ratio change from 1995 to 2005. The graph suggests that the CBC has lowed down the requirement ratio consistently from 1995 to 1996 since huge capitals fled out of Taiwan because of the military exercises of Mainland China. The CBC even further reduced the reserve requirement ratios on demand deposits in 1999 to increase banks' asset quality because of September earthquake.

Although the CBC raised the reserve requirement ratio marginally due to the rising inflation and monetary aggregate in 2000, it declined again because the price level turned to deflation in late 2001.

Figure 4-3-7f: Reserve Requirement Ratio on Deposits (%), 1995 – 2005



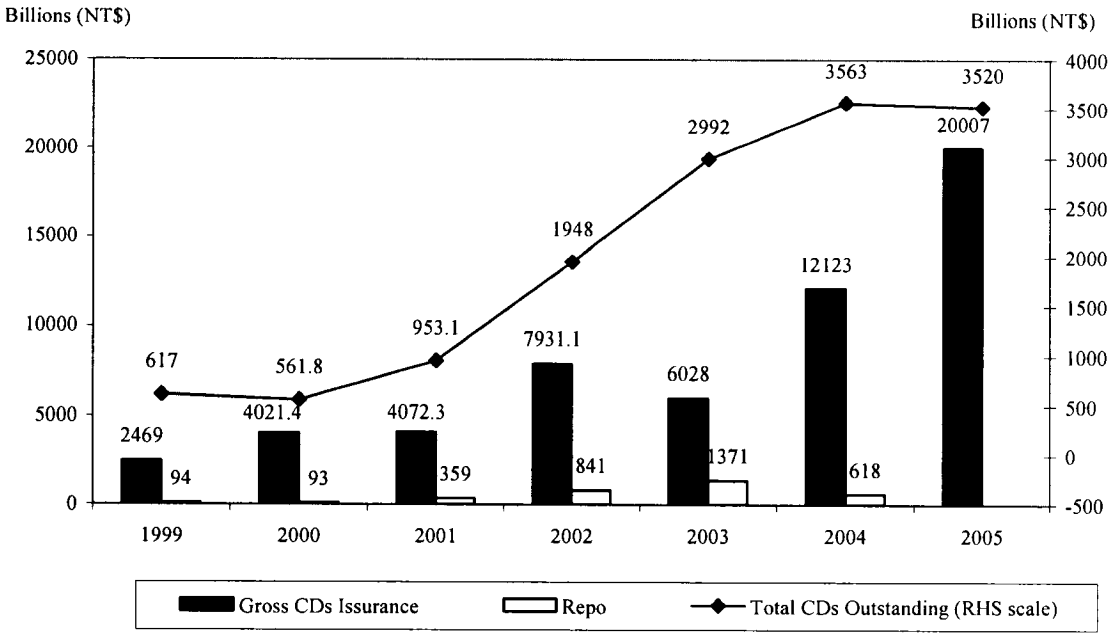
Source: Annual Monetary Reports issued by the CBC.
Note: The required reserve ratio is imposed on newly-taken currency deposits with the domestic banking units (DBU) of financial institutions on December 8th, 2000.

b. Open Market Operations (OMOs)

In addition to adjusting the reserve requirement ratios, the CBC frequently issues government securities and certificates of deposits (CDs) to do open market operations. In addition, the Bank also conducted OMOs by way of repurchase agreements if special events occur. Figure 4-3-7g indicates that the total CDs outstanding has been increasing sharply since 2001. In 2005, CBC issued NT$20,007 billions CDs, which is almost twice as many as issued in previous year. During 2002 and 2003, the CBC also increased the amount of repurchase agreements to absorb excess liquidity resulted in the rapid reserve accumulation at the same time. In addition to issuing CDs and government securities, the

CBC also receives redeposits from financial institutions, or uses foreign exchange swaps as instruments to adjust domestic liquidity.

Figure 4-3-7g: Issuance of CDs and Total CDs Outstanding, 1999 – 2005



Source: Annual Monetary Reports issued by the CBC.

c. Adjusting Discount Rates

The CBC has been adjusting the discount rates to manage domestic liquidity as well. For example, the Bank raises the discount rates in 2000 in response to the widened interest spread between US dollar and NT dollar assets, and the inflation pressure caused by the soared oil price. Also, due to the September 11 terrorist attacks in the U.S., Taiwan's export shrank substantially in 2001. To stimulate weak domestic economy, the Bank had cut the discount rate 11 times continuously from 4.375% to 2.125%, and even further reduced the discount rate to 1.375% in mid 2003 due to the US-Iraq War and the

Severe Acute Respiratory Syndrome (SARs). However, the CBC has changed its low interest rate policy in late 2004 since inflation began to surge from previous year as the global energy prices soared. The CBC has been raised discount rates since late 2004. By the end of 2005, the discount rate has gone back to 2.25% again.

d. Capital Controls

Generally speaking, Taiwanese government has gradually opened both current account and capital account markets in recent years. For example, the maximum amount of money that each qualified foreign institutional investor (QFII) may invest in domestic securities increased from US$1.2 billion in 1999 to US$3 billion in 2001. Although the QFII system was abolished in late 2003, a new registration-based scheme was adopted. Now foreign investors can be registered as Foreign Institutional Investors (FINI) and Foreign Individual Investors (FIDI). The former does not have an upper investment limit.

e. Window Guidance

Finally, the CBC also uses measures to guide the domestic liquidity. For example, to support small and medium-sized (SMEs) firms, the CBC will transfer the money from the postal savings redeposits to domestic banks to extend loans to SMEs. The Bank also used the same way to support the financial institutions to accommodate the September 21 earthquake victims. To boost the real estate market and save some specific industries, the Bank continued to promote preferential mortgage loan programs and Preferential Loans and Credit Guarantees program to new home buyers and traditional industries, respectively.

(3) The Empirical Results for Taiwan

Table 4-3-7a and Table 4-3-7b show the similar estimation results. The estimated offset coefficient pre-crisis is around 0.91 to 0.95, while the estimated sterilization coefficient around 1. This suggests that Taiwan had a fairly high degree of capital mobility pre-crisis and the Central Bank of China (CBC) also undertook aggressive sterilization operations. While the offset coefficient has decreased somewhat post-crisis to around 0.74 to 0.8, the estimated sterilization coefficient has remained stable around 0.8 to 1.

The estimated coefficients for the change of money multiplier were significantly negative for both the functions pre- and post-crisis. The lagged cyclical income and government expenditure are statistically significant and positive pre-crisis, indicating high economic growth and the expansionary fiscal policy were the main reason to attract capitals inflows before the crisis. However, these two variables become negative and lost their significance after the crisis. The exchange rate adjusted interest rate term is the correct sign and significant under the assumption of perfect foresight. The lagged REER is insignificant throughout all periods, while the current account is significant and positive pre-crisis under the assumption of static expectations. Both exchange rate and interest rate volatility terms have inconsistent signs and statistically insignificant in both periods, except that the exchange rate volatility term is significant in the balance of payments function post-crisis with static expectations. The empirical results (Figure 4-3-7c and Figure 4-3-7d) also suggest that change in money multiplier variable does not affect the estimation much.

Table 4-3-7a: Taiwan - Estimated Simultaneous Equations, 1990:Q1-1997:Q2 and 1998Q3-2004:Q3

Taiwan: 2SLS	Perfect Foresight				Static expectations			
	1990:Q1-1997:Q2		1998Q3-2004:Q3		1990:Q1-1997:Q2		1998Q3-2004:Q3	
	ΔNFA_t^*	ΔNDA_t^*	ΔNFA_t^*	ΔNDA_t^*	ΔNFA_t^*	ΔNDA_t^*	ΔNFA_t^*	ΔNDA_t^*
Intercept	**0.034***	**0.034***	**0.070***	0.041	**0.039***	**0.040***	**0.073***	0.009
	(0.009)	(0.010)	(0.033)	(0.042)	(0.011)	(0.011)	(0.040)	(0.048)
ΔNDA_t^*	**-0.940***	-	**-0.810***	-	**-0.912***	-	**-0.708***	-
	(0.058)		(0.105)		(0.089)		(0.152)	
ΔNFA_t^*	-	**-1.022***	-	**-1.070***	-	**-0.974***	-	**-0.925***
		(0.064)		(0.141)		(0.094)		(0.195)
Δmm_t	**-0.733***	**-0.766***	**-0.556****	**-0.646***	**-0.565***	**-0.635***	**-0.515****	**-0.655****
	(0.135)	(0.146)	(0.184)	(0.206)	(0.170)	(0.161)	(0.225)	(0.232)
Δp_{t-1}	0.056	0.012	-3.183	-1.682	-0.300	-0.557	-3.132	-0.572
	(0.470)	(0.589)	(2.298)	(2.745)	(0.533)	(0.620)	(2.713)	(3.056)
$Y_{c,t-1}$	**1.690****	**1.652***	-1.020	-0.644	**2.084****	**2.122****	-1.533	0.224
	(0.743)	(0.804)	(1.344)	(1.623)	(0.845)	(0.905)	(1.693)	(1.957)
ΔG_t	**0.464****	**0.449****	-0.223	-0.168	**0.601****	**0.550****	-0.334	-0.163
	(0.180)	(0.186)	(0.486)	(0.512)	(0.216)	(0.237)	(0.583)	(0.578)
$\Delta(r_t^* + E_t S_{t+1})$	**-0.589****	**-0.585****	**-1.010****	**-1.024***	-0.367	-0.081	-0.719	0.454
	(0.218)	(0.257)	(0.393)	(0.482)	(0.323)	(0.349)	(0.621)	(0.653)
$\Delta REER_{t-1}$	0.0003	0.0003	0.001	-0.005	0.002	0.002	-0.001	-0.009
	(0.002)	(0.002)	(0.007)	(0.007)	(0.002)	(0.002)	(0.008)	(0.008)
$(d_2 - 1)\sigma_{s,t-1}$	-0.001	-	0.041	-	-0.003	-	0.061	-
	(0.017)		(0.033)		(0.020)		(0.041)	
$(d_1 - 1)\sigma_{r,t-1}$	-	-0.001	-	-0.086	-	0.003	-	-0.112
		(0.005)		(0.093)		(0.006)		(0.104)
Q1	0.011	0.011	-0.076	-0.046	-0.003	-0.004	-0.071	-0.025
	(0.013)	(0.013)	(0.059)	(0.065)	(0.013)	(0.013)	(0.069)	(0.073)
Q2	-0.002	-0.001	-0.047	-0.024	0.003	0.006	-0.036	0.008
	(0.017)	(0.016)	(0.052)	(0.062)	(0.020)	(0.019)	(0.061)	(0.068)
Q3	-0.013	-0.010	-0.027	-0.015	-0.020	-0.015	-0.011	0.007
	(0.015)	(0.016)	(0.035)	(0.041)	(0.018)	(0.019)	(0.041)	(0.045)
R-square	0.968	0.967	0.887	0.888	0.956	0.956	0.843	0.858
Adj. R-square	0.946	0.945	0.791	0.794	0.927	0.926	0.710	0.738

Table 4-3-7b: Taiwan - Robustness Check, Replace $\Delta REER_{t-1}$ with CA_t

Taiwan: 2SLS	Perfect Foresight				Static expectations			
	1990:Q1-1997:Q2		1998Q3-2004:Q3		1990:Q1-1997:Q2		1998Q3-2004:Q3	
	ΔNFA_t^*	ΔNDA_t^*	ΔNFA_t^*	ΔNDA_t^*	ΔNFA_t^*	ΔNDA_t^*	ΔNFA_t^*	ΔNDA_t^*
Intercept	**0.022***	**0.025***	0.058	-0.007	0.017	0.019	0.030	-0.035
	(0.011)	(0.012)	(0.043)	(0.054)	(0.010)	(0.012)	(0.048)	(0.056)
ΔNDA_t^*	**-0.959*****	-	**-0.740*****	-	**-0.927*****	-	**-0.515*****	-
	(0.053)		(0.118)		(0.071)		(0.170)	
ΔNFA_t^*	-	**-1.012*****	-	**-1.087*****	-	**-1.043*****	-	**-0.863*****
		(0.059)		(0.176)		(0.082)		(0.274)
Δmm_t	**-0.688*****	**-0.719*****	**-0.507****	**-0.605****	**-0.624*****	**-0.666*****	**-0.414***	**-0.575****
	(0.132)	(0.143)	(0.191)	(0.230)	(0.140)	(0.138)	(0.215)	(0.250)
Δp_{t-1}	-0.248	-0.246	-0.896	2.365	-0.340	-0.421	-0.561	3.521
	(0.471)	(0.590)	(2.260)	(2.555)	(0.434)	(0.535)	(2.486)	(2.697)
$Y_{c,t-1}$	**2.146****	**2.077****	-1.957	-1.057	**2.449*****	**2.648*****	-1.878	-0.148
	(0.774)	(0.885)	(1.601)	(2.060)	(0.700)	(0.799)	(1.766)	(2.236)
ΔG_t	**0.408****	**0.384****	-0.142	-0.027	**0.398****	0.363	0.033	-0.051
	(0.166)	(0.180)	(0.509)	(0.550)	(0.180)	(0.209)	(0.561)	(0.612)
$\Delta(r_t^* + E_t S_{t+1})$	-0.236	-0.319	**-1.057****	**-1.115****	-0.082	-0.034	**-1.553****	0.505
	(0.302)	(0.323)	(0.398)	(0.522)	(0.282)	(0.303)	(0.707)	(0.962)
CA_t	0.359	0.257	-0.115	0.302	**0.502*****	**0.465****	0.916	0.182
	(0.243)	(0.238)	(0.507)	(0.583)	(0.166)	(0.174)	(0.683)	(0.895)
$(d_2 - 1)\sigma_{s,t-1}$	-0.014	-	0.052	-	-0.016	-	**0.068***	-
	(0.017)		(0.034)		(0.017)		(0.037)	
$(d_1 - 1)\sigma_{r,t-1}$	-	-0.00003	-	-0.081	-	0.001	-	-0.098
		(0.005)		(0.099)		(0.005)		(0.108)
Q1	0.003	0.007	-0.019	0.036	-0.001	0.002	0.002	0.046
	(0.011)	(0.011)	(0.055)	(0.061)	(0.009)	(0.010)	(0.061)	(0.067)
Q2	-0.0004	0.004	-0.052	-0.015	0.002	0.009	-0.050	0.018
	(0.016)	(0.016)	(0.055)	(0.069)	(0.016)	(0.016)	(0.060)	(0.075)
Q3	-0.018	-0.013	0.004	0.025	-0.021	-0.017	-0.001	0.051
	(0.014)	(0.015)	(0.034)	(0.039)	(0.015)	(0.017)	(0.038)	(0.042)
R-square	0.971	0.969	0.855	0.852	0.971	0.967	0.823	0.826
Adj. R-square	0.951	0.948	0.755	0.750	0.950	0.945	0.701	0.706

Table 4-3-7c: Taiwan - Robustness Check, Without Δmm_t

Taiwan: 2SLS	Perfect Foresight				Static expectations			
	1990:Q1-1997:Q2		1998Q3-2004:Q3		1990:Q1-1997:Q2		1998Q3-2004:Q3	
	ΔNFA_t^*	ΔNDA_t^*	ΔNFA_t^*	ΔNDA_t^*	ΔNFA_t^*	ΔNDA_t^*	ΔNFA_t^*	ΔNDA_t^*
Intercept	**0.042****	**0.042****	**0.095****	0.068	**0.043*****	**0.046*****	**0.103****	0.045
	(0.016)	(0.016)	(0.040)	(0.054)	(0.014)	(0.015)	(0.043)	(0.059)
ΔNDA_t^*	**-1.020*****	-	**-0.714*****	-	**-0.933*****	-	**-0.559*****	-
	(0.105)		(0.124)		(0.117)		(0.153)	
ΔNFA_t^*	-	**-0.949*****	-	**-1.158*****	-	**-1.016*****	-	**-1.075*****
		(0.100)		(0.183)		(0.127)		(0.248)
Δp_{t-1}	-1.167	-1.397	-4.954	-3.327	-1.148	-1.438	-4.814	-2.415
	(0.782)	(0.842)	(2.818)	(3.493)	(0.694)	(0.785)	(3.006)	(3.750)
$Y_{c,t-1}$	2.181	**2.261***	-1.176	-0.962	**2.201***	**2.359***	-2.049	-0.432
	(1.267)	(1.283)	(1.710)	(2.093)	(1.128)	(1.227)	(1.928)	(2.446)
ΔG_t	**0.549***	**0.553***	-0.208	-0.261	**0.656****	**0.679****	-0.355	-0.256
	(0.311)	(0.298)	(0.619)	(0.659)	(0.287)	(0.319)	(0.673)	(0.715)
$\Delta(r_t^* + E_t S_{t+1})$	-0.177	-0.093	**-1.085****	-1.072	-0.502	-0.391	-1.053	0.226
	(0.369)	(0.385)	(0.500)	(0.621)	(0.404)	(0.465)	(0.689)	(0.820)
$\Delta REER_{t-1}$	0.003	0.003	0.009	0.001	0.003	0.003	0.006	-0.003
	(0.003)	(0.003)	(0.008)	(0.009)	(0.003)	(0.003)	(0.008)	(0.010)
$(d_2 - 1)\sigma_{s,t-1}$	-0.007	-	0.039	-	-0.003	-	0.066	-
	(0.029)		(0.042)		(0.026)		(0.047)	
$(d_1 - 1)\sigma_{r,t-1}$	-	0.004	-	-0.193	-	0.004	-	**-0.231***
		(0.009)		(0.112)		(0.008)		(0.121)
Q1	-0.011	-0.012	-0.123	-0.102	-0.011	-0.013	-0.114	-0.082
	(0.021)	(0.020)	(0.073)	(0.081)	(0.018)	(0.018)	(0.077)	(0.087)
Q2	0.001	0.005	-0.061	-0.030	0.003	0.005	-0.052	-0.004
	(0.029)	(0.026)	(0.065)	(0.080)	(0.026)	(0.025)	(0.069)	(0.085)
Q3	-0.026	-0.026	-0.038	-0.018	-0.032	-0.033	-0.021	0.002
	(0.025)	(0.025)	(0.044)	(0.053)	(0.023)	(0.026)	(0.047)	(0.056)
R-square	0.898	0.910	0.803	0.800	0.917	0.914	0.775	0.765
Adj. R-square	0.839	0.856	0.661	0.657	0.868	0.863	0.614	0.597

Table 4-3-7d: Taiwan - Robustness Check, Without Δmm_t, Replace $\Delta REER_{t-1}$ with CA_t

Taiwan: 2SLS	Perfect Foresight				Static expectations			
	1990:Q1-1997:Q2		1998Q3-2004:Q3		1990:Q1-1997:Q2		1998Q3-2004:Q3	
	ΔNFA_t^*	ΔNDA_t^*	ΔNFA_t^*	ΔNDA_t^*	ΔNFA_t^*	ΔNDA_t^*	ΔNFA_t^*	ΔNDA_t^*
Intercept	0.013	0.017	**0.089***	0.037	0.023	0.026	0.055	0.001
	(0.019)	(0.019)	(0.049)	(0.063)	(0.016)	(0.018)	(0.052)	(0.061)
ΔNDA_t^*	**-1.022*****	-	**-0.616*****	-	**-0.930*****	-	**-0.358***	-
	(0.094)		(0.126)		(0.109)		(0.174)	
ΔNFA_t^*	-	**-0.966*****	-	**-1.223*****	-	**-1.046*****	-	**-0.958*****
		(0.092)		(0.210)		(0.124)		(0.326)
Δp_{t-1}	**-1.591****	**-1.711****	-2.715	0.521	**-1.254***	**-1.447***	-2.099	1.889
	(0.748)	(0.805)	(2.567)	(2.979)	(0.653)	(0.751)	(2.646)	(2.951)
$Y_{c,t-1}$	**3.066****	**3.147****	-2.417	-1.951	**2.546****	**2.770****	-2.332	-0.850
	(1.272)	(1.353)	(1.908)	(2.455)	(1.081)	(1.213)	(1.971)	(2.532)
ΔG_t	0.366	0.348	-0.140	-0.198	0.471	0.475	0.079	-0.249
	(0.280)	(0.283)	(0.613)	(0.651)	(0.275)	(0.315)	(0.633)	(0.688)
$\Delta(r_t^* + E_t S_{t+1})$	0.407	0.336	**-1.061****	**-1.110***	-0.320	-0.293	**-1.819****	0.537
	(0.484)	(0.466)	(0.478)	(0.625)	(0.404)	(0.450)	(0.794)	(1.122)
CA_t	**0.739***	0.591	-0.454	-0.052	0.425	0.402	0.810	-0.183
	(0.394)	(0.360)	(0.592)	(0.679)	(0.254)	(0.264)	(0.776)	(1.008)
$(d_2-1)\sigma_{s,t-1}$	-0.027	-	0.039	-	-0.011	-	0.058	-
	(0.029)		(0.040)		(0.026)		(0.042)	
$(d_1-1)\sigma_{r,t-1}$	-	0.005	-	**-0.213***	-	0.002	-	**-0.219***
		(0.008)		(0.103)		(0.008)		(0.109)
Q1	-0.016	-0.011	-0.052	-0.015	-0.006	-0.005	-0.023	-0.002
	(0.017)	(0.016)	(0.065)	(0.070)	(0.014)	(0.014)	(0.068)	(0.072)
Q2	0.006	0.016	-0.062	-0.022	0.004	0.010	-0.063	0.018
	(0.026)	(0.025)	(0.066)	(0.083)	(0.024)	(0.024)	(0.068)	(0.086)
Q3	-0.033	-0.029	-0.002	0.028	-0.034	-0.033	-0.012	0.056
	(0.0240	(0.024)	(0.040)	(0.047)	(0.022)	(0.025)	(0.042)	(0.048)
R-square	0.912	0.919	0.777	0.775	0.926	0.920	0.762	0.763
Adj. R-square	0.860	0.872	0.646	0.642	0.882	0.872	0.622	0.624

4.3.8 Thailand

(1) The Evolution of Balance of Payments in Thailand

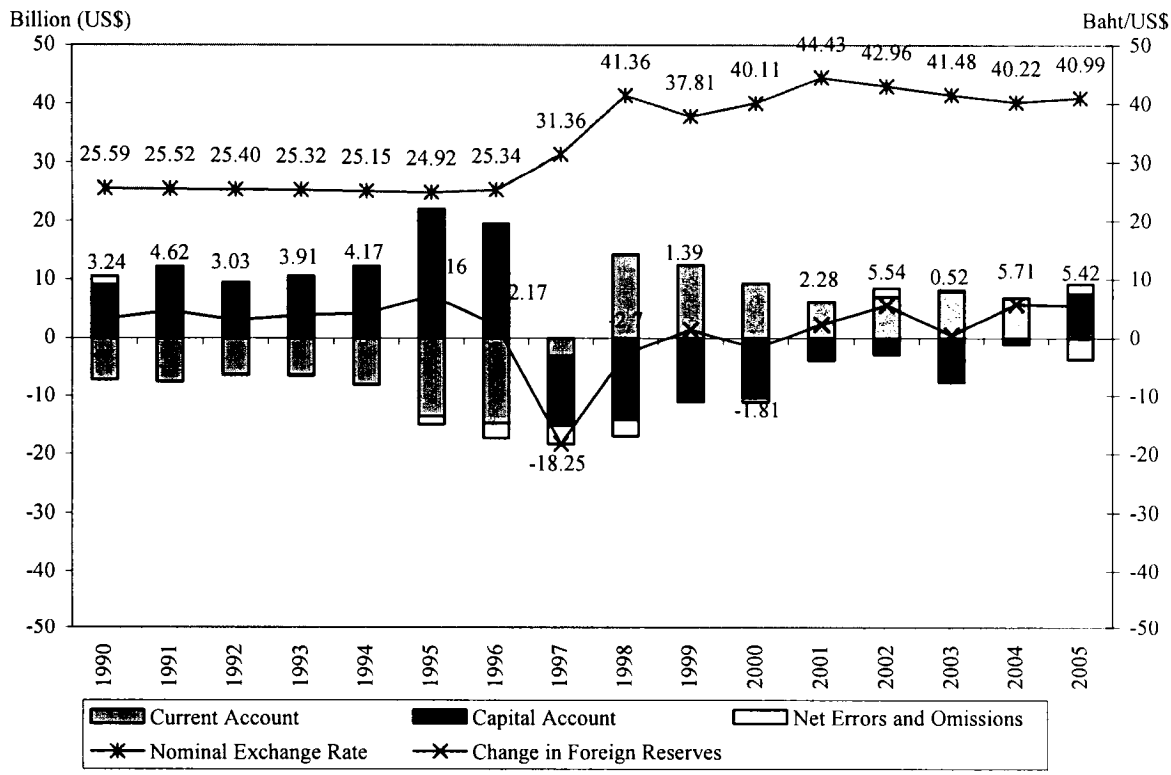
Thailand's monetary policy can be classified into three periods. The first period is from the Second World War to June 1997. During this period, the Bank of Thailand (BOT) adopted a pegged exchange rate regime, and pegged Thai Baht to a basket of currencies since November 1984. Due to the fixed exchange rate and balance of payments surplus, Thailand accumulated its foreign reserves rapidly from US$13.31 billion in early 1990s to US$37.73 right before the currency crises occurred in 1997 (Figure 4-3-8a). The BOPs surplus was mainly contributed by the capital account surplus, while the current account consistently remained in deficit during this period. Moreover, the surplus in the other investments dominant the capital account since a large amount of short-term debts borrowed by the financial institutions in Thailand.

After the currency crises occurred in 1997, the BOT began to float its exchange rate and depreciated it from B 25.34 per US dollar in 1996 to B 41.36 per US dollar in 1998. Due to the sharp depreciation, a large amount of capital escaped out of the country, and turned capital account into deficit in 1997. Most of the capital outflows were from the private sector, especially from the bank sectors which had substantial external debt repayments from both international banking facilities (IBF) and commercial banks. Although the current account deficit shrunk due to the depreciation, it did not turn into surplus until 1998. Both current account and capital account deficit made Thailand have a deficit of US$18.25 billion in 1997. After the currency crises, the BOT received financial assistance from the International Monetary Fund (IMF), and adopted monetary targeting

regime. Under this new regime, the BOT set the daily and quarterly monetary base targets, and made sure that its daily liquidity can reach its targets.

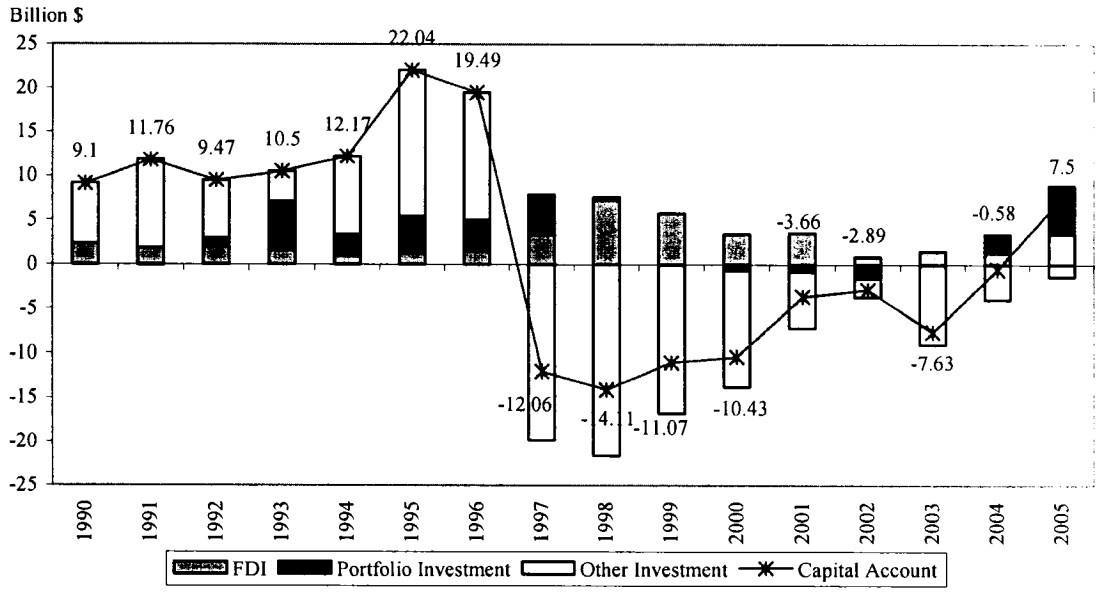
After the IMF program, the BOT changed its monetary policy and adjusted it to inflation targeting regime. This new regime was adopted in May 2000. During this period, the capital account has remained in deficit after the crises, and did not turn into surplus until 2005. The capital account surplus was mainly contributed by the surplus in both FDI and portfolio investments (Figure 4-3-8b). But the current account moved exactly the opposite way. Since the exchange rate depreciated, the current account has turned into surplus and did not become deficit until 2005. During this period, the BOPs has gradually increased and reached US$64.7 billion in December, 2006.

Figure 4-3-8a: Trends in Thailand's Balance of Payments Transactions



Source: IFS and Bank of Thailand Official Website

Figure 4-3-8b: Capital Account Components in Thailand



Source: IFS and Bank of Thailand Official Website

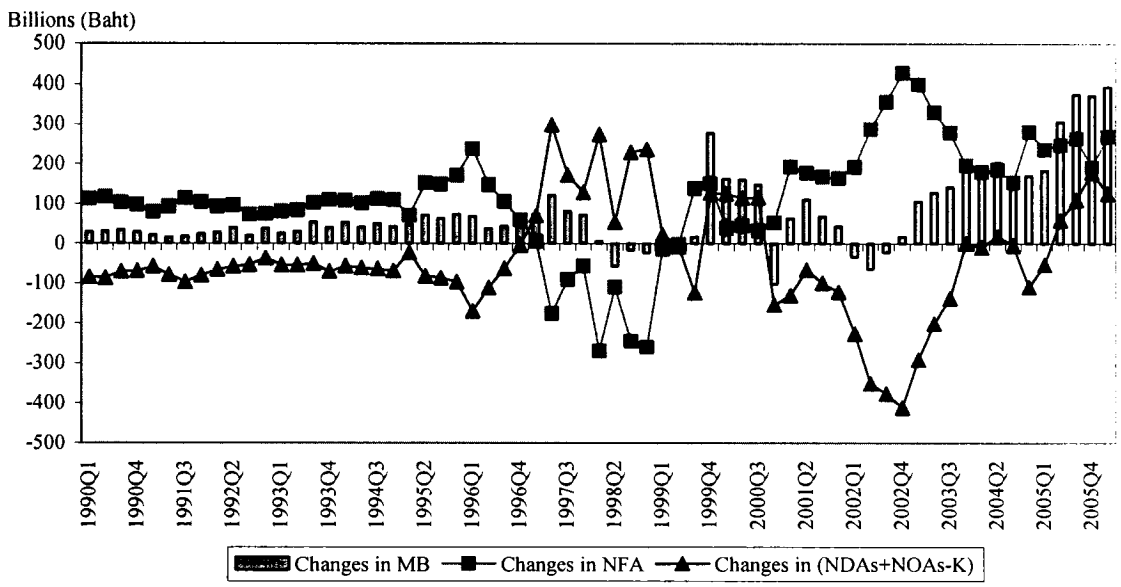
(2) Monetary Sterilization Policies in Thailand

As mentioned, the BOT has adopted three different monetary policies since 1990s. To achieve the policy target, the BOT frequently uses open market operations, reserve requirement ratio, and liquidity windows to adjust domestic liquidity. The changes in monetary base as well as the change in its domestic and foreign components in Figure 4-3-8c and Figure 4-3-8d shows that the monetary base grew steadily before the crises, while the inflation was under control and fluctuated around 2 to 6 percent (Figure 4-3-8e). However, the sharp depreciation during the currency crises made the inflation substantially increased to almost 10 percent in the third quarter of 1998. The high inflation did not last long. The appreciation of the Thai Baht in 1999, the reduction of the value added tax rate from 10% to 7%, and the decline of oil price in the world market

help the BOT to reduce an inflation rate. The price level even became negative during the mid-1999.

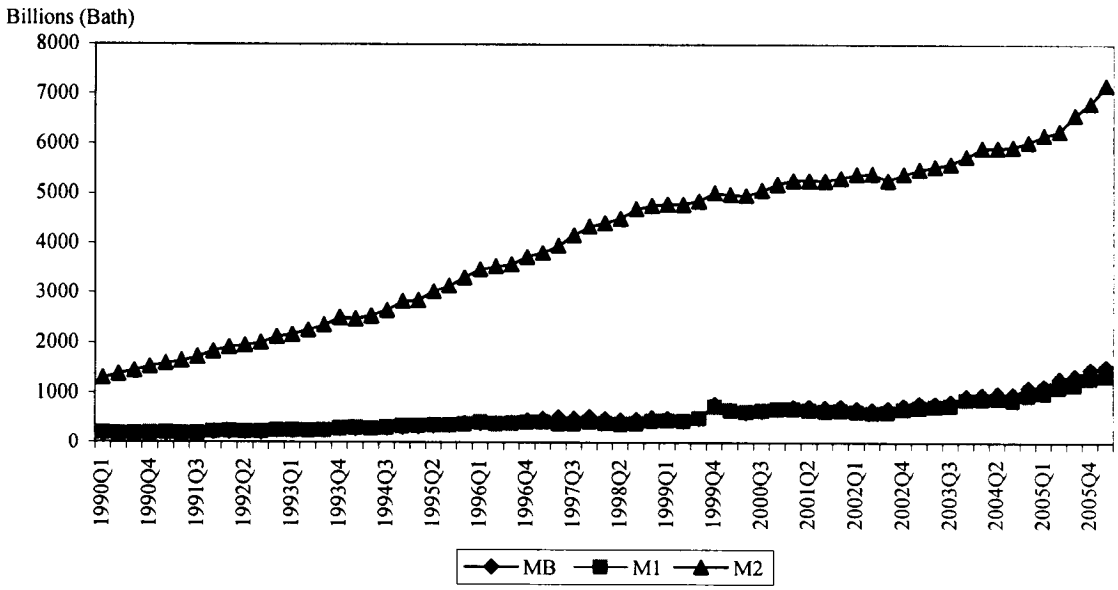
Since May 2000, the BOT has adopted the inflation targeting regime because the targeting of inflation is considered to be more effective than the targeting of money supply. To stimulate domestic economy and escape from the deflation, the BOT adjusted the reserve requirement and other sterilization instruments to expand domestic liquidity so that the inflation has gradually increased and reached to around 6% in early 2006. From Figure 4-3-8d, we can easily see that the change in monetary base has largely increased since 2003. The most frequently used monetary instruments are introduced below.

Figure 4-3-8c: Quarterly Annual Change in NFAs, NDAs, and Reserve Money in Thailand, 1990: Q1 – 2006: Q1



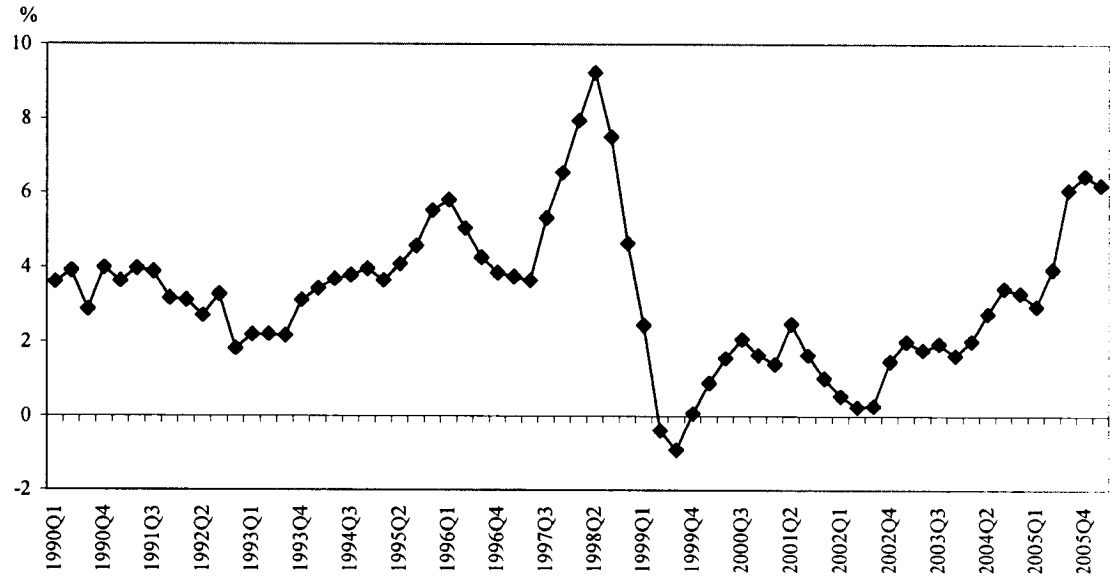
Source: IFS

Figure 4-3-8d: Reserve Money, M1, and M2 in Thailand, 1990: Q1 – 2006: Q1



Source: IFS

Figure 4-3-8e: Inflation (CPI % Change) in Thailand, 1990: Q1 – 2006: Q1



Source: IFS

a. Reserve Requirements

The BOT has been using the reserve requirement to adjust domestic liquidity. For example, to stimulate the economy after the currency crises in 1999, the BOT adopted an expansionary monetary policy by reducing the reserve requirement from not less than 2% to 1% of deposit and short-term foreign borrowing. But so far, the current reserve requirements ratio has increased to 6% of the reserve assets, including a minimum (1%) non-remunerated deposits at the BOT, a vault cash (up to 2.5%) and eligible public securities (as residual).

b. Open Market Operations (OMOs)

The BOT has mainly adopted four types of OMOs. The first type is the repurchase operations (RPs). The BOT has conducted RPs through the BOT-operated repurchase market since 1979. There are 60 repurchase members in the market, including commercial banks, financial institutions, and securities companies. The transaction matching is served on a first-come first serve basis, and the eligible securities include secured public debt securities (including government bonds, treasury bills, FIDF bonds, and government-guaranteed state enterprises bonds) and the BOT bonds. Among the participants, the Financial Institution Development Fund (FIDF) is one of the major players in the RP market and has become a main borrower to finance losses from its operations after the currency crises.

But to develop private repurchase market, the BOT has begun to conduct the "Bilateral Repurchase" operation since Dec. 2000, in parallel with the operation in the BOT-operated RP market. The BOT has gradually increased the frequency and the amount of the bilateral repurchase operations in recent years, and has regularly conducted bilateral repurchase operations twice a week since June 2004. The eventual purpose is to let the bilateral repurchase operations replace the BOT-operated RP market.

The second type of OMOs is to do outright purchase/sale of government securities. The BOT can buy and sell all types of secured public debt securities with Outright Primary Dealers. But the most used securities are government bonds since it is most liquid. In addition, the BOT began to issue the BOT bonds in early 2003 to expand the available instruments. The eligible bidders include commercial banks, Government Pension fund, and most of the financial institutions. Finally, the BOT also conducts foreign exchange swaps quite frequently when domestic securities are scare. The only difference between the FX swap and the repurchase agreement is that the BOT exchange the Thai baht for foreign currency rather than domestic securities in the former transaction.

c. Lending Policy

Similar to Korea, the BOT also provides an overnight credit facility, called the "End-of-Day Liquidity Window", to the financial institutions with insufficient liquidity. The purpose of setting this credit facility is to build a mechanism to stabilize money market even though actual borrowings through these windows are fairly limited. The

End-of-Day-Liquidity Window rate is equal to the policy rate plus an adjustable margin. The BOT can adjust money market by setting an upper ceiling on overnight market rates.

d. Capital Controls

Capital controls have been applied to restrict irregular speculation movement in Thailand, particular during the 1997 currency crises. A series of capital control measures were conducted to limit capital inflows. For example, in 1997, the BOT temporary limited outright forward transactions in baht with nonresidents, while the exchange rate was allowed to float freely, and a two-tier currency market was introduced. In addition, the BOT only allowed each financial institution to fund at most B50 million per counterparty in 1998.

The capital controls were eased up after the crises, and did not rise until December 2006. Due to the irregular Thai appreciation caused by the speculative capital inflows at late 2006[60], the BOT suddenly imposed a 30 percent reserve on short-term foreign capital inflows, and caused the key Stock Exchange of Thailand (SET) composite index dropped by 14.84%, the biggest decrease in a single trading day in Thailand's 31-year history. The BOT immediately adjusted its policy and excluded equities investment from the requirement at the next day.

[60] According to the BOT, there were short-term inflows of US$300 million per week in November, had tripled to $950 million per week in early December.

(3) The Empirical Results for Thailand

Thailand's empirical results are reported in Table 4-3-8a and Table 4-3-8b. The estimated offset coefficient pre-crisis is around 0.94 to 1, suggesting very high capital mobility, while the estimated sterilization coefficient is around 0.9 to 1, suggesting the Bank of Thailand (BOT) undertook fairly aggressive sterilization operations. During the post-crisis period, the estimated offset coefficient decreased slightly to 0.8 from 1 with the assumption of perfect foresight, but remained constant with the assumption of static expectations. But when the current account variable is used in the model, both estimated offset and sterilization coefficients decline marginally under both assumptions of expectations after the crisis.[61] The results suggest that the de factor capital mobility in Thailand has dropped slightly post-crisis, while the BOT adopts a moderate extent of sterilization policy.

The estimated coefficients for the change in the money multiplier are consistently significant in all functions both pre and post-crisis with a negative sign. The lagged inflation term is the inconsistent sign throughout but only statistically significant in the monetary reaction function post-crisis with positive sign. The lagged output, the government expenditure variables, and the lagged change in the REER are all statistically insignificant with inconsistent sign. The exchange rate adjusted interest rate has inconsistent signs. With perfect foresight, the variable is the wrong sign (positive) pre-crisis and only significant in the monetary reaction function, but it turns to the right sign

[61] Using monthly data for the period 1990:m1 and 1999:m8, Hataiseree and Musigchai (2000) find Thailand's sterilization coefficient to be about 0.55. In addition they find that the capital mobility parameter -- measured using the Edwards and Khan (1985) framework -- to be around 0.7 - 0.8 for the period 1991:m1 and 1999:m1.

(negative) post-crisis and only significant in the balance of payments function. With static expectations, the exchange rate adjusted interest rate has wrong sign pre and post-crisis, but only significant in the monetary reaction function post-crisis. The exchange rate volatility variable is positive in both periods but only statistically significant in the second sub-period. The interest rate volatility variable term is statistically insignificant in both periods. In addition, the change in money multiplier variable has significant effect on monetary response function. After dropping it from both estimating functions, the estimated sterilization coefficients in the post-crises period declined substantially from $0.6 \sim 0.8$ to zero.

To sum up, Thailand has fairly high degree of capital mobility in the pre-crises period. Even hit by the currency crises in 1997, the degree of capital mobility during the post-crises period still kept around 0.8, while its extent sterilization has substantially declined from over 90 percent pre-crises to around 60 percent post-crises. It is because that Thailand has adopted expansionary monetary policy and loosened its sterilization policy to stimulate the economy growth and low inflation since 2002.

Table 4-3-8a: Thailand - Estimated Simultaneous Equations, 1990:Q1-1997:Q2 and 1998Q3-2004:Q3

Thailand: 2SLS	Perfect Foresight				Static expectations			
	1990:Q1-1997:Q2		1998Q3-2004:Q3		1990:Q1-1997:Q2		1998Q3-2004:Q3	
	ΔNFA_t^*	ΔNDA_t^*	ΔNFA_t^*	ΔNDA_t^*	ΔNFA_t^*	ΔNDA_t^*	ΔNFA_t^*	ΔNDA_t^*
Intercept	**0.014****	**0.013****	0.020	-0.018	**0.013****	0.009	0.007	-0.007
	(0.005)	(0.005)	(0.017)	(0.019)	(0.005)	(0.005)	(0.022)	(0.016)
ΔNDA_t^*	**-1.059*****	-	**-0.800*****	-	**-0.999*****	-	**-1.081****	-
	(0.076)		(0.219)		(0.040)		(0.426)	
ΔNFA_t^*	-	**-0.900*****	-	**-0.599*****	-	**-0.982*****	-	**-0.368****
		(0.062)		(0.193)		(0.052)		(0.155)
Δmm_t	**-0.324*****	**-0.306*****	**-0.363****	**-0.571*****	**-0.322*****	**-0.343*****	**-0.549****	**-0.560*****
	(0.051)	(0.043)	(0.158)	(0.084)	(0.049)	(0.046)	(0.259)	(0.071)
Δp_{t-1}	-0.205	-0.283	-1.020	**3.048***	-0.144	-0.072	1.205	**3.319****
	(0.248)	(0.239)	(1.571)	(1.553)	(0.224)	(0.241)	(2.485)	(1.168)
$Y_{c,t-1}$	-0.084	-0.016	0.160	-0.948	-0.152	-0.099	-0.034	-0.892
	(0.118)	(0.104)	(0.722)	(0.675)	(0.111)	(0.115)	(1.052)	(0.564)
ΔG_t	0.016	0.028	0.280	0.102	-0.046	-0.039	0.347	0.139
	(0.091)	(0.085)	(0.285)	(0.337)	(0.076)	(0.087)	(0.382)	(0.280)
$\Delta(r_t^* + E_t S_{t+1})$	0.096	**0.149****	**-0.946*****	-0.387	0.234	0.249	0.314	**0.642****
	(0.080)	(0.063)	(0.261)	(0.327)	(0.168)	(0.187)	(0.468)	(0.246)
$\Delta REER_{t-1}$	0.001	0.001	-0.004	-0.003	0.001	0.001	0.002	0.002
	(0.001)	(0.001)	(0.003)	(0.003)	(0.001)	(0.001)	(0.004)	(0.003)
$(d_2 - 1)\sigma_{s,t-1}$	0.012	-	**0.033***	-	0.029	-	0.030	-
	(0.022)		(0.019)		(0.019)		(0.025)	
$(d_1 - 1)\sigma_{r,t-1}$	-	0.001	-	0.027	-	-0.001	-	0.002
		(0.001)		(0.019)		(0.002)		(0.019)
Q1	-0.003	-0.006	0.028	0.012	0.002	0.005	0.003	-0.021
	(0.005)	(0.005)	(0.021)	(0.021)	(0.004)	(0.005)	(0.034)	(0.019)
Q2	-0.002	-0.004	-0.027	**-0.051***	0.002	0.005	-0.047	**-0.075****
	(0.006)	(0.006)	(0.033)	(0.028)	(0.005)	(0.006)	(0.054)	(0.026)
Q3	0.006	0.004	0.016	-0.015	0.009	0.010	0.028	-0.026
	(0.006)	(0.006)	(0.035)	(0.032)	(0.006)	(0.007)	(0.048)	(0.028)
R-square	0.986	0.992	0.732	0.845	0.987	0.991	0.529	0.891
Adj. R-square	0.976	0.987	0.559	0.744	0.978	0.984	0.224	0.820

Table 4-3-8b: Thailand - Robustness Check, Replace $\Delta REER_{t-1}$ with CA_t

Thailand: 2SLS	Perfect Foresight				Static expectations			
	1990:Q1-1997:Q2		1998Q3-2004:Q3		1990:Q1-1997:Q2		1998Q3-2004:Q3	
	ΔNFA_t^*	ΔNDA_t^*	ΔNFA_t^*	ΔNDA_t^*	ΔNFA_t^*	ΔNDA_t^*	ΔNFA_t^*	ΔNDA_t^*
Intercept	0.011	**0.015***	-0.003	-0.020	0.009	0.009	-0.013	-0.014
	(0.007)	(0.008)	(0.018)	(0.019)	(0.007)	(0.009)	(0.021)	(0.016)
ΔNDA_t^*	**-0.989*****	-	**-0.698*****	-	**-0.945*****	-	**-0.925****	-
	(0.087)		(0.211)		(0.043)		(0.384)	
ΔNFA_t^*	-	**-0.913*****	-	**-0.701****	-	**-1.048*****	-	**-0.366****
		(0.070)		(0.244)		(0.065)		(0.170)
Δmm_t	**-0.303*****	**-0.288*****	**-0.444*****	**-0.632*****	**-0.292*****	**-0.323*****	**-0.566****	**-0.563*****
	(0.053)	(0.051)	(0.146)	(0.096)	(0.055)	(0.054)	(0.217)	(0.081)
Δp_{t-1}	-0.041	-0.173	-0.824	2.099	-0.054	-0.006	1.334	**3.735*****
	(0.250)	(0.253)	(1.520)	(1.679)	(0.237)	(0.257)	(2.251)	(1.139)
$Y_{c,t-1}$	-0.108	0.031	**1.697***	0.147	-0.175	-0.068	1.575	-0.788
	(0.159)	(0.132)	(0.868)	(1.077)	(0.145)	(0.150)	(1.205)	(0.866)
ΔG_t	-0.027	0.007	0.232	0.182	-0.039	-0.056	0.301	0.083
	(0.097)	(0.091)	(0.267)	(0.344)	(0.083)	(0.095)	(0.331)	(0.278)
$\Delta(r_t^* + E_t S_{t+1})$	0.033	**0.142***	**-0.664****	-0.365	0.140	0.109	0.248	**0.594****
	(0.092)	(0.071)	(0.230)	(0.327)	(0.181)	(0.209)	(0.405)	(0.227)
CA_t	-0.022	0.040	**0.537****	0.299	-0.057	-0.012	**0.660****	0.117
	(0.081)	(0.071)	(0.237)	(0.293)	(0.076)	(0.081)	(0.291)	(0.242)
$(d_2 - 1)\sigma_{s,t-1}$	0.017	-	0.017	-	0.026	-	0.022	-
	(0.028)		(0.018)		(0.023)		(0.022)	
$(d_1 - 1)\sigma_{r,t-1}$	-	0.001	-	0.016	-	0.0001	-	0.009
		(0.002)		(0.018)		(0.002)		(0.014)
Q1	0.001	-0.005	0.031	0.017	0.002	0.004	0.016	-0.017
	(0.005)	(0.006)	(0.020)	(0.023)	(0.004)	(0.005)	(0.030)	(0.020)
Q2	0.001	-0.002	-0.002	-0.040	0.002	0.004	-0.020	**-0.071****
	(0.006)	(0.006)	(0.032)	(0.031)	(0.006)	(0.007)	(0.050)	(0.028)
Q3	0.008	0.005	0.028	-0.007	0.008	0.009	0.029	-0.026
	(0.007)	(0.007)	(0.032)	(0.033)	(0.007)	(0.007)	(0.042)	(0.029)
R-square	0.984	0.990	0.772	0.844	0.984	0.988	0.651	0.889
Adj. R-square	0.972	0.983	0.616	0.736	0.973	0.979	0.411	0.813

Table 4-3-8c: Thailand - Robustness Check, Without Δmm_t

Thailand: 2SLS	Perfect Foresight				Static expectations			
	1990:Q1-1997:Q2		1998Q3-2004:Q3		1990:Q1-1997:Q2		1998Q3-2004:Q3	
	ΔNFA_t^*	ΔNDA_t^*	ΔNFA_t^*	ΔNDA_t^*	ΔNFA_t^*	ΔNDA_t^*	ΔNFA_t^*	ΔNDA_t^*
Intercept	**0.021****	**0.022****	0.027	**-0.071***	**0.022****	**0.025***	0.014	-0.037
	(0.009)	(0.009)	(0.019)	(0.034)	(0.009)	(0.012)	(0.024)	(0.034)
ΔNDA_t^*	**-0.745*****	-	**-0.612***	-	**-0.805*****	-	**-0.195**	-
	(0.143)		(0.294)		(0.068)		(0.511)	
ΔNFA_t^*	-	**-0.993*****	-	-0.072	-	**-1.269*****	-	**0.154**
		(0.157)		(0.396)		(0.146)		(0.371)
Δp_{t-1}	-0.048	-0.452	**-2.757***	**5.843***	-0.169	-0.218	-2.545	**4.820***
	(0.481)	(0.496)	(1.542)	(2.992)	(0.444)	(0.582)	(2.184)	(2.552)
$Y_{c,t-1}$	-0.158	0.069	0.728	-1.465	-0.112	0.041	1.138	-1.282
	(0.228)	(0.214)	(0.769)	(1.301)	(0.221)	(0.278)	(1.024)	(1.244)
ΔG_t	0.113	**0.301***	0.055	-0.760	0.190	0.208	0.301	-0.579
	(0.171)	(0.153)	(0.310)	(0.613)	(0.133)	(0.188)	(0.452)	(0.585)
$\Delta(r_t^* + E_t S_{t+1})$	-0.116	0.192	**-1.047*****	0.146	0.013	-0.073	-0.408	**1.019***
	(0.159)	(0.141)	(0.291)	(0.648)	(0.332)	(0.467)	(0.540)	(0.552)
$\Delta REER_{t-1}$	-0.0001	-0.0001	-0.006	-0.007	-0.0003	-0.001	-0.0005	-0.001
	(0.002)	(0.002)	(0.004)	(0.006)	(0.002)	(0.002)	(0.004)	(0.006)
$(d_2 - 1)\sigma_{s,t-1}$	0.052	-	**0.057****	-	0.030	-	0.036	-
	(0.041)		(0.027)		(0.038)		(0.038)	
$(d_1 - 1)\sigma_{r,t-1}$	-	0.001	-	**0.076****	-	0.002	-	0.024
		(0.003)		(0.033)		(0.004)		(0.041)
Q1	0.002	-0.012	0.032	-0.0002	-0.002	-0.003	0.036	-0.040
	(0.010)	(0.011)	(0.024)	(0.041)	(0.007)	(0.011)	(0.038)	(0.043)
Q2	-0.006	-0.016	0.009	-0.001	-0.010	-0.013	0.038	-0.046
	(0.011)	(0.012)	(0.032)	(0.052)	(0.010)	(0.014)	(0.047)	(0.056)
Q3	0.007	0.002	**0.069***	0.079	0.004	0.003	**0.085***	0.038
	(0.012)	(0.013)	(0.035)	(0.054)	(0.012)	(0.016)	(0.047)	(0.058)
R-square	0.946	0.964	0.636	0.392	0.947	0.941	0.375	0.439
Adj. R-square	0.913	0.942	0.433	0.055	0.913	0.904	0.028	0.127

Table 4-3-8d: Thailand - Robustness Check, Without Δmm_t, Replace $\Delta REER_{t-1}$ with CA_t

Thailand: 2SLS	Perfect Foresight				Static expectations			
	1990:Q1-1997:Q2		1998Q3-2004:Q3		1990:Q1-1997:Q2		1998Q3-2004:Q3	
	ΔNFA_t^*	ΔNDA_t^*	ΔNFA_t^*	ΔNDA_t^*	ΔNFA_t^*	ΔNDA_t^*	ΔNFA_t^*	ΔNDA_t^*
Intercept	0.020	**0.036*** **	0.009	-0.043	**0.024** **	**0.039** **	0.003	-0.018
	(0.013)	(0.012)	(0.022)	(0.036)	(0.011)	(0.017)	(0.028)	(0.032)
ΔNDA_t^*	**-0.716*** **	-	**-0.462***	-	**-0.807*** **	-	-0.731	-
	(0.175)		(0.255)		(0.065)		(0.516)	
ΔNFA_t^*	-	**-0.918*** **	-	-0.064	-	**-1.276*** **	-	**0.004**
		(0.144)		(0.418)		(0.134)		**(0.319)**
Δp_{t-1}	-0.019	-0.474	-2.806	4.450	-0.138	-0.190	-1.212	**4.681***
	(0.456)	(0.422)	(1.690)	(3.059)	(0.420)	(0.530)	(2.384)	(2.224)
$Y_{c,t-1}$	-0.186	0.246	**2.117***	-2.372	-0.062	0.216	2.045	-2.555
	(0.296)	(0.215)	(1.068)	(1.878)	(0.254)	(0.299)	(1.534)	(1.622)
ΔG_t	0.088	**0.246***	-0.037	-0.543	0.179	0.142	-0.006	-0.434
	(0.172)	(0.137)	(0.316)	(0.608)	(0.128)	(0.182)	(0.433)	(0.528)
$\Delta(r_t^* + E_t S_{t+1})$	-0.148	**0.248***	**-0.729** **	0.102	-0.074	-0.277	0.113	**0.906***
	(0.188)	(0.129)	(0.286)	(0.595)	(0.314)	(0.430)	(0.538)	(0.437)
CA_t	-0.015	0.190	0.346	-0.613	0.039	0.179	0.359	-0.596
	(0.150)	(0.111)	(0.309)	(0.480)	(0.130)	(0.156)	(0.437)	(0.426)
$(d_2-1)\sigma_{s,t-1}$	0.057	-	**0.045***	-	0.023	-	**0.068***	-
	(0.052)		(0.024)		(0.041)		(0.037)	
$(d_1-1)\sigma_{r,t-1}$	-	0.003	-	**0.057***	-	0.004	-	0.025
		(0.003)		(0.031)		(0.004)		(0.028)
Q1	0.003	-0.017	0.029	-0.012	-0.002	-0.007	0.015	-0.043
	(0.010)	(0.010)	(0.025)	(0.042)	(0.007)	(0.011)	(0.041)	(0.039)
Q2	-0.004	-0.016	0.040	-0.018	-0.008	-0.014	0.034	-0.059
	(0.011)	(0.010)	(0.035)	(0.057)	(0.010)	(0.014)	(0.053)	(0.055)
Q3	0.008	0.001	**0.097*** **	0.073	0.004	0.002	**0.124*** **	0.038
	(0.012)	(0.011)	(0.032)	(0.058)	(0.012)	(0.016)	(0.042)	(0.056)
R-square	0.944	0.969	0.625	0.421	0.946	0.944	0.391	0.544
Adj. R-square	0.911	0.951	0.405	0.081	0.915	0.911	0.032	0.276

Chapter 5: China as a Reserve Sink

5.1 Introduction

China has become the world's largest foreign exchange reserve holder, having amassed over US$ 800 billion of international reserves by early 2006 (Figure 5-1).[62] The rapid accumulation of reserves has generated several controversies. One concern is whether this continuing balance of payments surplus signals the need for a substantial revaluation or appreciation of the Chinese Yuan (CNY) to protect China both from the inflationary consequences of the liquidity buildup and a misallocation of resources[63] as well as to help ease global economic imbalances. An alternative view, particularly associated with McKinnon and Schnabl (2003a,b, 2004), argues that a fixed exchange rate is an optimal policy for China and the larger Asian region both on the grounds of macroeconomic stability and rapid economic development. The global monetarist approach of McKinnon is based on the assumption of little or no sterilization of reserve accumulations, so that any payments imbalance is temporary. However, many other commentators have suggested that the Chinese government's concern with inflation has led the People's Bank of China (PBC) to heavily sterilize these reserve inflows.

Contrary to the wide spread concerns among many economists about the huge size of current global economic imbalance, Dooley et al. (2004) famously argued that mainstream economists have failed to recognize that we are now in a new informal

[62] China overtook Japan to become the world's largest reserve holder in February 2006. The other top reserve holders in the world at this time are also Asian – Taiwan, Korea, India, Singapore and Hong Kong – with each country holding over US$ 100 billion in reserves.

[63] Rodrik (2006) discusses the issue of opportunity costs of stockpiling reserves. The World Bank (2005) and Mohanty and Turner (2005) discuss the quasi fiscal costs of sterilization and capital losses on reserve assets arising from exchange rate fluctuations. We return to the issue of fiscal costs of sterilization specifically for China in the concluding section.

version of the Bretton Woods system (BW2) and the global economy is therefore not in genuine disequilibrium. While there are clearly important analogies between the current international monetary system and Bretton Woods (BW1), the question is still open to whether we are currently closer to the early or late days of BW1. In the later days of BW1 much attention was given to the concept of countries as *reserve sinks* into which reserves flowed. Instead of stimulating adjustments, as assumed in global monetarist models, the reserves effectively disappear from the system (down the sink) and hence contributed to continuing disequilibrium. Germany was seen as the prototype of the reserves sink during the BW1 days. Today China appears to be playing that role. Thus investigating how China has reacted to its reserve increases is of international as well as national importance.[64]

An intermediate view is that while China has sterilized most of its past reserve increases, continuing to do so is becoming increasingly difficult for China as its reserves continue to rise and capital controls become more porous (Prasad, 2005, Prasad and Wei, 2005, and Xie, 2006). One of the reasons why there is so much disagreement is because, as Goodfriend and Prasad (2006) have noted, "(t)he fraction of reserves sterilized by the central bank has varied over the last few years and it is not straightforward to assess exactly how much sterilization has taken place."

This chapter estimates the degree of recent sterilization in China, as well as the degree of capital mobility as measured by offset coefficients, i.e. the fraction of an autonomous change in the domestic monetary base that is offset by international capital flows.[65] In one sense, the level of sterilization can be observed from the degree to which

[64] See Willett (1980) for references to this literature.
[65] After this paper was initiated, two other studies on sterilization in China by Burdekin and Siklos (2005)

the central bank takes action to offset the effects of increases in international reserves on the domestic base or other monetary aggregates. However, this can offer a misleading picture of the effectiveness of sterilization since if the central bank wants the base to increase anyway, then it would decide not to neutralize the reserve increases; this would not imply that it had lost control of the domestic monetary process. China's large balance of payments surplus in 2003 was accompanied by rapid domestic money and credit expansion which is consistent with an inability to effectively sterilize. It appears, however, that the primary cause of the rapid expansion of money and credit was Chinese government's concern with maintaining rapid economic growth, not the inability of the PBC to control the domestic monetary base.[66] Thus, the PBC did not try to fully neutralize the domestic monetary effects of the reserve increases under government direction.

I also make use of recursive estimation to investigate changes in offset coefficients and sterilization over time. While I find no evidence of the inability of the government to sterilize a high proportion of reserve accumulations, I do find substantial increases over time in our estimates of the offset coefficients, suggesting that sterilization is becoming increasingly difficult.

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and He et al. (2005) became available. While using a different methodology, they reach broadly similar conclusions. These studies are considered in FN 41.

[66] Lardy (2005) argues that the money expansion in 2003 was the government's mistaken overreaction to the potential adverse effect of severe acute respiratory syndrome (SARS) on economic growth.

5.2 Reserve Growth and Sterilization Policy Measures in China

5.2.1 Evolution of China's Balance of Payments[67]

Our empirical analysis begins with 1999 since relevant monthly data are not available for earlier years. China's large reserve accumulation began in earnest in 2001 (Figure 5-2). China has experienced large and growing surpluses on both the capital and current accounts since 2001, while even the errors and omissions balance (a broad proxy for capital flight by residents) turned positive. Thus, reserves increased markedly during this period. An interesting dynamic appears to have taken hold in China (as well as in many other Asian economies) during this period. Large reserves are viewed as a sign that the domestic currency will eventually appreciate. They also tend to be taken as an indication of "strong fundamentals," hence leading to an upgrading of the country's credit ratings. This expectation of future capital gains and lower risk perceptions motivated large-scale capital inflows and added to the country's stock of reserves as central banks have mopped up excess US dollars.

From Figure 5-3, it is apparent that the swelling of China's capital account surplus since 2003 was largely because of a surge in portfolio capital flows as well as "other investments" (i.e. short-term debt flows), most likely a reflection of mounting market expectations of an impending revaluation of the Chinese currency (i.e. speculation on the CNY as a one-way trade). As noted by Prasad and Wei (2005), "much of the recent increase in the pace of reserve accumulation is potentially related to 'hot money' rather than a rising trade surplus or capital flows such as FDI that are viewed as being driven

[67] The evolution of capital inflows to China throughout the 1990s is explored in more detail by Prasad and Wei (2005) and Prasad (2005). Also see He et al. (2005), and Ma and McCauley (2005).

by fundamentals" (p.8).[68] Goldstein and Lardy (2006) concludes, however, that even with hot money flows excluded, China faces a substantial payments disequilibrium.

The Chinese government finally loosened its strict US dollar peg and allowed for a small revaluation from 8.28 to 8.11 CNY per US dollar in July 21, 2005 and simultaneously announced that the currency would be pegged to a basket of currencies.[69] Interestingly, China has since experienced a sharp increase in its trade surplus relative to the capital account despite expectations of continued upward pressure on the CNY[70] (i.e. one logically would have expected to see an intensification of speculative inflows). On the one hand, the decline in the capital account surplus was partly policy-induced. The government has been promoting outward investments by Chinese corporates and domestic institutional investors and has loosened a number of restrictions on capital outflows to ease some appreciation pressures from huge reserves accumulation, while simultaneously tightening some restrictions on capital inflows such as imposing a quota in July 2004 on offshore borrowing by foreign banks operating in China. On the other hand, the sharp increase in the country's current account balance is somewhat harder to

[68] Three caveats should be noted. First of all, part of the change in reserves is also because of a valuation effect as a portion of reserves that was invested in non-US dollars (gold, euros, etc) has changed in US dollar terms (while most central banks including the PBC do not disclose the composition of assets in which reserves are being invested, it is generally suggested that a large part has been invested into dollar-denominated assets like Treasury securities). Prasad and Wei (2005) offer some "guess-timates" on the possible valuation effects. Secondly, there was a one-off fall in reserves in China in 2004. This was because since 2003 the government transferred US$ 60 billion to three state-owned banks, Bank of China (US$ 22.5 billion), China Construction Bank (US$ 22.5 billion), and Industrial and Commercial Bank of China (US$ 15 billion) to aid in their recapitalization (see Ma, 2006 for details). And lastly, while China has not yet become fully convertible on the capital account, a large number of so-called "qualified foreign investment institutions" or QFIIs received approval by the China Securities Regulatory Commission to increase their investments to China which in turn has fuelled large-scale portfolio capital inflows (see Hu, 2004 for details).

[69] The CNY has been on a very gradual appreciating path since July 2005. See Ogawa and Sakane (2005) for a discussion of the currency weights in China's basket.

[70] This expectation is apparent from examining the Non Deliverable Forward (NDF) market on the CNY.

rationalize.[71] It has been suggested by some observers that the current account surplus has been partly driven by over-invoicing of exports and under-invoicing of imports. As noted by one market commentator:

> The massive flip-over between the financial account and trade account... in 2005...raises the possibility that capital flow for...(CNY)..speculation masqueraded as a trade surplus last year due to improving capital account control. This is important in understanding the nature of China's BoP surplus. 2005 BoP data suggest that capital account flows accounted for one-third of the BoP surplus, while 2004 data suggest that this was three-quarters. If 2004 data are more accurate, the appreciating pressure appears to be mainly a speculative phenomenon (Xie, 2006).[72]

5.2.2 Sterilization Policy Measures in China

What are the monetary consequences of this huge reserve buildup in China? Figure 5-4 shows that, since December 2002, domestic high-powered money creation proxied by the growth in broadly defined net domestic assets (NDA)[73] has remained rather low if not negative. This helped moderate the increase in the domestic monetary base (MB) and overall money supply ($M2$) (Figure 5-5), suggesting that the PBC was actively neutralizing the impact of the reserves buildup using various policies and instruments. Two conventional sterilization policies frequently used by the PBC are open market operations (OMOs) and raising reserve requirements (He et al., 2005). In early 1998, the PBC used treasury bonds or securities as the sterilization tools. But since September 2002, the PBC has replaced all outstanding securities with central bank bills (CBCs) for use in the OMOs. Figure 6 reveals the sharp growth in PBC issuances in the

[71] Prasad and Wei (2005) and Liu and Otani (2005) detail the steps taken to deregulate China's capital account transactions.

[72] Also see Ma and McCauley (2005) who state that a large part of the overall current account surplus in China (40 percent) was also due to net income transfers. They further note that the Chinese government required banks to report "unusually large" (US$ 10000) remittance inflows and related dollar sales.

[73] Broadly defined net domestic assets (NDAs) equals monetary base (MB) minus net foreign assets (NFAs).

last five years. In addition, the PBC has begun to issue short-term repurchases ranging from 7 days to 182 days to do sterilization in these three years.[74]

Since 1998, the PBC has required state banks to hold greater levels of bank reserves to reduce the money multiplier. The PBC has also begun increasing the benchmark interest rate to curb liquidity growth. In addition, the PBC has undertaken a series of market-based interest rate reforms, such as broadening the floating band of financial institution lending rates at the beginning of 2004.[75] These monetary policy actions have been accompanied by administrative measures including window guidance to halt the nongovernment-approved construction loans and cool down specific sectors. Other measures, such as moral suasion and risk warnings, have also been conveyed to commercial banks to try to maintain "reasonable" credit growth and optimize resource allocation. The government also introduced measures to curb the rapid escalation of property prices in May 2006 (Ma, 2006).

5.3 Data and Model Specification

5.3.1 Data

Our estimations are based on monthly observations over the sample period from 1999: m6 to 2005: m9. All the data are from the *IMF-IFS* or *TEJ Great China* database[76] (except the three month CNY non-deliverable forward rate (NDF) which is from *Bloomberg*). Appendix 1 summarizes the definitions and sources of the various data used in the estimating equations. The relevant variables, such as the change in the "adjusted"

[74] He et al. (2005) outline some of the improvements/changes made by the PBC in its conduct of OMOs in 2003-2004.
[75] In addition, commercial banks have been allowed a greater degree of autonomy in deciding medium and long-term RMB loan interest rates.
[76] See http://www.tei.com.tw/greatdb/greatDB.html .

ΔNFA_t^*, ΔNDA_t^* and ΔG_t fiscal deficit are scaled by GDP.[77] To check for stationarity I applied the standard ADF unit root test to each of the variables and found all variables to be stationary at the 10 percent significant levels with the exception of the exchange rate adjusted foreign interest rates (see Table 5-1).[78,79]

I used the Hodrick-Prescott (HP) method to measure the trend of real output. I assume that economic agents have three different ways of forming their expectations about the exchange rate. If economic agents have perfect foresight then the difference between the actual nominal exchange rate at the next period and the current nominal exchange rate is the appropriate proxy for the expected exchange rate depreciation for the next period. If agents have static expectations then the exchange rate change at the current period is used as the proxy. Finally, the three month CNY NDF rate is also used as a proxy for the expected exchange rate for the next period.

5.3.2 Specification of the Simultaneous Equation Model

The theoretical model modified in Chapter 3 has been applied to the other selected Asian economies. However, the modified framework cannot be applied directly to China which maintained a fixed peg to the US dollar until July 2005. Nevertheless, the vector of controls I use in the simultaneous model is informed by the modified BGT model and from existing empirical work in this area (for instance, see Celasun et al., 1999,

[77] Three caveats should be noted. One, the manner of "adjustment" of the NFAs for revaluation effects is discussed in Section 4.2. Two, for the monthly data, the variables are scaled by "monthly GDP", which is measured by distributing quarterly GDP into corresponding three months weighted by the industrial production ratio. Three, we tried the regressions without scaling by GDP (since we are using first differences), but the coefficient on some variables, like the money multiplier, turned out to be far too large to make any economic sense.

[78] The ADF results were confirmed by the Kwiatkowski-Phillips-Schmidt-Shin (KPSS) test.

[79] Siklos (2000) pointed out a similar problem with the Hungarian-German interest rate differential and has argued that interest rates should not be difference stationary.

Fry, 1993, Kim, 1995, Nyatepe-Coo, 1995, Sarjito, 1996 and Rooskareni 1998). I specify a set of simultaneous equations as follows:

$$\Delta NFA_t^* = \alpha_0 + \sum_{i=0}^{n} \alpha_{1i} \Delta NDA_{t-i}^* + \sum_{i=0}^{n} \alpha_{2i} \Delta mm_{t-i} + \sum_{i=1}^{n} \alpha_{3i} \Delta p_{t-i} + \sum_{i=1}^{n} \alpha_{4i} y_{c,t-i} + \sum_{i=0}^{n} \alpha_{5i} \Delta REER_{t-i} + \sum_{i=0}^{n} \alpha_{6i} \Delta (r_{t-i}^* + E_t e_{t+1-i}) + \varepsilon_t \quad (5\text{-}1)$$

$$\Delta NDA_t^* = \beta_0 + \sum_{i=0}^{n} \beta_{1i} \Delta NFA_{t-i}^* + \sum_{i=0}^{n} \beta_{2i} \Delta mm_{t-i} + \sum_{i=1}^{n} \beta_{3i} \Delta p_{t-i} + \sum_{i=1}^{n} \beta_{4i} y_{c,t-i} + \sum_{i=0}^{n} \beta_{5i} \Delta G_{t-i} + \sum_{i=0}^{n} \beta_{6i} \Delta (r_{t-i}^* + E_t e_{t+1-i}) + v_t \quad (5\text{-}2)$$

5.4 Empirical Results and Robustness Checks

5.4.1 Empirical Results

I use two-stage least squares (2SLS) to estimate the simultaneous equations (5-1) and (5-2). I apply autocorrelation and heteroskedasticity tests to the residuals from the estimated equations [80] Newey-West heteroskedasticity and autocorrelation consistent (HAC) covariance estimates are used if there is a problem.[81] Table 5-2 summarizes the results of the estimating equations applying two-stage least squares on monthly data. I have three sets of estimations depending on whether I assume perfect foresight, static expectations, or forward-looking expectations. Forward-looking expectations are

[80] The serial correlation Lagrange multiplier (LM) test is used to check for the autocorrelation, while White's heteroskedasticity test is used to test the heteroskedasticity in the residuals.

[81] Newey and West (1987) have derived a consistent covariance matrix estimator in the presence of both heteroskedasticity and autocorrelation. Since we use the Newey-West HAC estimates we do not need to include lagged dependent terms as done by Brissimis, Gibson and Tsakalotos (2002) and others.

captured using the three-month forward rate (the one-month forward rate unfortunately being unavailable).

The estimated offset coefficients are around 0.63 to 0.70 and are statistically significant, indicating a substantial degree of capital mobility despite China's capital controls. The estimated sterilization coefficients are also highly statistically significantly different from zero, averaging in the range 0.92 to 0.97[82], suggesting that the PBC has heavily sterilized its reserve accumulations in the last six years. This explains how China has been able to maintain relatively low inflation (Figure 5-7) despite the surge of capital inflows. The money multiplier is statistically and economically significant across all the estimations with the correct sign. Cyclical output is statistically significant and positive in the case of the balance of payments function, which suggests that the income effect leading to a worsening of the current account may be outweighed by a direct impact that positive cyclical income has on attracting capital inflows. The positive coefficient in the monetary reaction function is harder to fathom and is statistically insignificant. With one exception (that being the balance of payments function using the forward rate) the exchange rate adjusted foreign interest rate coefficients have the correct sign though they are also statistically insignificant. In the case of the balance of payments function, the lagged REER has the correct sign. In the case of the monetary reaction function, government expenditure is statistically significant with the correct sign. The lagged inflation term is positive in both periods across most regressions but statistically insignificant. Overall, the lack of either statistical or economic significance of the inflation coefficient in most if not all the regressions (pooled and country-specific) may

[82] The 95 percent confidence interval for the estimated sterilization coefficients is between 0.6 and 1.2.

be due to the fact that while the dependent variables are fairly volatile, the inflation series is quite stable (also see Brissimis, Gibson and Tsakalotos, 2002).

Following Siklos (2000) I also applied the recursive estimation on monthly data to estimate the dynamic change of offset and sterilization coefficients (see Figures 5-8a to 5-8c).[83] The recursive offset coefficient remained fairly stable between early 2003 and mid 2004 at 0.2 before rising sharply from thereafter to an average of about 0.6 by late 2005, indicating that *de facto* capital mobility increased quite substantially during this period. With regard to the recursive sterilization coefficients, the degree of sterilization during 2003 fluctuated from a low 0.5 to almost full sterilization by the end of the year. From early 2004 onward, however, sterilization has remained relatively stable at around 0.9. A closer examination suggests that there may have been a slight increase in sterilization in 2005 compared to 2004.

5.4.2 Robustness Checks

I undertook a number of robustness checks. First, I tried various currency compositions of reserves. With the assumption of 90 percent US$ assets and 10 percent Euro assets (Table 5-3), the estimated offset coefficients vary from 0.64 to 0.73 (depending on different ways of forming expected exchange rate depreciation), while the estimated sterilization coefficients vary from 0.9 to 0.93. With the assumption of 70 percent US$ assets, 20 percent Euro assets and 10 percent Japanese Yen assets (Table 5-4), the estimated offset coefficients vary from 0.65 to 0.75, while the estimated sterilization coefficients vary from 0.88 to 0.9. Overall the empirical results are robust

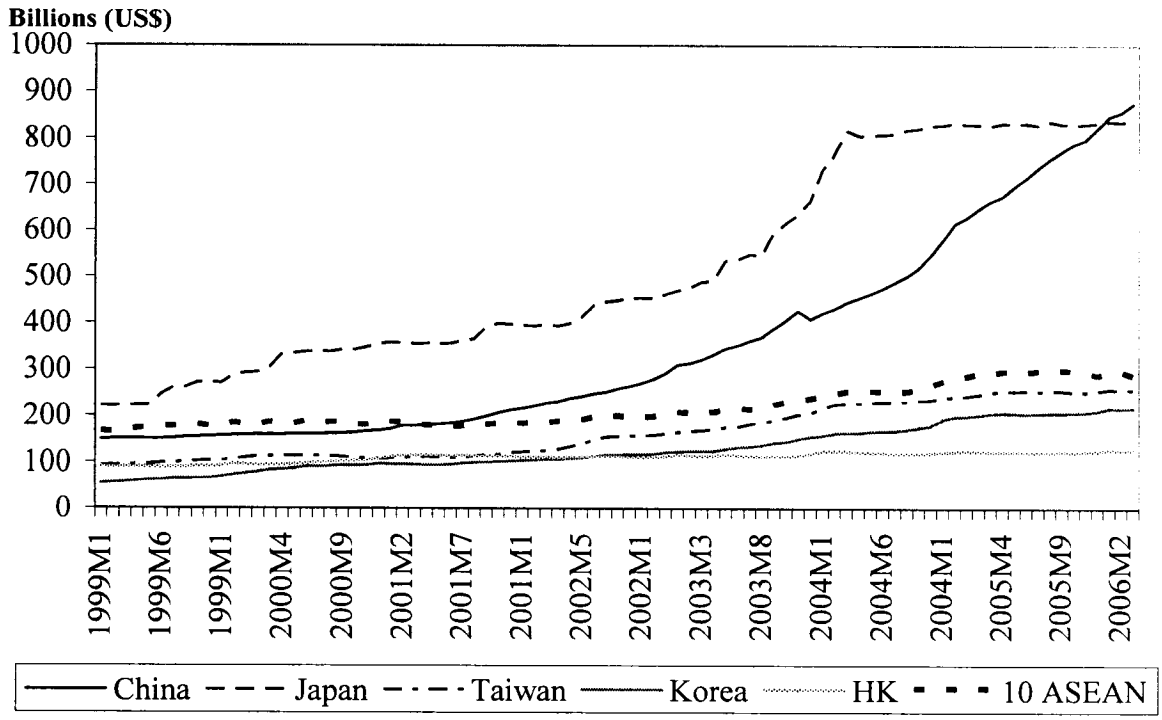
[83] Forward recursive estimation is applied. The first estimate is derived by using the sample from 1999: M6 to 2002: M12 and then adding one more observation each time to re-estimate the offset and sterilization coefficients.

across different scenarios and assumptions.[84] I therefore maintained the assumption of 100 percent US$ assets for simplicity.

Second, I replaced the lagged cyclical income and lagged REER with the trade balance (Table 5-5) (a done by as done by Brissimis, Gibson and Tsakalotos, 2002 and others). Third, I replaced the change in REER with deviation of REER from trend (Table 5-6) (as ideally one needs to use a measure of real exchange rate misalignment rather than change). Finally, since theory has not offered guidance on lag structures, I tried up to two lags of all independent variables including adding the lagged dependent variables. In all of the cases the results were largely unchanged.[85] A Chow test (Table 5-7) for a structural break in late 2002 found that there is a significant increase in estimated offset coefficients as expectations of Chinese Yuan appreciation first begins to be evident in the non-deliverable forward rate data.

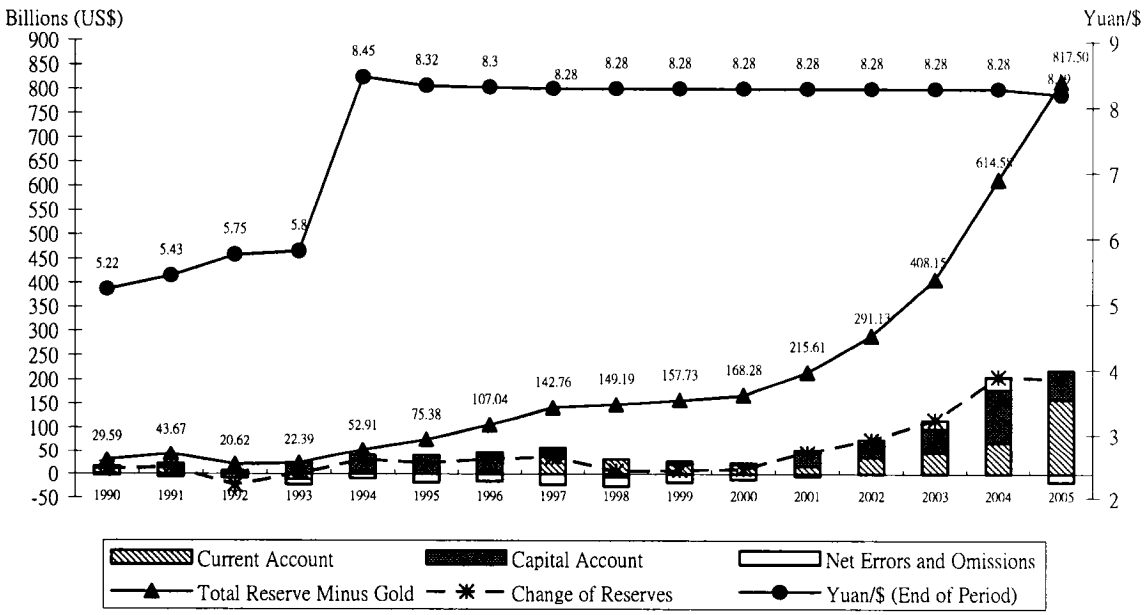
[84] Across various currency compositions of reserves considered, the 95 percent confidence interval for the estimated sterilization coefficients is between 0.54 and 1.19.
[85] Detailed regression results available from authors on request.

Figure 5-1: Reserve Growth in China and Japan and East Asia



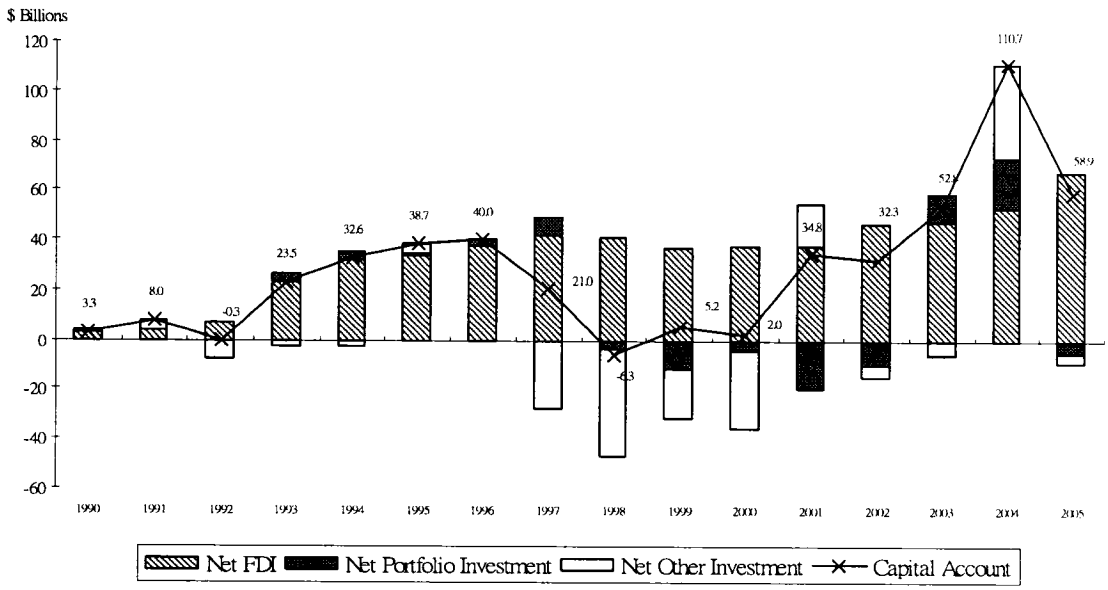
Source: All the data are from International Financial Statistics (IFS), expect Taiwan. The data for Taiwan is from AREMOS Economic Statistical Databanks, which published by Taiwan Economic Data Center (TEDC).

Figure 5-2: Trends in China's Balance of Payments Transactions



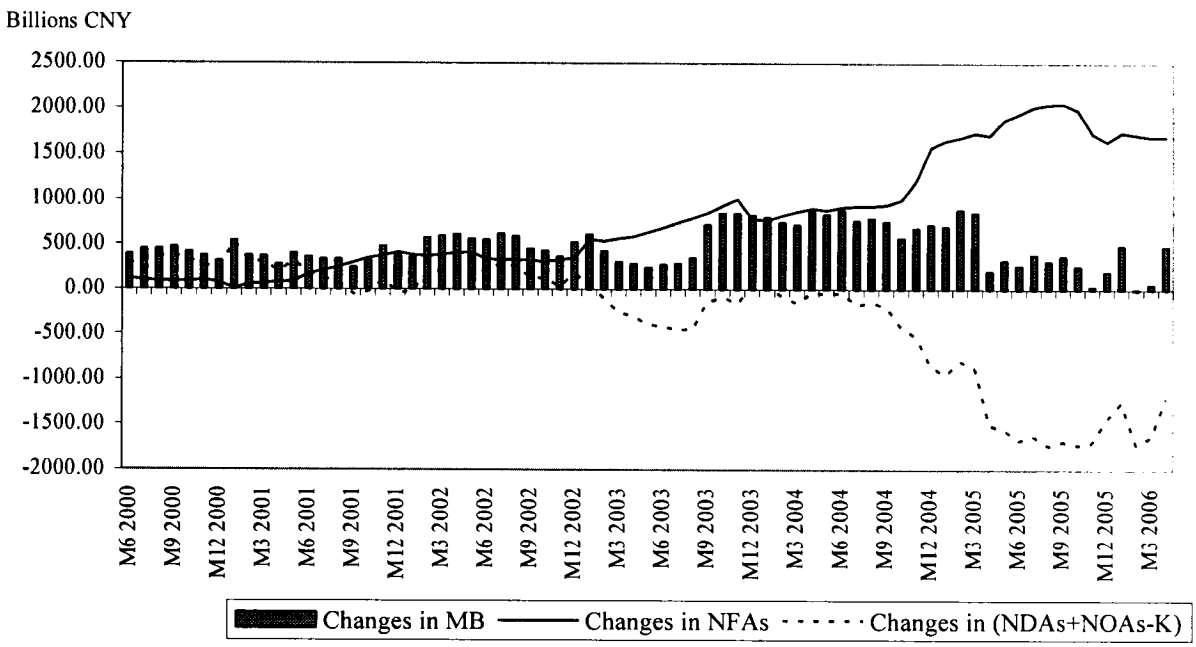
Source: IFS, the State Administration of Foreign Exchange (SAFE)'s website and Taiwan Economic Journal (TEJ) Great China Database.

Figure 5-3: Capital Account Components in China



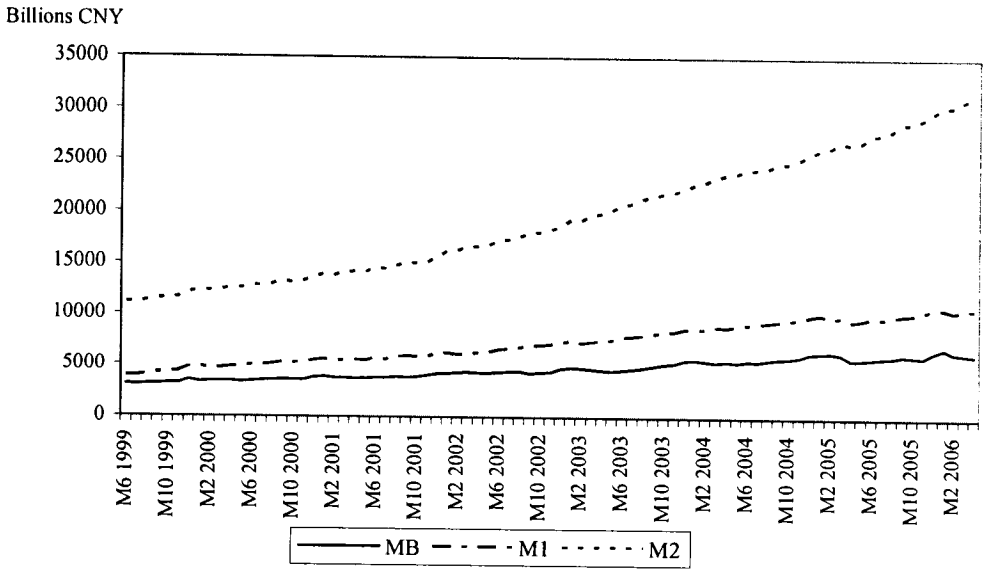
Source: IFS and the SAFE's website

Figure 5-4: Monthly Annual Change in NFAs, NDAs, and Reserve Money in China, 2000: M6 – 2006: M4



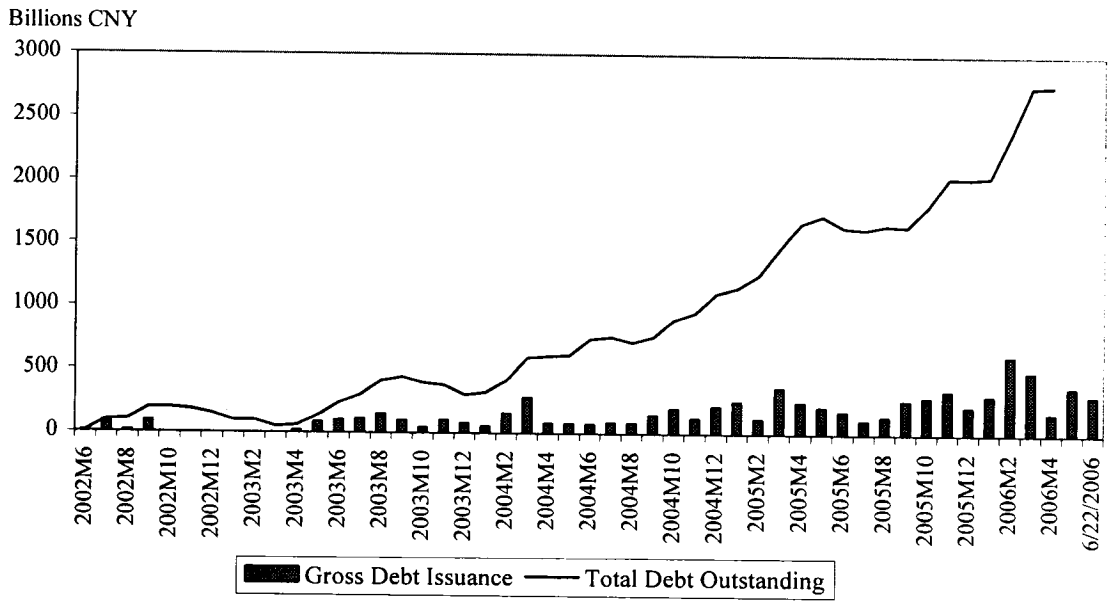
Source: IFS and the PBC's website

Figure 5-5: Reserve Money, M1, and M2 in China, 1999: M6 – 2006: M4



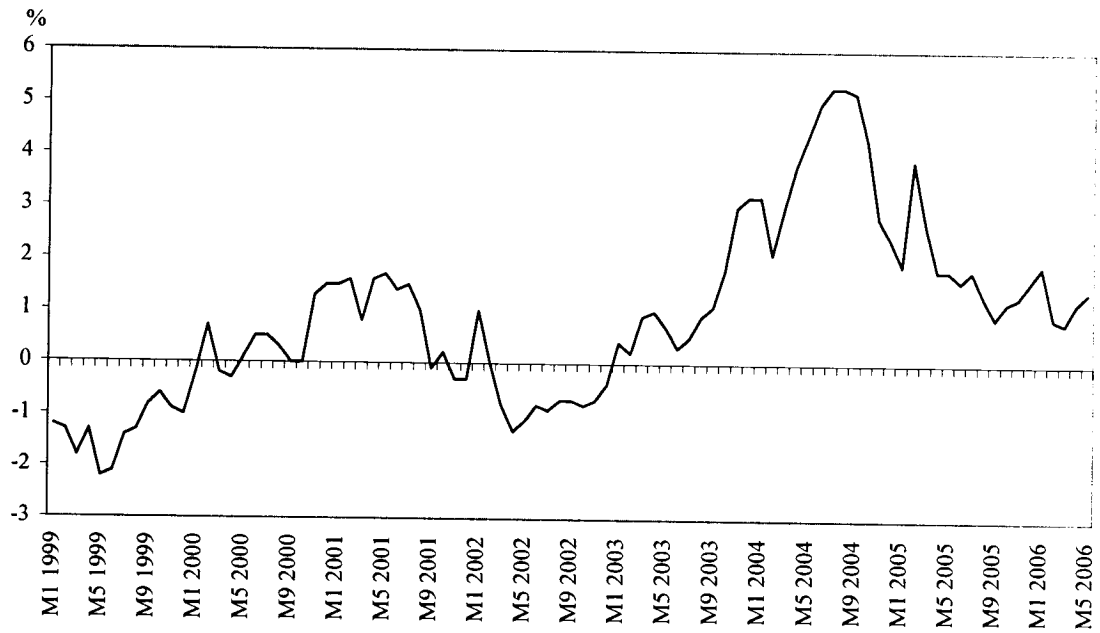
Source: IFS

Figure 5-6: Issuance of Central Bank Bills and Total PBC Debt Outstanding, 2002: M6 – 2006: M6



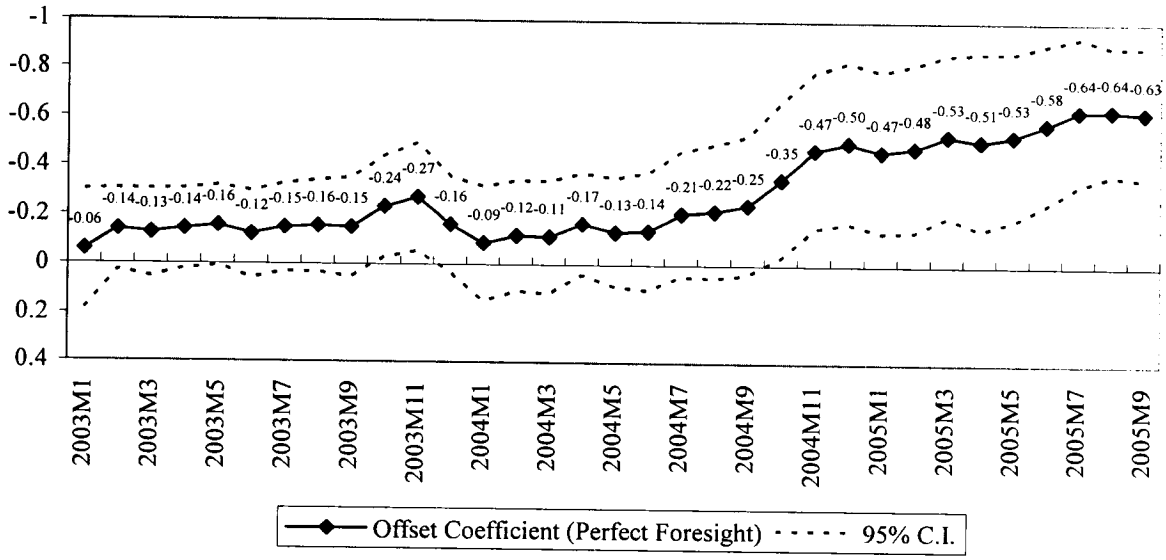
Source: PBC's website.

Figure 5-7: Inflation (CPI % Change) in China, 1999: M1 – 2006: M5



Source: IFS and TEJ Great China Database

Figure 5-8a: Recursive Estimated Offset and Sterilization Coefficients, 2003:M1-2005:M9, (Perfect Foresight)



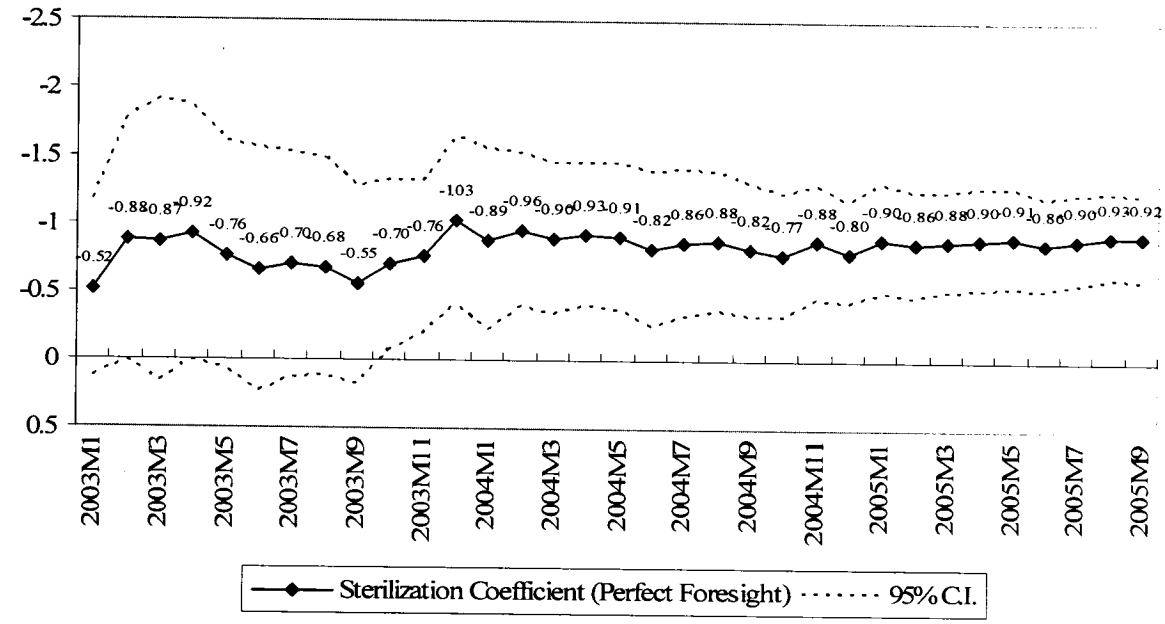
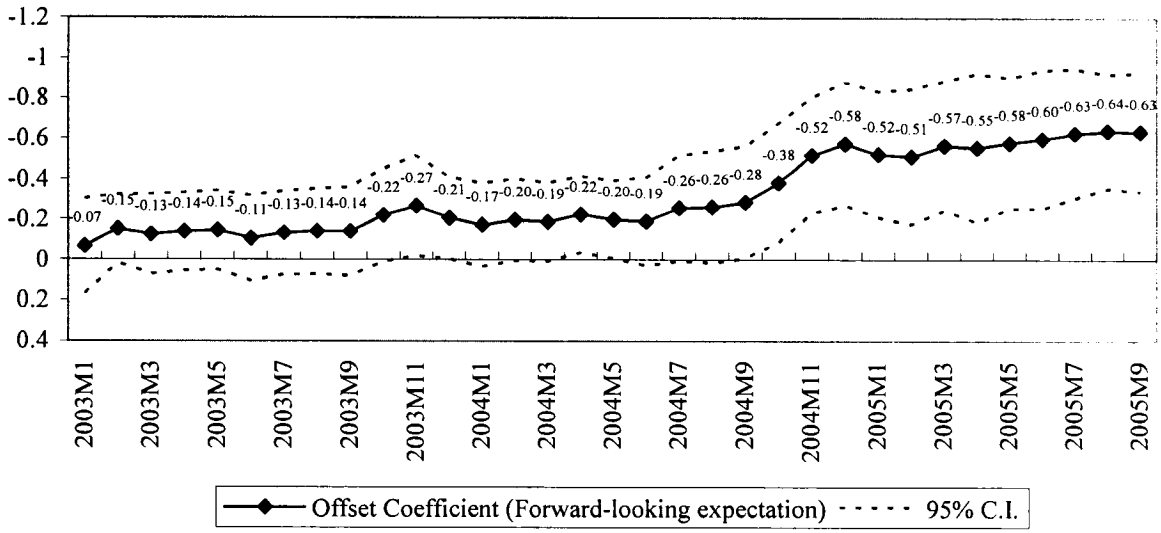


Figure 5-8b: Recursive Estimated Offset and Sterilization Coefficients, 2003:M1-2005:M9, (Forward-looking expectations)



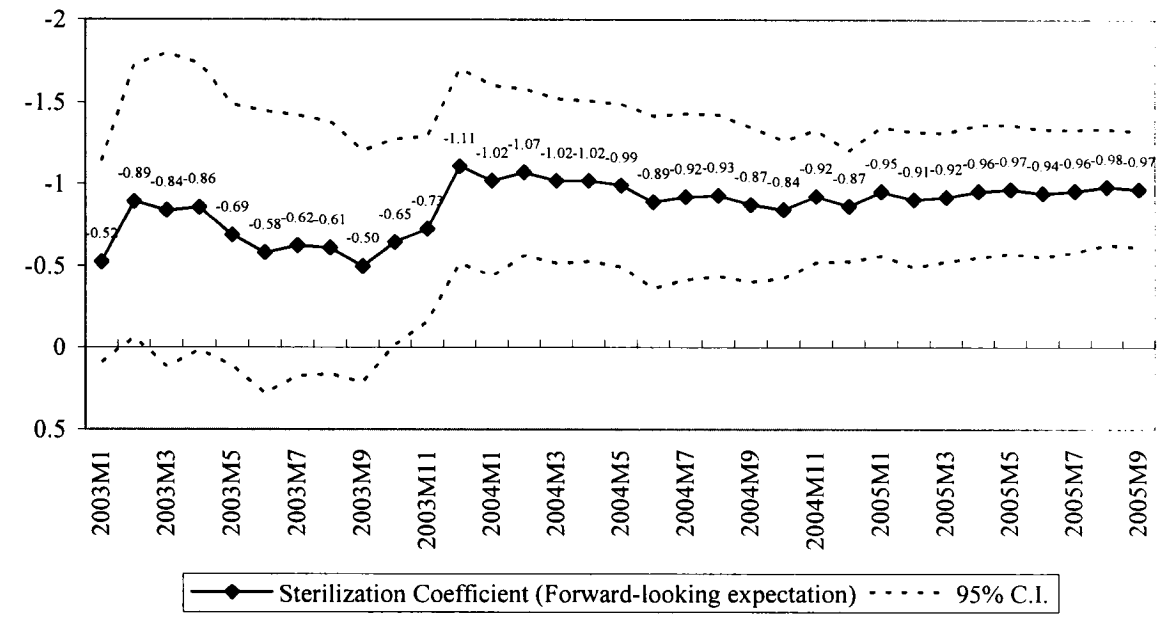
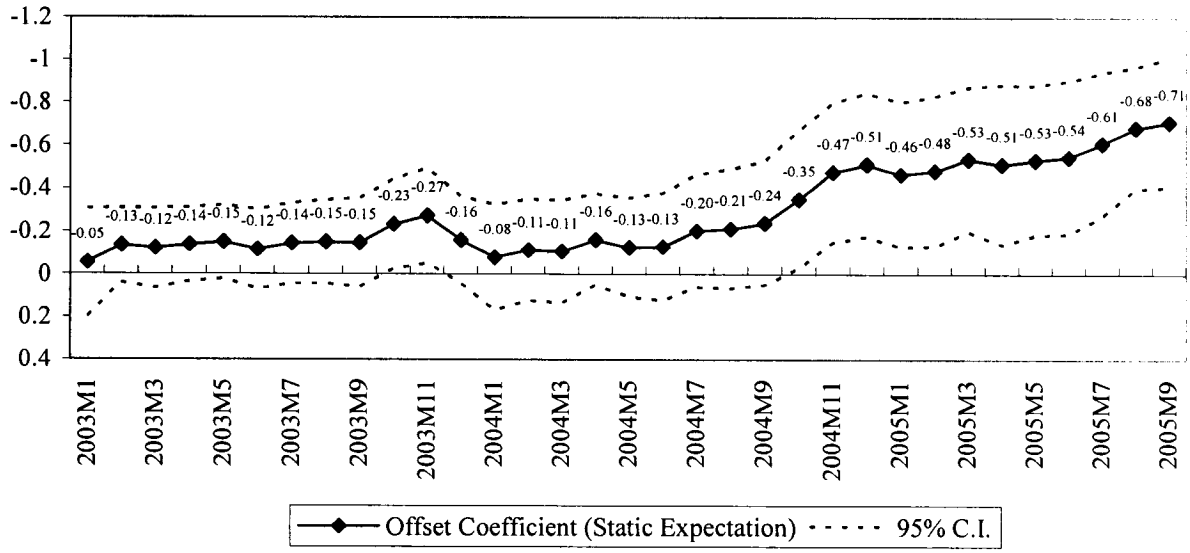


Figure 5-8c: Recursive Estimated Offset and Sterilization Coefficients, 2003:M1-2005:M9, (Static expectations)



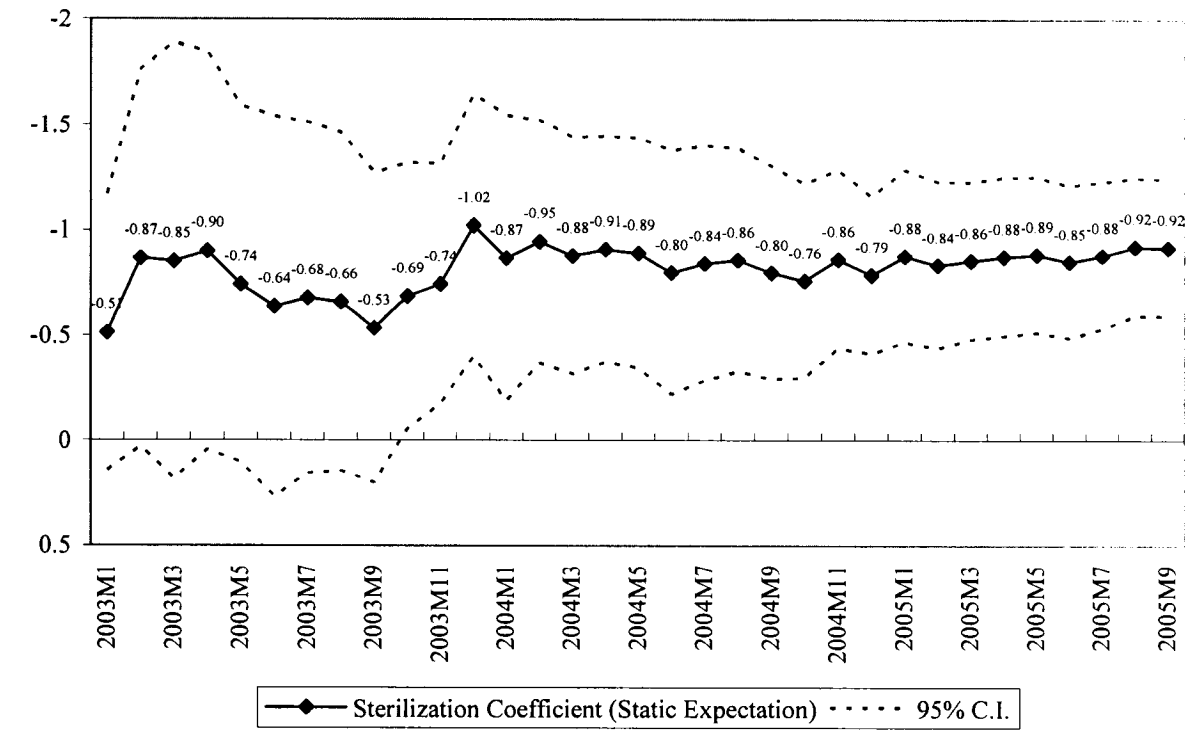


Table 5-1: ADF Unit Roots Test for China Data (1999: M6 - 2005: M9)

Variables	Type of Test	ADF test Statistic (P-value) H_0 : Variable has a unit root
ΔNDA_t^*	Intercept	-7.199***(0.000)
ΔNFA_t^*	Intercept and trend	-8.785***(0.000)
Δmm_t	Intercept	-8.337***(0.000)
$\Delta REER_t$	Intercept	-7.171***(0.000)
$y_{c,t}$	Intercept	-6.500***(0.000)
Δp_t	Intercept	-8.057***(0.000)
$\Delta(r_t^* + E_t e_{t+1})$ (Perfect foresight)	Intercept	-5.224***(0.000)
$\Delta(r_t^* + E_t e_{t+1})$ (Forward-looking expectations)	Intercept	-7.726***(0.000)
$\Delta(r_t^* + E_t e_{t+1})$ (Static expectations)	Intercept	-4.824***(0.000)
ΔG_t	Intercept	-9.746***(0.000)

Note: (*) Significant at more than 10 percent; (**) Significant at more than 5 percent; (***) Significant at more than 1 percent.

Table 5-2: China -Estimated Simultaneous Equations, 1999: M6 – 2005: M9

Assumed composition of reserves: 100% US$

China: 2SLS	Perfect Foresight: $E_t e_{t+1} = \ln(e_{t+1})$		Forward Exchange Rate: $E_t e_{t+1} = \ln(F_{3M,t})$		Static expectations: $E_t e_{t+1} = \ln(e_t)$	
	ΔNFA_t^*	ΔNDA_t^*	ΔNFA_t^*	ΔNDA_t^*	ΔNFA_t^*	ΔNDA_t^*
Intercept	**0.062***** (0.008)	**0.052***** (0.014)	**0.064***** (0.008)	**0.057***** (0.015)	**0.061***** (0.008)	**0.052***** (0.014)
ΔNDA_t^* (Offset)	**-0.630***** (0.137)	-	**-0.634***** (0.150)	-	**-0.710***** (0.153)	-
ΔNFA_t^* (Sterilization)	-	**-0.920***** (0.164)	-	**-0.968***** (0.181)	-	**-0.921***** (0.166)
Δmm_t	**-2.632***** (0.764)	**-4.551***** (0.389)	**-2.680***** (0.790)	**-4.590***** (0.389)	**-2.974***** (0.814)	**-4.555***** (0.391)
$\Delta REER_{t-1}$	-0.028 (0.442)	-	0.028 (0.437)	-	-0.001 (0.538)	-
$y_{c,t-1}$	**0.224*** (0.127)	0.137 (0.152)	**0.237*** (0.124)	0.145 (0.148)	**0.248*** (0.144)	0.138 (0.152)
Δp_{t-1}	0.116 (0.848)	1.359 (0.883)	-0.053 (0.833)	1.083 (0.860)	0.326 (0.877)	1.319 (0.886)
$\Delta(r_t^* + E_t e_{t+1})$	-0.156 (2.148)	-1.415 (2.417)	1.781 (1.633)	1.611 (2.055)	-0.062 (2.356)	-0.966 (2.660)
ΔG_t	-	**-0.201**** (0.080)	-	**-0.207**** (0.080)	-	**-0.201**** (0.080)
R-square	0.290	0.841	0.299	0.841	0.218	0.840
Adj. R-square	0.226	0.826	0.235	0.826	0.147	0.826

Note: (*) Significant at more than 10 percent; (**) Significant at more than 5 percent; (***) Significant at more than 1 percent.

Table 5-3: China -Estimated Simultaneous Equations, 1999: M6 – 2005: M9

Assumed composition of reserves: 90% US$ and 10% Euros

China: 2SLS	Perfect Foresight: $E_t e_{t+1} = \ln(e_{t+1})$		Forward Exchange Rate: $E_t e_{t+1} = \ln(F_{3M,t})$		Static Expectations: $E_t e_{t+1} = \ln(e_t)$	
	ΔNFA_t^*	ΔNDA_t^*	ΔNFA_t^*	ΔNDA_t^*	ΔNFA_t^*	ΔNDA_t^*
Intercept	**0.062***** (0.008)	**0.050***** (0.014)	**0.063***** (0.008)	**0.055***** (0.015)	**0.061***** (0.008)	**0.050***** (0.014)
ΔNDA_t^* (Offset)	**-0.648***** (0.145)	-	**-0.661***** (0.157)	-	**-0.739***** (0.159)	-
ΔNFA_t^* (Sterilization)	-	**-0.897***** (0.164)	-	**-0.930***** (0.180)	-	**-0.897***** (0.167)
Δmm_t	**-2.719***** (0.787)	**-4.545***** (0.390)	**-2.800***** (0.813)	**-4.582***** (0.390)	**-3.103***** (0.821)	**-4.549***** (0.392)
$\Delta REER_{t-1}$	-0.051 (0.457)	-	0.002 (0.456)	-	-0.031 (0.564)	-
$y_{c,t-1}$	**0.237*** (0.132)	0.137 (0.151)	**0.250*** (0.130)	0.145 (0.147)	**0.261*** (0.150)	0.137 (0.152)
Δp_{t-1}	0.262 (0.853)	1.381 (0.870)	0.138 (0.826)	1.138 (0.842)	0.493 (0.880)	1.338 (0.875)
$\Delta(r_t^* + E_t e_{t+1})$	-0.176 (2.219)	-1.475 (2.437)	1.507 (1.634)	1.563 (1.993)	-0.316 (2.412)	-0.965 (2.667)
ΔG_t	-	**-0.198**** (0.081)	-	**-0.203**** (0.082)	-	**-0.198**** (0.082)
R-square	0.294	0.839	0.292	0.839	0.215	0.838
Adj. R-square	0.230	0.824	0.228	0.824	0.143	0.823

Note: (*) Significant at more than 10 percent; (**) Significant at more than 5 percent; (***) Significant at more than 1 percent.

Table 5-4: China -Estimated Simultaneous Equations, 1999: M6 – 2005: M9

Assumed composition of reserves: 70% US$, 20% Euros, and 10% Japanese yen

China: 2SLS	Perfect Foresight: $E_t e_{t+1} = \ln(e_{t+1})$		Forward Exchange Rate: $E_t e_{t+1} = \ln(F_{3M,t})$		Static Expectations: $E_t e_{t+1} = \ln(e_t)$	
	ΔNFA_t^*	ΔNDA_t^*	ΔNFA_t^*	ΔNDA_t^*	ΔNFA_t^*	ΔNDA_t^*
Intercept	**0.062*** ** (0.008)	**0.048*** ** (0.013)	**0.063*** ** (0.008)	**0.053*** ** (0.015)	**0.061*** ** (0.008)	**0.049*** ** (0.014)
ΔNDA_t^* (Offset)	**-0.654*** ** (0.156)	-	**-0.671*** ** (0.167)	-	**-0.752*** ** (0.170)	-
ΔNFA_t^* (Sterilization)	-	**-0.872*** ** (0.166)	-	**-0.904*** ** (0.182)	-	**-0.877*** ** (0.169)
Δmm_t	**-2.740*** ** (0.816)	**-4.543*** ** (0.388)	**-2.835*** ** (0.841)	**-4.579*** ** (0.388)	**-3.155*** ** (0.847)	**-4.547*** ** (0.390)
$\Delta REER_{t-1}$	-0.051 (0.467)	-	0.008 (0.467)	-	-0.036 (0.579)	-
$y_{c,t-1}$	**0.247*** (0.135)	0.134 (0.150)	**0.261*** (0.134)	0.144 (0.147)	**0.270*** (0.154)	0.135 (0.151)
Δp_{t-1}	0.339 (0.858)	1.398 (0.863)	0.217 (0.829)	1.164 (0.832)	0.573 (0.880)	1.350 (0.868)
$\Delta(r_t^* + E_t e_{t+1})$	-0.375 (2.241)	-1.457 (2.428)	1.391 (1.637)	1.548 (1.974)	-0.507 (2.453)	-0.920 (2.653)
ΔG_t	-	**-0.195** ** (0.082)	-	**-0.200** ** (0.083)	-	**-0.195** ** (0.082)
R-square	0.305	0.838	0.300	0.839	0.224	0.838
Adj. R-square	0.242	0.823	0.236	0.824	0.154	0.823

Note: (*) Significant at more than 10 percent; (**) Significant at more than 5 percent; (***) Significant at more than 1 percent.

Table 5-5: China -Estimated Simultaneous Equations, 1999: M6 – 2005: M9

Replace $\Delta REER_{t-1}$ with ΔCA_t

China: 2SLS	Perfect Foresight: $E_t e_{t+1} = \ln(e_{t+1})$		Forward Exchange Rate: $E_t e_{t+1} = \ln(F_{3M,t})$		Static Expectations: $E_t e_{t+1} = \ln(e_t)$	
	ΔNFA_t^*	ΔNDA_t^*	ΔNFA_t^*	ΔNDA_t^*	ΔNFA_t^*	ΔNDA_t^*
Intercept	**0.065*** ** (0.009)	**0.051*** ** (0.014)	**0.067*** ** (0.008)	**0.056*** ** (0.016)	**0.066*** ** (0.008)	**0.050*** ** (0.014)
ΔNDA_t^* (Offset)	**-0.633*** ** (0.155)	-	**-0.634*** ** (0.166)	-	**-0.715*** ** (0.175)	-
ΔNFA_t^* (Sterilization)	-	**-0.913*** ** (0.164)	-	**-0.955*** ** (0.183)	-	**-0.899*** ** (0.170)
Δmm_t	**-2.671*** ** (0.865)	**-4.550*** ** (0.389)	**-2.705*** ** (0.876)	**-4.587*** ** (0.390)	**-3.031*** ** (0.957)	**-4.552*** ** (0.390)
ΔCA_t	-0.129 (0.278)	-	-0.118 (0.279)	-	-0.188 (0.271)	-
$y_{c,t-1}$	**0.231*** (0.123)	0.138 (0.152)	**0.240*** (0.120)	0.145 (0.148)	**0.256*** (0.132)	0.139 (0.152)
Δp_{t-1}	0.038 (0.871)	1.373 (0.884)	-0.095 (0.825)	1.109 (0.868)	0.239 (0.870)	1.359 (0.896)
$\Delta(r_t^* + E_t e_{t+1})$	-0.149 (2.182)	-1.429 (2.425)	1.746 (1.650)	1.577 (2.061)	-0.084 (2.126)	-1.011 (2.697)
ΔG_t	-	**-0.200** ** (0.081)	-	**-0.206** ** (0.082)	-	**-0.198** ** (0.082)
R-square	0.290	0.841	0.300	0.841	0.218	0.840
Adj. R-square	0.225	0.826	0.237	0.827	0.146	0.826

Note: (*) Significant at more than 10 percent; (**) Significant at more than 5 percent; (***) Significant at more than 1 percent.

Table 5-6: China -Estimated Simultaneous Equations, 1999: M6 – 2005: M9

Replaced $\Delta REER_t$ with $REER_t$ -*HP Filter Trend*

China: 2SLS	Perfect Foresight: $E_t e_{t+1} = \ln(e_{t+1})$		Forward Exchange Rate: $E_t e_{t+1} = \ln(F_{3M,t})$		Static Expectations: $E_t e_{t+1} = \ln(e_t)$	
	ΔNFA_t^*	ΔNDA_t^*	ΔNFA_t^*	ΔNDA_t^*	ΔNFA_t^*	ΔNDA_t^*
Intercept	**0.064***** (0.007)	**0.050***** (0.014)	**0.066***** (0.007)	**0.054***** (0.015)	**0.063***** (0.007)	**0.048***** (0.014)
ΔNDA_t^* (Offset)	**-0.544***** (0.125)	-	**-0.574***** (0.138)	-	**-0.658***** (0.158)	-
ΔNFA_t^* (Sterilization)	-	**-0.894***** (0.166)	-	**-0.929***** (0.184)	-	**-0.858***** (0.174)
Δmm_t	**-2.230***** (0.718)	**-4.548***** (0.389)	**-2.383***** (0.747)	**-4.583***** (0.390)	**-2.690***** (0.842)	**-4.548***** (0.391)
$\Delta REER_{t-1}$	0.003 (0.003)	-	0.004 (0.003)	-	0.005 (0.004)	-
$y_{c,t-1}$	**0.213*** (0.111)	0.139 (0.152)	**0.239**** (0.108)	0.146 (0.148)	**0.255*** (0.127)	0.141 (0.153)
Δp_{t-1}	-0.146 (0.898)	1.408 (0.891)	-0.208 (0.863)	1.158 (0.872)	0.197 (0.899)	1.432 (0.911)
$\Delta(r_t^* + E_t e_{t+1})$	0.744 (2.131)	-1.464 (2.449)	**2.620*** (1.512)	1.512 (2.042)	1.668 (2.139)	-1.094 (2.759)
ΔG_t	-	**-0.198**** (0.081)	-	**-0.203**** (0.082)	-	**-0.194**** (0.081)
R-square	0.354	0.841	0.364	0.841	0.293	0.840
Adj. R-square	0.295	0.826	0.306	0.827	0.229	0.826

Note: (*) Significant at more than 10 percent; (**) Significant at more than 5 percent; (***) Significant at more than 1 percent

Table 5-7: Chow Test
(H_0: No Structural change in December 2002)

	F Statistic (P-value)
Perfect Foresight	**9.657570*** (0.000)
Forward Exchange Rate	**9.463148*** (0.000)
Static Expectations	**9.709574*** (0.000)

Note: (*) Significant at more than 10 percent; (**) Significant at more than 5 percent; (***) Significant at more than 1 percent.

Chapter 6: Conclusion and Summary

Many emerging economies in Asia and elsewhere have been plagued by sharp boom and bust cycles of capital inflows and outflows. While much recent research has focused on the causes and consequences of the bust and crises, it is equally important to pay attention to the pre- and post-crises boom. The surge of capital inflows that takes place during the pre-crises boom period inevitably places significant upward pressure on the domestic currency. The monetary authorities often actively intervene in the foreign exchange market in order to try to offset this currency appreciation (because of concerns about loss of export competitiveness). Even though most of the Asian economics have changed to a more flexible exchange rate system after the 1997, the experience of the currency crises has given many Asian economies incentives to accumulate a large amount of international reserves. However, the unintended but natural consequence of such actions is a sharp rise in domestic liquidity growth (given that foreign reserves are part of the overall domestic monetary base). Left unchecked, this domestic monetary growth could be inflationary. Accordingly, many central banks have attempted to offset the liquidity impact of their foreign exchange rate intervention.

The aim of my dissertation is twofold. First, I examine the extent of sterilization and the degree of *de facto* capital mobility in nine Asian economies before and after the 1997 Asian currency crises, namely China, India, Indonesia, Korea, Malaysia, the Philippines, Singapore, Taiwan, and Thailand. To do so I estimate what the literature refers to as the "sterilization coefficient", i.e. the how much domestic credit changes in response to a change in international reserves, as well as the "offset coefficient", i.e. how

much private capital changes in response to a change in domestic credit. Higher the absolute value of sterilization and offset coefficients represents heavy sterilization and higher *de facto* degree of capital mobility respectively. The estimated equations were derived from the expanded theoretical model based on Brissimis, Gibson, and Tsakalotos (2002). I use the two-stage least square methodology to estimate the simultaneous equations. Second, my dissertation is to explore the various types of sterilization instruments used by these Asian economies.

The empirical results suggest that China's effective degree of capital mobility has risen substantially in recent years with offset coefficients rising from around 0.1 to 0.2 in 2003 to above 0.6 for the most recent data.[86] This is consistent with the judgments of a number of economists that China's capital controls have been becoming increasingly less binding.[87] To date, however, this increased effective capital mobility has not undermined the PBC's ability to effectively sterilize its huge reserve accumulation. Based on my estimate the PBC has typically sterilized around 90 percent of the reserve inflows, which is similar to those obtained by Burdekin and Siklos (2005) and He et al. (2005). While Burdekin and Siklos (2005) suggest the PBC has over-sterilized the foreign reserves, they find the PBC has not done so sufficiently to prevent M2 (broader money supply) from increasing, He et al. (2005) find that the PBC has fully sterilized the capital inflows, and most of the responses finish in a month.[88] This in turn explains how China has been able

[86] This conclusion is consistent with Liu and Otani (2005) and Ma and McCauley (2005), both of which undertake a battery of tests on various interest parity conditions.
[87] See for example Lardy (2005) and Prasad and Wei (2005).
[88] In related work, Burdekin and Siklos (2005) regress the change of base money on the change of foreign reserves for the period of 1990:q1 to 2002:q4 and find that one unit increases in the change of foreign reserves will lead to decreases of 0.1 to 0.2 units in the change of base money (based on OLS and GMM). However, they also find that one unit increases in the change of foreign reserves has significantly increased M2 growth by 0.11 units. Using VAR analysis, He et al. (2005) find that sterilization intensity increased

to maintain relatively low rates of money growth and inflation despite the surge of capital inflows. The recursive estimations match recent historical episodes, such as the substantial increase in sterilization at the beginning of 2004 as the PBC succeeded in slowing money growth after the acceleration in 2003.

The estimates of high sterilization over the period of China's recent huge buildup in reserves support the view that China has operated as a reserve sink, much as Germany and Japan did during the later stages of the Bretton Wood system. While Dooley et al. (2004) have suggested the current global economic imbalances are much less worrisome than most economists have suggested, the chaotic end of the Bretton Woods exchange rate regime in the early 1970s is but one of many examples that large prolonged international payments imbalances seldom lead to happy endings.

Finally, the high level of sterilization I found is not consistent with the strong form of the monetary approach and raises questions about arguments that China's pegged exchange rate has been an important source of discipline over domestic inflation (see, McKinnon, 2003a, 2003b, and 2004). Indeed, in recent years with the absence of sterilization, China's peg would have been a source of substantial inflationary pressure. Going forward, the Chinese authorities would do well to continue to relax the management of the exchange rate, in addition to taking further steps towards deregulation of capital outflows in a judicious manner. Less management of the exchange rate in turn should provide the PBC greater opportunities to use interest rate policy to manage domestic liquidity conditions and pressures.

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somewhat in 2003:m1-2004:m12 compared to 1998:m1-2002:m12. They also find that one unit increases in NFAs will lead to a decline of around one unit in NDAs.

With regard to the other Asian economies, most of them had heavily or fully sterilized the capital inflows during the pre-crises period. Table 6-1 shows that Indonesia, Korea, the Philippines, Taiwan and Thailand at least sterilized over 90 percent of their reserve accumulation in the pre-crises period, while India and Malaysia sterilized at least 60 percent. The estimation for Singapore gives an inconsistent result. The estimated sterilization coefficient is around 1.02 with the assumption of perfect foresight, while it is 0.28 with the assumption of static expectations.

However, my empirical results also suggest that some of the sample economies have substantially reduced the extent of sterilization after mid-1998, such as Indonesia, Korea, and Thailand. The estimation of the extent of sterilization has reduced from over 1 to 0.15 in Indonesia, while the sterilization coefficients have moved from 1.09 to 0.76 in Korea. Thailand's estimated sterilization coefficients also declined from over 0.9 to around 0.59. The Philippines and Taiwan remained the high extent of sterilization in the post-crises period. The estimated sterilization coefficients are all close to 1. In addition, India and Malaysia have increased their extent of sterilization in the post-crises period to manage domestic liquidity. The estimated sterilization coefficients increase from 0.6 to around 1. Again, the results for Singapore are still ambiguous. The results yield conclusion of heavy sterilization with the assumption of perfect foresight, but low extent of sterilization with the assumption of static expectations.

In regard to the *de facto* degree of capital mobility, most of the sample economics had relative high capital mobility during the pre-crises period, but dropped to the moderate level after the crises. The estimated *de facto* degree of capital mobility in Korea and the Philippines is around 0.8 during the pre-crises period, but marginally reduces to

0.47 during the post-crises period. Indonesia, Taiwan, and Thailand have similar movements. The estimated offset coefficients in Taiwan and Thailand decrease from 0.91 to 0.8, while Indonesia had lowest *de facto* capital mobility in the early 1990s (around 0.30), and even reduced to 0.03 (positive) after the crises. India's degree of capital mobility remained constant around 0.68 in both pre- and post-crises period. The only two countries with increasing *de facto* capital mobility are Malaysia and Singapore. The estimated offset coefficient increases from 0.73 to 0.91 in Malaysia, while the coefficient increases from 0.53 to 1.05 in Singapore.

The *de facto* low capital mobility in Indonesia is probably a consequence of the sharp capital account withdrawals in the country well after the rest of the region had stabilized. The low and declining offset coefficients in Indonesia may also be consistent with the adoption and tightening of some administrative measures to curb net private capital inflows, including tighter restrictions on the Non Deliverable Forwards (NDF) market and on nonresident domestic currency deposits in the banking system.[89] The results for Malaysia are seemingly counter-intuitive. As discussed previously (section 5.3.2), it is likely that that the model may not be suitable for Malaysia post-crisis given the country maintained a fixed exchange rate (for the duration of the sample used). Another possibility is that Malaysian controls imposed in September 1998 may not have been very effective and in any case were rapidly reversed in a year, while capital controls imposed by the country in 1994 were, by all accounts, quite effective (Jomo, 2005 and Magud and Reinhart, 2005).

[89] See BI (2005) for discussions of foreign exchange measures imposed in the case of Indonesia. Also see the survey of selected central banks by Mihaljek (2005).

Table 6-1: The Summary of the Estimated Offset Coefficients and Sterilized Coefficients for Eight Selected Asian Economies

	Offset Coefficient		Sterilization Coefficient	
	Pre-crises	Post-crises	Pre-crises	Post-crises
India	0.68-0.74	0.65-0.71	0.61-0.85	0.93–1.21
Indonesia	0.29-0.33	0.01-0.03*	1.54-1.61	0.05-0.15
Korea	0.66-0.80	0.47-0.55	1.09-1.10	0.21-0.76
Malaysia	0.73-0.79	0.91-0.95	0.61-0.62	0.91-1.01
The Philippines	0.79-0.80	0.42-0.47	1.14-1.15	0.97-1.22
Singapore	0.53-1.12	1.05-1.19	0.28-1.02	0.37-0.91
Taiwan	0.91-0.94	0.70-0.81	0.97-1.02	0.92-1.07
Thailand	0.99-1.05	0.80-1.08	0.90-0.98	0.36-0.59

Note: All the numbers are taken from the empirical results listed in Chapter 4.
* Indonesia's estimated offset coefficients in the post-crises period are positive, but insignificantly different from zero.

My dissertation also explores the various types of sterilization instruments used by the selected Asian economies. The two most common instruments used for sterilization are open market operations (OMOs) and legal reserves requirements. To do OMOs, the Asian central banks either issue their own central bank bills or buy/sell government securities to financial institutions. China, Indonesia, Korea, and Taiwan have substantially increased the issuance of OMOs bonds to mop up the excess domestic liquidity in the post-cries period. On the other hand, legal reserve requirements are the minimum amount of the deposit that banks need to save in the central bank. Most of the Asian economies have used reserve requirements to adjust domestic liquidity, such as India, Korea, Malaysia, the Philippines, and Taiwan. Generally speaking, most of the Asian economies have gradually replaced legal reserve requirements policy with OMOs since the latter is more efficient on manage short-term liquidity, and can be operated

There are a number of other sterilization tools that have been employed by the Asian economies, such as shifting public sector or pension funds from commercial banks

to the central banks, adjusting discount rates, setting the restricted lending policy, or capital controls. Malaysia, the Philippines, and Singapore have frequently used the government funds or public sector fund to do sterilization. To do so they can either transfer the fund from commercial banks to central bank directly or buy/sell the government securities. Since a large portion of the pension funds are required to invest in government securities, the demand for the securities will be more inelastic, and will not raise interest rates as much as regular OMOs. Besides, Indonesia, Malaysia, and Thailand have implemented a series of capital controls recently to restrict spectacular capital flows. The most significant case is Thailand. The BOT announced the capital control measures on short-term foreign capital inflows in late 2006 and caused the stock market index decline substantially.

Finally, the lower extent of sterilization in the post-crises period might attribute to the flexible exchange rate regimes conducted in most of the Asian economies after the crises. A higher degree of exchange rate flexibility provides monetary authorities one more choice to absorb excess liquidity in addition to doing regular sterilization policies.

Appendix 1: Definitions and Measurement of the Variables Used in Empirical Study

Variables	Definitions	Measured as	Data (Source)
NFA_t^*	Foreign reserves denominated in domestic currency minus foreign liabilities	*Reserve(\$)* $\times e_t$ - *Foreign Liabilities*	*IFS*
ΔNFA_t^*	The change in NFA_t^* without revaluation effect	$[NFA_t^* - NFA_{t-1}^*(\frac{e_t}{e_{t-1}})]/GDP_t$	
ΔNDA_t^*	The change in (net domestic assets + net other assets – capital item) +revaluation effect scaled by the GDP.	$[\Delta NDA_t + \Delta NOA_t - \Delta K_t + NFA_{t-1}^*(\frac{e_t}{e_{t-1}} - 1)]/GDP_t$	*IFS*
mm_t	Money Multiplier for M2	*M2/Reserve Money*	*IFS*
Δmm_t	The change in money multiplier for M2	$Log(mm_t) - Log(mm_{t-1})$	
$\Delta REER_t$	The change in Real Effective Exchange Rate.	$REER_t - REER_{t-1}$	*IFS and JP Morgan*
$y_{c,t}$	Cyclical Income. The real output deviated from its trend scaled by the trend. The trend is measured by HP filter.	*[Log(Real GDP) – HP filter trend] / HP filter trend*	*IFS and Central Banks Official Websites*
Δp_t	Inflation Rate	$Log(cpi_t) - Log(cpi_{t-1})$	*IFS*
$\Delta(r_t^* + E_t e_{t+1})$	The change in exchanged adjusted foreign interest rate. The foreign interest rate is the interest rate for US 3-month treasury bill. $F_{3-month}$ is the 3-month non-deliverable forward rate.	$\Delta[r_t^* + \ln(e_{t+1})]$ *if perfect foresight.* $\Delta[r_t^* + \ln(F_{3-month})]$ *if forward-looking* $\Delta[r_t^* + \ln(e_t)]$ *if Static expectations*	*IFS and Bloomberg*
ΔG_t	The change in government fiscal deficit scaled GDP	$\Delta G_t / GDP_t$	*IFS*
σ_{ex}	Volatility of exchange rate	*The standard deviation of the within quarter change in the monthly real effective exchange rate.*	*IFS*
σ_r	Volatility of domestic interest rate.	*The standard deviation of the within quarter change in the monthly domestic interest rate (bank rate).*	*IFS*
d_1	Dummy variable for $\Delta NDA < 0$	d_1*=2 if* $\Delta NDA < 0$*;* *0 otherwise.*	
d_2	Dummy variable for $\Delta NFA_t < 0$	d_2*=2 if* $\Delta NFA_t < 0$*;* *0 otherwise.*	
Q2-Q4	Seasonal dummies	*Q2=1 if the second quarter; Q3=1 if the third quarter; Q4=1 if the forth quarter; otherwise 0.*	

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