

The Compensation Thesis vs the Mundell-Fleming Model
In a Fixed Exchange Rate Regime

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ABSTRACT

This paper seeks to look at an open economy in a fixed exchange system by virtue of comparing neoclassical view with post-Keynesian view as followed by former studies. In particular, it is critical to deploy the influential Mundell-Fleming (M-F) model and finds that the characteristic Compensation thesis is plausibility once a full set of double entry accounts is borne in mind. The paper clearly indicates a time series econometric methodology in which targets for the compensation thesis should be set. Some empirical evidences would be illustrated using China data. If a country shows a blistering pace growth in foreign reserves, the compensation thesis does well forecast the possibility of the expansionary monetary policy in that the changes in monetary base are limited. In this case, the imported capital would ultimately be balanced by the total amount of the capital.

KEYWORDS: OPEN ECONOMY, FIXED EXCHANGE RATE REGIME, COMPENSATION THESIS, MUNDELL-FLEMING

1. Introduction

Macroeconomics arose as a reaction to the Great Depression of the 1930's, and provided government authorities with the tools to analyze and steer large-scale economic phenomena. Post-Keynesian theory and neoclassical theory are the two major schools of thought in this field. The paper tackles the case of open economies with fixed exchange rates. It is inspired by recent work on the so-called compensation thesis, which is akin to post-Keynesian theory, with the intent of making a comparison with the dominant Mundell-Fleming model of neoclassical economics.

China provides an excellent case study of an open economy with fixed exchange rates. Relative to most of the other countries, China has had a high rate of GDP growth over the recent years. According to the national economy and social development communiqués, the growth rate was 8%, 7.3%, 8% and 9.1% in the years of 2000, 2001, 2002 and 2003 respectively. With the successful experiences gained in the reform and opening up, theories linked to Chinese monetary policies will be explored in the paper.

The structure of the paper is as follows. Section 2 reviews the compensation thesis, the Mundell-Fleming model as shown in standard textbook representations, and presents the main differences between the two models, as exemplified by the original Mundell and Fleming papers. Section 3 provides the assumptions of the compensation thesis in China. Section 4 introduces the econometric methodology, while section 5 performs the empirical analysis with Chinese up-to-date data to justify the principle of compensation. Finally, I conclude by supporting the reflux mechanism for the economic theory of open economies.

2. The Compensation Thesis versus the Mundell-Fleming Model

A fully coherent accounting framework, which takes into account not only the sources and uses but also the changes in stocks, becomes the alternative to the neoclassical framework in modern macroeconomic research. “Within such a fully coherent accounting framework, all the flows will have to be coming from somewhere and they will all go somewhere, there are no black holes.”(Lavoie, 2001, p. 1)

Some of the essential elements in post-Keynesian theory are briefly recalled. The supply of money is endogenous and demand-led, and it can be viewed as horizontal. Short-term rates of interest are exogenous and set by the central bank. Along this line, there is a multiplicity of possible natural rates of interest, and causality runs from credit to money aggregates and to reserves. Inflation and output growth cause money growth, and all economic sectors need buffers as adjustment factors.

By contrast, the standard neoclassical view supposes that the supply of money is exogenous and can be viewed as a vertical curve. Rates of interest are endogenous. In this case, there exists a natural rate of interest. Causality runs from reserves or high-powered money, to money and then to credit, and excess money growth causes price inflation.

2.1. Literature review of the compensation thesis

The best-known facet of the compensation approach is the demonstration that sterilization effects can be explained by an automatic mechanism within a stock-flow accounting analysis.

The distinction between an overdraft economy and an asset-based economy is important to build the bedrock of the compensation thesis. Whether the central bank has claims or does not have claims over the private domestic financial sector is the dividing line between the two kinds of financial systems.

Consider the effect of a trade surplus in the context of a fixed exchange rate system. Foreign currencies held by agents are transformed into domestic banking deposits, and the banks would sell the foreign monies to the central bank, who is the residual buyer when it attempts to keep the exchange rate fixed. The foreign currencies now held by the central bank would be balanced by the increase in bank reserves. (As shown in Table 2.1.1 step 1 and Table 2.1.2 step 1).

An overdraft economy. Because it is a world of endogenous money, banks make loans first, and search for reserves later. Lavoie (2001, p. 229) claims that if agents wind up with money that they do not want to spend, they will use it to reduce their debits. Therefore, private banks would exchange the foreign reserves that they acquired for deposits at the central bank; and then they would use these deposits to reduce their debt towards the central bank. In response to bank reserves increases, the advances made to the domestic banking sector decrease. There would be no increase in the size of the balance sheet of the central bank and this process would occur automatically (Table 2.1.1 step 2).

Table 2.1.1: The balance sheet with an overdraft economy

Step1

Central Bank		Domestic Banks	
Assets	Liabilities	Assets	Liabilities
Foreign reserves +100	Currency in circulation	Bank reserves +100	Deposits +100
Advances to private banks	Bank reserves +100		Loans from the central bank
	Government deposits		

Step2

Central Bank		Domestic Banks	
Assets	Liabilities	Assets	Liabilities
Foreign reserves +100	Currency in circulation	Bank reserves 0	Deposits +100
Advances to private banks -100	Bank reserves 0		Loans from the central bank -100
	Government deposits		

An asset-based economy. In an endogenous money world, when agents dispose of money balances that they do not wish to hold, these excess money balances can be extinguished by the reimbursement of previously accumulated debt. But what happens if these agents have no debts? In an asset-based economy, the excess bank reserves would be used to purchase government securities, which will bring interest income at no risk. (Table 2.1.2 step 2).

Table 2.1.2: The balance sheet with an asset-based economy

Step1

Central Bank			Domestic Banks			
Assets		Liabilities	Assets		Liabilities	
Foreign reserves	+100	Currency in circulation	Bank reserves	+100	Deposits	+100
Treasury bills		Bank reserves +100	Treasury bills			
		Government deposits				

Step2

Central Bank			Domestic Banks			
Assets		Liabilities	Assets		Liabilities	
Foreign reserves	+100	Currency in circulation	Bank reserves	0	Deposits	+100
Treasury bills	-100	Bank reserves 0	Treasury bills	+100		
		Government deposits				

Alternatively, a balance of payment deficit in a fixed exchange market still needs not to have any impact on the monetary base unless the foreign reserves become exhausted. The decreasing reserves of private banks will be accompanied by borrowing at discount window in an overdraft economy. With respect to an asset-based economy, private banks can sell their government securities to the central bank. Indeed, the central bank will accommodate this change, in a defensive operation.

As noted, this compensation thesis is clearly an extension of the reflux mechanism brought up by Lavoie, Tooke, Kaldor, Trevithick, Nurkse and Robinson.

Early studies (Nurkse, 1947, p. 81) documented that, "The compensatory increase in domestic demand will tend to prevent a general depression in the given country. The principle of compensatory domestic spending can and should be applied in reverse when foreign demand is excessive and threatens to produce an inflationary expansion of domestic money income." Kaldor (1980, p. 129) also reasoned that the velocity of circulation of money is not determined by factors that are independent either of the supply of money or the volume of money payments.

Perhaps the most important insight is gained by introducing a formal dynamic model of a world comprising two economies based on endogenous money and a rigorous and watertight system of stock and flow accounts¹. This model is a formalized proof of the compensation phenomenon. Simulations with the model explicitly exhibit a *quasi*² steady state, where in the country with the trade deficit the gold reserves are continuously diminishing, the value of bills purchased by the central bank is exactly equal to the value of gold losses that it incurs, and the money stock hardly changes. Other papers³ written by Lavoie also shed some light on this reflux mechanism.

¹ Godley, W. & Lavoie, M. (2004), 'Two-country stock-flow-consistent macroeconomics using a closed model within a dollar exchange regime', CERF working paper, University of Cambridge & University of Ottawa, <http://www.cerf.cam.ac.uk/publications/files/WP10%20-%20Godley%20&%20Lavoie.pdf>

² Since some of the main variables are still changing.

³ Lavoie, M. (2003), 'A fully coherent model of currency boards', working paper

Lavoie, M. (2003), 'A fully-coherent post Keynesian model of the euro zone', in P. Arestis, M. Baddeley and J. McCombie (eds), *Globalisation, Regionalism and Economic Activity*, Edward Elgar, pp.98-126

So far it suffices to illustrate the nature of the compensation system, and why it has arisen. Of paramount importance today is the stabilization of money income (apart from growth), and any change in the external balance that threatens to affect it will be met by endogenous monetary steps. Many countries may therefore remain in external disequilibrium for a considerable period of time, taking no explicit policy steps to correct the situation, and preventing the adjustment process from having its natural corrective influence.

2.2. The Mundell-Fleming model, as shown in standard textbook representations

One of the most significant advances made by Robert Mundell was the extension of the standard workhorse of macroeconomics — the IS-LM model of the Hicks-Hansen synthesis — to an open economy. The Mundell-Fleming model, as it came to be known, was the first to integrate international monetary flows into macroeconomic analysis. In the early 1960s, this model had foreseen the importance of international capital flows in determining key macroeconomic variables such as real national income, unemployment, price level and the interest rate. In this section, I analyze the basic neoclassical view as shown in standard textbook representations in order to justify the compensation thesis.

The main assumptions of the Mundell-Fleming model

Mundell assumed the extreme degree of mobility that prevails when a country cannot maintain an interest rate different from the general level prevailing abroad. It implies that there are no barriers to capital mobility and that investors are risk-neutral.⁴ As a result, perfect capital mobility is likely to be a good approximation for many purposes.

For exchange-rate expectations, the simplest assumption is that investors do not expect the exchange rate to change.

It will be helpful to bear in mind that there are barriers to the instantaneous adjustment of nominal prices and wages. Nominal price adjustment appears sluggish in practice. Countries with floating currencies and open capital markets show that exchange rates are an order of magnitude more volatile than CPIs (Obstfeld and Rogoff, 1996, p. 606). The intuition behind this is that it is a short run neoclassical model. For this horizon it lays out automatic mechanisms (such as flexible nominal prices), and only takes into account the adjustment of balance of payments and internal equilibria.

Monetary policy will be assumed to take the form of open market purchases of securities, and fiscal policy the form of an increase in government spending (on home goods) financed by an increase in the public debt. Mundell also assumed that, initially, each sector and market is in equilibrium.

⁴ The reason a high mobility of capital improves the effectiveness of the fixed exchange rate system is that the adjustment variable (the rate of interest) has a *direct* effect on the market to which it responds (the balance of payments).

Review of the IS/LM/BP model

First, consider a standard version of the IS-LM model. The IS curve shows the combinations of output and the interest rate such that planned and actual expenditures on output are equal.

$$Y = E\left(Y, i - \pi^e, G, T, \frac{\varepsilon P^*}{P}\right),$$

where $0 < E_Y < 1, E_{i-\pi^e} < 0, E_G > 0, E_T < 0, E_{\frac{\varepsilon P^*}{P}} > 0$ (Romer, 2001, p. 226)

The LM curve shows the combinations of output and the interest rate that lead to equilibrium in the money market for a given price level.

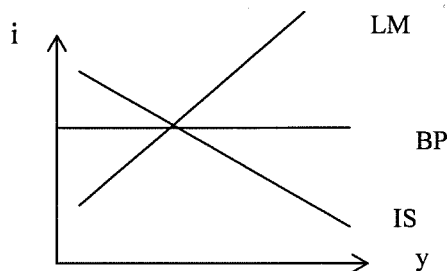
$$\frac{M}{P} = L(i, Y), \text{ where } L_i < 0, L_Y > 0. \text{ (Romer, 2001, p. 222)}$$

Second, the BP curve extends the closed economy to an open economy. The balance of payments equilibrium requires

$$CF(i - i^*) + NX\left(Y, i - \pi^e, G, T, \frac{\varepsilon P^*}{P}\right) = 0,$$

where CF is the capital flow ($CF'(\bullet) > 0$), and NX is net exports (Romer, 2001, p. 232). The assumption of perfect capital mobility shows the horizontal BP curve in interest rate and income quadrant. These curves are shown in Figure 2.2.1:

Figure 2.2.1: The IS/LM/BP diagram

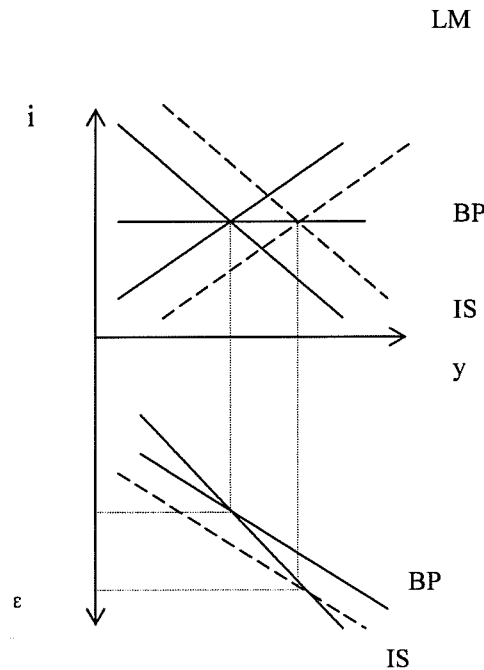


Given that IS/LM/BP model, I analyze the effect of monetary policy and fiscal policy under flexible and fixed exchange markets.

A flexible exchange regime closure

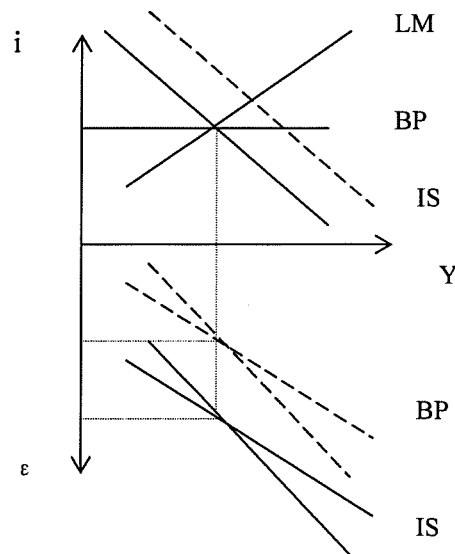
Monetary policy. A central bank purchase of securities creates excess reserves and puts downward pressure on the interest rate. But the interest rate is prevented from falling by an outflow of capital, which causes a deficit in the balance of payments, and a depreciation of the exchange rate. In turn, the exchange rate depreciation improves the balance of trade and stimulates income and employment. A new equilibrium is established, which is illustrated by diagram (Figure 2.2.2). Monetary policy achieves a higher level of output under flexible exchange rate regime.

Figure 2.2.2: Monetary policy under flexible exchange rates



Fiscal policy. Suppose that government purchases rise. This change shifts the IS curve to the right in both quadrants. As shown in Figure 2.2.3, however, at a given price level this leads only to appreciation of the exchange rate and has no effect on output. The aggregate demand curve is unaffected.

Figure 2.2.3: Fiscal policy under flexible exchange rates



A fixed exchange regime closure

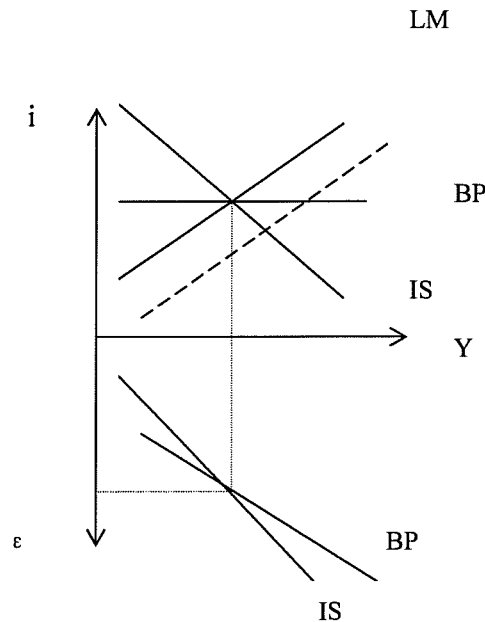
Assuming a fixed rather than a flexible exchange rate requires two changes to the model. The exchange rate is pegged at some level and the money supply becomes endogenous rather than exogenous. For the government to fix the exchange rate, it must stand ready to buy or sell domestic currency in exchange for foreign currency at the constant rate. With a fixed exchange rate, the exchange rate itself is a policy instrument.

Monetary policy. Consider the effect of an open market purchase of domestic securities. This results in a multiple expansion of money and credit, and downward pressure on the rate of interest. But a fall in the interest rate is prevented by a capital outflow⁵, and this worsens the balance of payments. To prevent the exchange rate from falling, the central bank intervenes in the market, selling foreign exchange and

⁵ Mundell shows that capital flows are responsive to interest rate differentials.

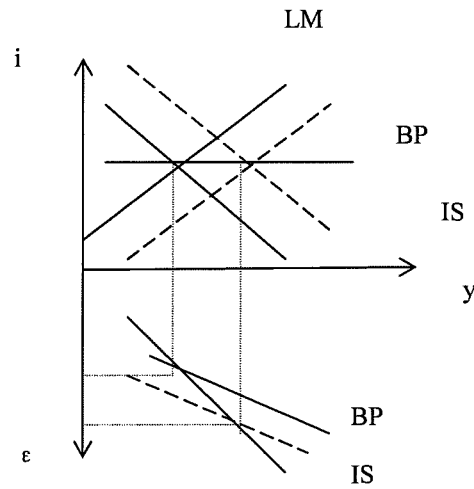
buying domestic money. The money supply is restored to its original level, as shown in Figure 2.2.4. Disturbances in the money market have no effect on output for a given price. A rise in the demand for money leads only to an increase in the money supply.

Figure 2.2.4: Monetary policy under fixed exchange rates



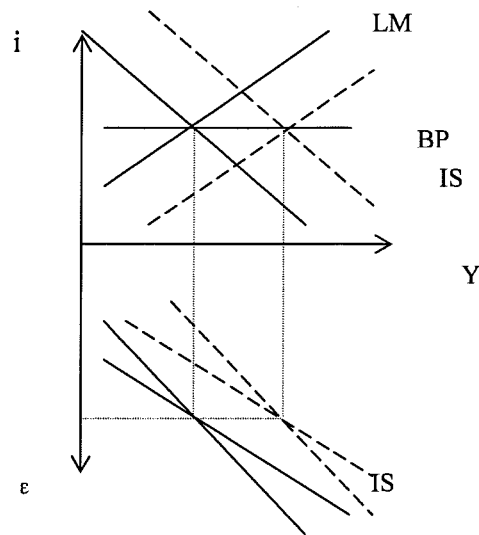
Monetary policy and sterilization operation. From an initial position of equilibrium, open market operations (monetary policy) by the central bank would cause a capital outflow, balance of payments deficit, and sales of foreign exchange by the central bank. The restrictive monetary impact of the foreign exchange sales are then offset by further open market purchases which induce further sales of foreign exchange. This process repeats itself at an accelerating speed. There is no new equilibrium, as shown in Figure 2.2.5. The sterilization procedures merely perpetuate the self-generating process until exchange reserves are exhausted, or until the world level of interest rates falls.

Figure 2.2.5: Monetary policy and sterilization operation under fixed exchange rates



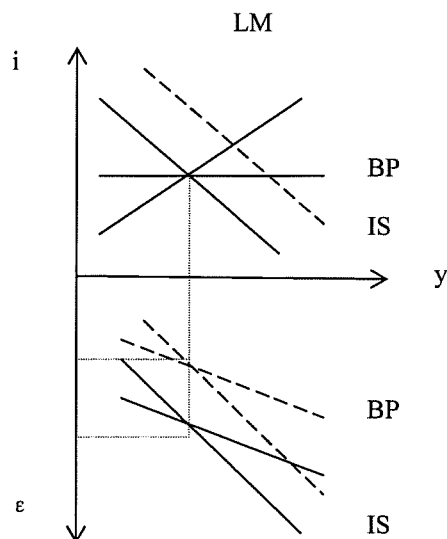
Fiscal policy. Changes in planned expenditure now affect aggregate demand. A rise in government purchases shifts the IS curve to the right in both quadrants. It creates an excess demand for money, raises interest rates, and attracts a capital inflow. This improves the balance of payments temporarily, forcing the central bank to intervene by buying foreign reserves and increasing the money supply. The money supply is therefore increased indirectly through the back door of exchange rate policy. Income cannot change unless the money supply changes. Thus, it will raise output for a given price level (Figure 2.2.6).

Figure 2.2.6: Fiscal policy under fixed exchange rates



Fiscal policy and sterilization operation. Suppose the government increases spending during a time when sterilization policy is being followed. The increase in spending would cause a capital inflow and induce a balance of payments surplus. But now the central bank buys foreign exchange and simultaneously sells securities. It would accelerate the inflow of capital. The system is inconsistent, for goods market equilibrium requires an increase in output, but an increase in output can only take place if either the money supply expands or interest rates rise. The capital inflow prevents interest rates from rising and the neutralization policy inhibits the money supply from expanding (Mundell, 1963, p. 481). As illustrated in Figure 2.2.7, there is no equilibrium. Either the exchange rate appreciates or money supply rises.

Figure 2.2.7: Fiscal policy and sterilization operation under fixed exchange rates



So far, our entire analysis has been for the original Mundell-Fleming model, and the standard results of this model are not taken seriously in modern open macroeconomics. Some of the newer development in this area is a variant of Dornbusch's (1976) work. The Mundell-Fleming-Dornbusch model is widely regarded as offering realistic predictions on the exchange rate, interest rate, and output effects of major changes in monetary policy. A central prediction of this model, and indeed of most Keynesian models, is that sticky nominal output prices can induce *overshooting* behavior in exchange rates.

2.3. The comparison between two models, with a look back to the original Mundell and Fleming articles

The compensation thesis is a reflux principle. In light of this statement, it outlines the vital weakness of the Mundell-Fleming mechanism in the case of a fixed exchange market.

Infinite asset substitution versus imperfect asset substitution

The compensation thesis does not assume infinite asset substitution (so there is a limit to capital flows), whereas most neoclassical authors and Mundell refer to perfect capital mobility AND infinite asset substitution.

The assumption of perfect capital mobility can be taken to mean that all securities in the system are perfect substitutes. If there were any difference in the expected rate of return between domestic and foreign assets, investors would put all their wealth into the asset with the higher yield.

The assumption of imperfect asset substitution means that capital is free to go from one country to another, but agents will only put a certain proportion of their wealth in the asset that yields the highest rate of return; they will not put 100% of their wealth in a single asset; they don't want to put all of their eggs in the same basket! Thus, if an interest rate goes down, agents will move out part of their wealth, but not all of it. There will be an adjustment in the initial period, but then stocks will be back in balance, and there will be no flow movement any more (Lavoie, 2004, p. 7).

Sterilization policy versus the Compensation Thesis

Sterilization (or neutralization) policy is a specific combination of monetary and exchange policy in a fixed exchange system. When the central bank buys or sells foreign exchange the money supply increases or decreases, and the purpose of sterilization policy is to offset this effect. The mechanism is for the central bank to sell securities at the same rate that it is buying foreign exchange, and to buy securities at

the same rate that it is selling foreign exchange (Mundell, 1963, p. 480)⁶. Therefore, the disequilibrium policy involves an exchange of foreign reserves and bonds. In another original paper⁷, Mundell (1961) noticed that a balance of payments disequilibrium has an automatic effect on the supply of cash because of the central bank's fixed-exchange-parity policy, but this effect can be canceled and typically is canceled by offsetting open market purchases; in others, the liquidity effect is canceled at the discretion of the central bank. In both cases, however, the end result is the same: external disequilibrium affects the money supply only if this coincides with the internal-balance policy of the monetary authorities (Mundell, 1961, p. 160). This view – basically a sterilization operation of Mundell's claim – is that whatever is the technique employed by the monetary authorities to divorce the money supply from the balance of payments, the result is to impede the operation of the adjustment process.

Mundell is aware of the possibility of compensation (a leading example of this claim is Mundell, 1961, p. 160-162), nevertheless, he thinks it is not automatic. He believes it is the result of some arbitrary decision by the central bank (gold sterilization). There are some other studies, such as those by Bloomfield (1959) “in the case of every central bank the year-to-year changes in international and domestic assets were more often in the opposite than in the same direction” or Nurkse (1944) “neutralization was the rule rather than the exception”, that show that there was consistently some form of sterilization.

With regards to the compensation thesis, it is important to note that sterilization is itself, to a large extent, the result of an endogenous process. A leader

⁶ Mundell, R. (1963), ‘Capital mobility and stabilization policy under fixed and flexible exchange rates’, *Canadian Journal of Economics and Political Science*, 29 (Nov.), 475-485.

⁷ Mundell, R. (1961), ‘The international disequilibrium system’, *Kyklos*, 14 (2), 153-172.

among skeptics of the sterilization view is Lavoie (2001, p. 229), who argues that: “With fixed exchange rates, sterilization occurs automatically. Despite the huge increase in foreign reserves, there will be no change in the overall size of the assets of the central bank, and hence no change in the monetary base or in the supply of money.” To paraphrase Lavoie (2001, p. 214-242), a theory of the reflux principle that has nothing to say about the automatic endogenous process is like a theory of earthquakes that explains only small tremors. Moreover, a dynamic model, based on a watertight stock-flow accounting, presented by Godley & Lavoie (2004, p. 1-30), is a formalized proof of this *compensation* phenomenon. Invariably, partly as a result of it, we can refute the *price-specie-flow* mechanism of Hume, the *income-specie-flow* mechanism of Keynes, as well as the bullionist principle.

It is an important claim of neoclassical economists that sterilization policy cannot achieve internal stability and balance-of-payments equilibrium under the effect of a fiscal or monetary policy. “Gold sterilization policies make no sense in a world of fixed exchange rates and perfect capital mobility and will ultimately lead to the breakdown of the fixed exchange system”(Mundell, 1963, p. 485). The compensation thesis is an automatic “sterilization policy”, thus, it still has no equilibria. Lavoie (2001, p. 216) notes that, “An obvious consequence of the compensation principle is that, with fixed exchange rates, no mechanism will spontaneously bring back the economy to a balance of payments equilibrium.” It is a *quasi* steady state, where the value of bills purchased by the central bank is a response to the losses in the value of gold rather than vice versa and the money stocks hardly change. Countries with external surpluses should pursue expansionary policies, so as to help out countries with external deficits (Davidson, 1994, p. 265). The reflux mechanism has deeply

influenced thinking on a board range of policy issues.

The obsolete view of the lack of control over monetary policy

The standard view in economics is that fiscal policy achieves new internal and external equilibria, while monetary policy brings back the economy to its original equilibria in the pegged exchange system. Just as mentioned in section 2. 2, based on the IS/LM/BP model, we can concluded that a rise in the demand for money leads only to an increase in the money supply, and the monetary policy lack of control in fixed exchange rate. In addition, Mundell (1963, p. 479-484) argued that, "Monetary policy under fixed exchange rates becomes a device for altering the levels of reserves, leaving unaffected the level of output and employment...The increase in the money supply arising form open market purchases is returned to the central bank through its exchange stabilization operations. What the central bank has in fact done is to purchase securities initially for the money, and then buy money with foreign exchange, the monetary effects of the combined operations canceling. The only final effect of the open market purchase is an equivalent fall in foreign exchange reserves: the central bank has simply traded domestic assets for foreign assets". Furthermore, it is documented that monetary policy ought to be aimed at external objectives and fiscal policy at internal objectives. In countries where employment and balance-of-payments policies are restricted to monetary and fiscal instruments, monetary policy should be reserved for attaining the desired level of the balance of payments and fiscal policy for preserving internal stability. The opposite system would lead to a progressively worsening unemployment and balance-of-payments situation (Mundell, 1962, p. 239).

Dating back to the work of Fleming⁸, “a monetary expansion must always exercise a more powerful effect on income and output when there is a freely floating rate of exchange than when the exchange rate is fixed.” “Under a fixed exchange rate – except to the extent that the external accounts were originally in surplus – monetary expansion can be sustained only as long as reserves hold out.” This belief, among most textbook writers, also shows that under a fixed exchange rate, there is little scope for the use of monetary policy for domestic stabilization purposes, because of the sensitivity of international capital flows to interest rates. The central bank will be forced to maintain domestic interest rates close to the levels existing in the rest of the world, and it will not be able to exercise independent control over the domestic money supply. Under a fixed exchange rate, interest-sensitive international capital flows stabilize the domestic interest rate and enhance the effectiveness of fiscal policy.

Unfortunately, the above arguments lose their strength if we introduce a full set of double entry accounts into this field. Godley & Lavoie (2004, p. 12)⁹ criticize the claim that monetary policy is powerless in a fixed exchange rate economy by setting up a stock flow model of two economies, showing that fiscal policy and also monetary policy, under the form of interest rate setting, are both fully under the control of each government. External deficits or surpluses do not generate any change in the money supply, which remains entirely demand-determined. Floating exchange

⁸ Fleming, J.M. (1962), ‘Domestic financial policies under fixed and under floating exchange rates’, *International Monetary Fund Staff Papers*, 9 (Nov.), 372-373.

⁹ Godley, W. and Lavoie, M. (April 2004), ‘Simple open economy macro with comprehensive accounting a radical alternative to the Mundell Fleming model’ Cambridge and Ottawa. p. 1-13

rates are not superior to fixed rates when money shocks are the dominant source of disturbance. Monetary policy thus turns out to be a domestic stabilizer even when the exchange rate is fixed. Just as fiscal policy derives its importance as a domestic stabilizer from its influence on capital flows, so monetary policy is not frustrated in its effects by these same considerations.

Foreign reserves versus the money supply

On a number of occasions, Mundell has underlined the relationship between foreign exchange reserves and the monetary base. Here are some quotes: "...To prevent the exchange rate from falling the central bank intervenes in the market, selling foreign exchange and buying domestic money..."; " ... Forcing the central bank to intervene by buying foreign reserves and increasing the money supply"; "When the central bank buys or sells foreign exchange the money supply increases or decreases" (Mundell, 1963).

The above means that with a balance-of-payments surplus, central banks acquire foreign reserves. This leads to rising high-powered money and hence rising money supply. This view however is highly implausible, since coherent stock flow accounting shows there is no long run relationship between the two variables.

Supply-led versus demand-led

Mainstream economists are usually keen to say that the money supply is endogenous in a fixed exchange rate regime, but it would be helpful to bear in mind that this endogenous process is supply-determined. The stock of money falls or rises because the amount of foreign reserves falls or rises. Unlike this supply-led endogenous money supply, post-Keynesian authors assert that it is endogenous and

demand-led. Money supply grows (or diminishes) because households demand banknotes in the domestic economy.

The IS/LM/BP model versus a watertight stock flow accounting

The models presented by Godley and Lavoie are set within an entirely different paradigm from that of Mundell-Fleming-type models, which largely ignore the concept of stock equilibrium and attempt to explore the *openness* of a single economy without taking explicit account of responses from the rest of the world (Godley & Lavoie, 2003, p. 3).

The balance sheet of the central bank

It may seem a paradoxical claim to say that balance sheets of central banks have only four significant items, two on each side, as indicated in Table 2.3.1: (Lavoie 2001, p. 221)

Table 2.3.1: A balance sheet of central bank in neoclassical view

Assets	Liabilities
Foreign reserves	Currency in circulation
Domestic securities	Bank reserves

Bank reserves plus currency in circulation equate the monetary base, and there is only one item on the liability side.

On a theoretical plane, the post-Keynesian view has the following balance sheet for central banks (Table 2.3.2):

Table 2.3.2: A balance sheet of the post-Keynesian central bank

Assets	Liabilities
Foreign reserves	Currency in circulation
Domestic securities	Bank reserves
Advance to the private bank	Central bank bills
	Foreign liabilities
	Government deposits

Adding more components (government deposits, foreign liabilities and central bank bills) to the liabilities of the central bank, as well as adding advances to private banks to the assets of the central bank, destroy the necessary association between the assets of the central bank and the monetary base. Thus, the neoclassical view does not withstand accounting scrutiny.

Asset-based economy versus overdraft economy

The Mundell-Fleming model is ill equipped to capture the overdraft economy, as it does not account for advances to the private banks. The model's lack of an overdraft component deprives it of any metric by which to evaluate contemporary macroeconomic policies in most financial systems of the world, including the Chinese one.

3. Empirical experience in China

Theory is valuable in that it can provide a direction for practice. We may justify the compensation thesis by providing a large number of examples. More detailed surveys can be found in Lavoie (2001), Claassen (1996), Berger (1972), Bloomfield (1959) and Nurkse (1944). In this section, a number of actual episodes suggest that

the compensation thesis is more than a theoretical possibility in the Chinese monetary system. I will model the problem formally, explore its bearing on the relationships among foreign reserves, advances to private banks, central bank bills and the monetary base, and ask whether the compensation thesis can help governments maintain monetary policy credibility.

A post-Keynesian view of Chinese banking

A series of significant reforms in the Chinese banking system have been launched since 1978. On March 18, 1995, the first central bank law was promulgated, which gave the central bank (the People's Bank of China -- PBC) the unique legal right to implement monetary policy. On May 11, 1995, the commercial bank law was enacted so that the major domestic banks were transformed to wholly state-owned commercial banks. Since then, monetary policy acts as a key role and a crucial instrument in macroeconomic management by the central bank.

China began to liberalize interest rates and make them become the main tool of monetary policy in 1978. The PBC adjusted the banking interest rates more than twenty times over the recent years (see Figure 3.1 in the appendix). Meanwhile in 1998, the imperative credit plan was abolished, transforming the money supply evolution from a planning mechanism to a market mechanism. It is self-evident that the interest rate is an exogenous variable determined by the central bank, while the money supply acts as an endogenous variable led by the interest rate, demanded by the private banks and the households. This evidences motivates a look at the compensation thesis.

The assumptions of the compensation thesis

A pegged exchange rate regime. On January 1, 1994, the official and swap

market exchange rates were unified at the prevailing swap market exchange rate at the end of 1993—RMB8.7 per US dollar and a unique managed floating regime was set up in China. The fluctuation of the RMB / Dollar exchange rate is permitted within a 0.3% band (see Figure 3.2 in the appendix). The PBC is committed to maintain a stable exchange rate through interventions in the China Foreign Exchange Trade System (CFETS). It is clear that a pegged exchange rate regime has been run from 1994 to the present, and a stable exchange rate becomes one of the objectives of the PBC.

A limit to capital flows. In October 1993, China made an official commitment to follow IMF guidelines by implementing current account convertibility by 2000. In 1994, the requirement to obtain prior approval from the State Administration for Exchange Control (SAEC) for the purchase of foreign exchange conducted by the domestic enterprises was rescinded. On Dec.1, 1996, the preliminary steps to carry out current account convertibility were established to make the Chinese market more integrated with the international market.

A trade surplus situation. Figure 3.3 in the appendix shows a blistering pace growth in foreign reserves in recent years. This is an objective drafted by the government since China had little foreign reserves at the beginning of the opening up process and needed to buy modern equipments and techniques to accelerate construction.

A more complicated balance sheet of the PBC. Table 3.1 indicates the structure of the balance sheet of the PBC.

Table 3.1: The balance sheet of the PBC in recent years

Assets	Liabilities
Foreign assets	Reserve money
Claims on central government	(of which currency outside banks)
Claims on other sectors	Central bank Bonds
Claims on deposit money banks	Foreign liabilities
Claims on other banking institutions	Central government deposits
Claims on nonbank financial institutions	Capital accounts
	Other items (net)

On the asset side, the sum of the items of claims on deposit money banks, claims on other banking institutions and claims on nonbank financial institutions denote advances to commercial banks. In other words, one may easily deduce that China runs an overdraft economy. On the liability side, currency in circulation plus reserves are equal to the monetary base, and the monetary base multiplied by a money multiplier (around 8 in China) is equal to the money supply. In general, reserve money alludes to the money supply. The other items, bonds, central government deposits and foreign liabilities, totally disrupt the straightforward association between the asset side and the monetary base. The item of central bank bonds is a *special entry* on the liability side, which is the result of “*an open market operation*”¹⁰. The PBC prefers to perform immediate compensation, at their initiative, making use in particular of central bank bills. By the end of 2003, the central bank has made 63 issues of central bank bills, with a total issuance amount of RMB722.68 billion yuan, and outstanding amount of RMB337.68 billion yuan.

In a world of endogenous money, if agents wind up with money that they do not want to spend, they will use it to reduce their debits, or find some means to increase their income. When there is an influx in foreign reserves of the PBC, the commercial

¹⁰ Actually it is a compensation process as I analyze below.

banks will use their increased reserves to reduce their debits at the PBC. Meanwhile, when the PBC issues central bank bills, the commercial banks buy them to increase their income. Both of these actions will cause a reduction in the excess reserves held by commercial banks. As a result, the variations in the monetary base were quite limited. The illustrations of Table 3.2 and Table 3.3 are simplistic. Nevertheless, they may suggest that the peaks in foreign exchange were accompanied by troughs in credits to the domestic economy, and by new issues of central bank bills. By contrast, the movements in the monetary base have not been large enough to account for the full variability in foreign reserves.

Table 3.2: The balance sheet of the PBC (unit: billion yuan)

	January, 2003	July, 2003
<u>Assets</u>	<u>4697.80</u>	<u>4983.41</u>
Foreign Assets	2447.45	2794.67
Claims on Central Government	286.38	300.72
Claims on Other Sectors	20.67	20.64
Claims on Commercial banks	1943.3	1867.38
<u>Liabilities</u>	<u>4697.79</u>	<u>4983.41</u>
Reserve Money	4809.73	4685.98
Bonds	95	301.91
Foreign Liabilities	43.38	44.02
Central Government Deposits	173.08	282.35
Capital Accounts	24.67	24.7
Other Items (Net)	-448.07	-355.55

Source: IMF, International Financial Statistics, April and May in 2003.

Table 3.3: The balance sheet of the PBC (unit: billion yuan)

	January, 2004	April, 2004
<u>Assets</u>	<u>5513.18</u>	<u>5660.40</u>
Foreign Assets	3218.86	3489.47
Claims on Central Government	302.31	300.70
Claims on Other Sectors	18.69	20.58
Claims on Commercial banks	1973.32	1849.65
<u>Liabilities</u>	<u>5513.18</u>	<u>5660.40</u>
Reserve Money	5606.78	5419.96
Bonds	325.01	609.87
Foreign Liabilities	48.26	51.87
Central Government Deposits	256.98	350.23
Capital Accounts	24.88	24.82
Other Items (Net)	-748.73	-796.34

Source: IMF, International Financial Statistics, January and April in 2004

Furthermore, Figure 3.3 illustrates that four nominal variables from June 1999 to March 2004. It is interesting to note that the rising amounts of foreign exchange are offset by the decrease in the claims on commercial banks and by the increase in central bank bills. One might conjecture that the compensation thesis exists in China.

4. The econometric methodology

Before we start to explore empirical results, it is necessary to have a brief introduction on the econometric methodology. The data are time series, and unit root tests would firstly be applied to determine the order of integration of variables. If each variable is I (1), it may be a cointegration relationship among the non-stationary variables. Johansen Cointegration test can be performed to examine whether a group of non-stationary series is cointegrated. If there exists a cointegration relationship, the

estimated Vector Error Correction Model (VECM) might be estimated. Furthermore, the Granger causality test can be adopted to measure the causal relations in terms of stationary variables.

The Unit Root tests

The Augmented Dickey-Fuller (ADF) test (Dickey and Fuller, 1979) has the following form to control for the higher-order correlation:

$$\Delta y_t = \alpha y_{t-1} + \delta_1 \Delta y_{t-1} + \delta_2 \Delta y_{t-2} + \dots + \delta_p \Delta y_{t-p} + \varepsilon_t,$$

and the hypotheses are:

$$H_0 : \alpha = 0$$

$$H_1 : \alpha < 0.$$

If there is nonzero mean or trend in the series, the DF-GLS test (Elliott, Rothenberg and stock, 1996) improves the size-adjusted power in finite samples relative to the ADF test. The GLS detrended data, y_t^d , are defined using the estimates associated with the \bar{a} :

$$y_t^d \equiv y_t - x_t' \delta(\bar{a}).$$

The DF-GLS test involves substituting the GLS detrended y_t^d for the original y_t to estimate the standard ADF test equation. The regression of the DF-GLS test is:

$$\Delta y_t^d = \alpha y_{t-1}^d + \beta_1 \Delta y_{t-1}^d + \dots + \beta_p \Delta y_{t-p}^d + v_t.$$

Since y_t^d is detrended, x_t is not included in the DF-GLS test regression.

Johansen's Cointegration test

The Johansen's cointegration test is developed by Johansen (1991,1995). Based on a VAR estimated of order p:

$$y_t = A_1 y_{t-1} + \dots + A_p y_{t-p} + Bx_t + \varepsilon_t,$$

where y_t is a n -vector of non-stationary $I(1)$ variables, x_t is a d -vector of deterministic variables, and ε_t is a vector of innovations, and rewrite the VAR as a VECM:

$$\Delta y_t = \Pi y_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta y_{t-i} + Bx_t + \varepsilon_t$$

where

$$\Pi = \sum_{i=1}^p A_i - I,$$

$$\Gamma_i = - \sum_{j=i+1}^p A_j$$

Granger's representation theorem asserts that if the coefficient matrix Π has reduced rank $r < k$, then there are $k \times r$ matrices α and β each with rank r such that $\Pi = \alpha\beta'$, and $\beta'y_t$ is $I(0)$, r is the number of cointegrating relations (the rank), and each column of β is a cointegrating vector. The elements of α are known as the adjusted parameters in the VEC model. Johansen's method estimates the Π matrix from the VECM, and tests whether we can reject the restrictions implied by the reduced rank of Π .

To determine the number of the cointegrating relations, Johansen (1988) proposes to use the following two statistics:

$$Q_r = -T \sum_{i=r-1}^k \ln(1 - \hat{\lambda}_i)$$

$$Q_{\max} = -T \ln(1 - \hat{\lambda}_{r+1})$$

where $\hat{\lambda}_i$ = the estimated values of the characteristic roots (also called eigenvalues), and

T = the number of observations.

The first statistic tests the null hypothesis that the number of distinct cointegrating vectors is less than or equal to r against a general alternative. The second statistic tests the null hypothesis that the number of cointegrating vectors is r against the alternative of $r+1$ cointegrating vectors.

Vector Error Correction (VEC) models

A vector error correction (VEC) model is a restricted VAR designed for use with nonstationary series that are known to be cointegrated. The VEC model has cointegration relations built into the specification so that it restricts the long-run behavior of the endogenous variables to converge to their cointegrating relationships while allowing for short-run adjustment dynamics. The cointegration term is known as the correction term since the deviation from long-run equilibrium is corrected gradually through a series of partial short-run adjustments.

To take the simplest possible example, consider a two variable system with one cointegrating equation and no lagged difference terms. The cointegrating equation is

$$y_{2,t} = \beta y_{1,t} ,$$

and the VEC model is

$$\Delta y_{1,t} = \alpha_1 (y_{2,t-1} - \beta y_{1,t-1}) + \varepsilon_{1,t}$$

$$\Delta y_{2,t} = \alpha_2 (y_{2,t-1} - \beta y_{1,t-1}) + \varepsilon_{2,t} .$$

In this simple model, the only right-hand side variable is the error correction term. In long run equilibrium, this term is zero. However, if y_1 and y_2 deviate from the long run equilibrium, the error correction term will be nonzero and each variable adjusts to partially restore the equilibrium relation. The coefficient α_i measures the speed of adjustment of the i -th endogenous variable towards the equilibrium.

Granger causality test

Granger (1969) points out that “whether x causes y is to see how much of the current y can be explained by past values of y and then to see whether adding lagged values of x can improve the explanation. In other words, y is said to be Granger-caused by x if x helps in the prediction of y, or equivalently if the coefficients on the lagged x’ s are statistically significant. To take the simple possible example, consider a two-time series model (Granger, 1969, p. 431):

$$x_t = \sum_{j=1}^m a_j x_{t-j} + \sum_{j=1}^m b_j y_{t-j} + u_t$$

$$y_t = \sum_{j=1}^m c_j x_{t-j} + \sum_{j=1}^m d_j y_{t-j} + v_t .$$

where time series x_t and y_t are assumed to be stationary, and the u_t and v_t are white noise residuals. y Granger causes x while $\sum_{j=1}^m b_j \neq 0$ and $\sum_{j=1}^m c_j = 0$, and vice versa. Stationary variables are a requirement for this test.

5. The empirical analysis

5.1 The data

The data are retrieved from the international monetary fund (IMF)—international financial statistics online service, and the survey is designed to provide information for foreign reserves, advances to the private banks, central bank bills as well as the monetary base in the balance sheet of the PBC. These are monthly data and cover the period from June 1999 to March 2004, totaling 57 observations. This specific period is chosen because the more recent the period, the better the accuracy to show theories linked to Chinese monetary policies. We carried out all tests with the help of the

Eviews 4.1 software.

5.2 The empirical results

Figure 5.2.1 displays time series in levels (*real_or*, *real_ad* and *real_hh* are transformed by taking natural logarithms, and except for *real_cb*), which have trends and non-zero means. Figure 5.2.2 suggests that time series in first differences are stationary around a zero mean, and trends are purged from the system.

The results of unit root tests

We now consider the order of integration in the light of the Augmented Dickey-Fuller (ADF) test and the Elliott, Rothenberg and Stock DF-GLS test.

Firstly, with a constant and linear trend in test regressions, the results for series in levels is shown in Table 5.2.1. Eviews 4.1 automatically selected the appropriate lag length, based on the MAIC. This criterion is better than other criteria because it provides the best combination of size and power in finite sample (Ng and Perron, 2000). The *t* statistics are all less than the critical value (in absolute value) even at the 1% level, and we cannot reject the null hypothesis that each variable has a unit root.

Secondly, with no trend in test regressions, the result for series in first differences is shown in Table 5.2.2. The MAIC sometimes gives us too higher lags. The usual advice is to include lags sufficient to remove any serial correlation in the residuals. Hence, the fixed lag length is proposed by 1 or 2. The *t* statistics are larger (in absolute value) than the critical value at least at the 5% level, and we can reject the null hypothesis to conclude that variables in first differences are stationary.

The Johansen Cointegration test for the whole case

As it stands, it is appropriate to apply a linear multivariate model by using standard Johansen Cointegration test to investigate the long run co-movement among

all variables: advances to commercial banks, the monetary base, bonds and the foreign exchange.

The result of the test can be quite sensitive to the lag length. The VAR lag order selection criteria test indicates that the optimal lag length is 4 in the unrestricted VAR (and 3 in first differences) based on the Akaike Information Criterion (AIC). In addition, it may be allowed for a linear deterministic trend in the data and intercept (no trend) in the cointegration equation.

Table 5.2.3 summarizes the result of the cointegration test. In accord with the trace statistic, the null hypothesis is that variables are not cointegrated ($r = 0$) against the alternative of one or more cointegrating vectors ($r > 0$), $\lambda_{trace}(0)$ statistic is 57.875, which is greater than the critical value at the 5% (47.21) and 1% (54.46) level. It is possible to reject the null hypothesis of no cointegrating vectors and accept the alternative of one or more cointegrating vectors. Next, we can use the $\lambda_{trace}(1)$ statistic to test the null of $r \leq 1$ against the alternative of two or three cointegrating vectors. In this case, the $\lambda_{trace}(1)$ is 27.44, which is less than the critical value at the 5% level (29.68). We cannot reject the null hypothesis at this significance level. However, 27.44 does exceed the 90% critical value of 26.8; one might reject the null and accept the alternative of two or three cointegrating vectors. The $\lambda_{trace}(2)$ statistic indicates no more than two cointegrating vectors at the 90% level significance level. Similarly, based on the λ_{max} statistic, it illuminates that there is one cointegrating vector at the 5% critical level, and no cointegration at the 1% level.

Following Reimers (1992), I may correct the value of Johansen's trace statistic for the finite sample size, using the following formula:

$$Q_r' = \frac{T - np}{T} Q_r$$

where T is the number of observations used to estimate the model, n is the number of variables included in the VAR system, and p is the number of lags in the VAR system. The corrected trace statistic indicates that one cointegrating vector at the 10% critical level.

As a result, the Trace and Max-eigenvalue statistics indicate that one cointegrating vector at the 5% critical level and the corrected Trace statistic reveals one cointegrating vector at the 10% critical level. It supports that there exists long run equilibrium in the balance sheet of the PBC, but which variable actually contributes to this long run co-movement, which has no effect on it? Exclusion restriction test would be proposed to consider these relationships.

Table 5.2.4 illustrates the results of the likelihood-ratio exclusion restriction tests on the cointegrating vector. The chi-square statistic for excluding `inreal_hh` is 0.335 and the P-value is 0.551 that largely exceeds the 5% critical level. Thus, we cannot reject the null hypothesis at this significant level. The most important of all, the monetary base has no effect on this long run co-movement. In other words, the change in the monetary base does not rely on the change in other three variables, which is consistent with our hypothesis. Subsequently, the p-value for excluding `inreal_ad` is 0.007, which is less than 1% critical level. It quite be rejected the null hypothesis and concluded that claims to commercial banks contribute to the long run cointegrating relation in the balance sheet of the PBC. Without the `real_cb`, the p-value (0.0003) is statistically significant even at the 1% level and it is obviously shown that central bank bills have crucial impact on the common trend. All of conclusions are statistically significant to link to the compensation thesis.

The whole case test underlies the vital characteristic of the reflux principle, and subcases would be processed in detail to further confirm the relationships among

series.

The empirical analysis for the first sub case

One of the most interesting discrepancies in two theories is whether the change in money supply responds to changes in foreign reserves. As shown in Table 5.2.4, we have already concluded that monetary base has no power on the long run co-movement.

In what follows I perform a sub case (only including two variables: *inreal_or* and *inreal_hh*) Johansen Cointegration test to clarify the fact. As shown in Table 5.2.5, lag-length test indicate setting $p=1$ and no lags in the first differences. $\lambda_{trace}(0)$ statistic is 7.441, which is less than the critical value at the 5% level (15.41) and 1% level (20.04), and we cannot reject the null hypothesis that the variables are not cointegrated. Similarly, the max-eigenvalue $\lambda_{max}(0,1)$ statistic is 7.385, and it is less than the critical value at the 5% and 1% level. The corrected trace statistic also indicates that no cointegrating vector at the 10% critical level. The above tests strongly support the point that there is no long run relationship between imported capital and the monetary base. Nothing here is essential for the compensation thesis, and the Mundell –Fleming model seems difficult to sustain.

Similar remarkable results are obtained when we carry out a pairwise Granger causality test. By using stationary variables in first differences and choosing lag length automatically, the result shows in Table 5.2.6. The p-values of the two hypotheses are higher than the critical value at 5%, which implies we cannot reject the null hypothesis in either direction. The monetary base does not Granger cause foreign reserves, while foreign reserves do not Granger cause the monetary base. The outcome is coherent with the result presented for the cointegration test (both the whole case and the subcase), showing that the Mundell-Fleming model cannot be

supported by Chinese data.

The empirical analysis for the second sub case

Since central bank bills are usually by far the important assets in the PBC, it provides a good opportunity to take into account the direct effect of central bank bills on foreign reserves.

Table 5.2.4 has revealed that central bills contribute to the long run linear relationship. The regression may be obtained in the VEC model (Table 5.2.3):

$$\text{Inreal_or} = -1.18 \text{Inreal_hh} + 2.75 \text{Inreal_ad} + 0.003 \text{Real_cb} - 3.68$$

The coefficient of `real_cb` is 0.003, which highlights a positive long run equilibrium between foreign capital and bonds.

The values of α in the VEC model (Table 5.2.3) are in the following order:

`Inreal_or`, `Inreal_hh`, `Inreal_ad` and `Real_cb`:

$$\alpha = (0.046, 0.007, 0.051, 126.285) .$$

It is easy to show that central bills substantially adjust to changes in foreign exchange rather than the reverse, which reflect the short run dynamics. According to the sign of α , it may imply that bonds and imported capital are in the same deviation from the long run equilibrium.

Furthermore, based on the whole case cointegration test, a restricted VEC model may be carried out to verify the robust impact of central bills on foreign reserves once again. The null hypotheses are: the coefficient of `inreal_or` is equal to one, the coefficients of `inreal_hh` and `inreal_ad` are equal to zero and the adjustment coefficients of `inreal_hh` and `inreal_ad` are equal to zero. As shown in Table 5.2.7, the coefficients of the cointegrating vector can be expressed as:

$$\text{Inreal_or} = 0.00151 \text{Real_cb} + 7.505.$$

This equation shows, as I hypothesized, a parallel movement of the two variables. A permanent rise in foreign exchange therefore makes central bank bills rise less than proportionately to the foreign exchange increase. In some extent, the coefficient is smaller than the expectation. It may be due to the amount of central bills are zero in previous periods (February 2000 - August 2002), and the skyrocketing increase of central bills followed by rapidly booming foreign reserves just in recent years (September, 2002 – at present). A striking phenomenon in line with this finding is that the Chinese central bank is using this special tool to compensate for the appearance of foreign exchange reserves. In 2003, foreign reserves injection added up to RMB 1146 billion yuan, while “open market operation” withdrew RMB 269 billion yuan.

In addition, as can be seen from the α coefficients in Table 5.2.7 by the order of Inreal_or and Real_cb:

$$\alpha = (0.047, 181.694)$$

The speed of adjustment coefficient denotes how fast variables adjust during the transition to the long-run equilibrium. The larger the value of the factor in α , the faster the variable adjusts. Thus, bonds that are quite sensitive adjust to changes in foreign reserves rather than the converse in the short run dynamics and they are in the same deviation from the steady state, which is once again what is being expected from the compensation thesis. But to some extent, 181.69 is too high to be credible, and it may be also due to the zero data from February 2000 to August 2002.

The empirical analysis for the third subcase

China runs an overdraft economy, and it is necessary to explore the impact of advances to commercial banks on foreign reserves. As noted, Table 5.2.4 sufficed to illustrate the nature of advances to banks that contribute to the long run equilibrium. In the light of the whole case cointegration test, a restricted VEC model may be

performed. The restrictions can be set by the coefficient of inreal_or that is equal to one, the coefficients of inreal_hh and real_cb and the adjustment coefficients of inreal_hh and real_cb are zero. The distinctive conclusions illustrate in Table 5.2.8, and coefficients of variables are shown in the following regression:

$$\text{Inreal_or} = -2.659 \text{ Inreal_ad} + 27.849 .$$

This equation captures the negative relationship between claims to banks and foreign reserves. The estimated coefficient is little higher. But in general, it is pretty much in line with expectation, since the sign is negative and one unit change in Inreal_or will tend to 2.659 units changes in Inreal_ad in the opposite direction.

The corresponding adjustment coefficients with respect to Inreal_or and Inreal_ad are illustrated in Table 5.2.8,

$$\alpha = (-0.007746, -0.033594) .$$

Obviously, advances to banks adjust to changes in foreign reserves rather than the converse in the short run dynamics, which further supports the compensation thesis.

This empirical section began by illustrating the compelling empirical case for incorporating the compensation thesis into Chinese open-economy analysis. The empirical evidence hardly provides any support for the Mundell-Fleming model with a fixed exchange rate. Perhaps this outcome should not be surprising given the large amount of institutional evidence in favor of the compensation thesis. The Governor of the Fed, Alan Greenspan, has claimed that: "Chinese accumulation of US treasury bills is making it difficult for them to manage their monetary policy." The above analysis strongly suggests that he is totally mistaken (Lavoie, 2003, p. 21). To summarize, I believe that the compensation thesis, a key component of the post-Keynesian view in describing open economies, is a sound description of the way

the Chinese financial system functions.

6. Conclusion

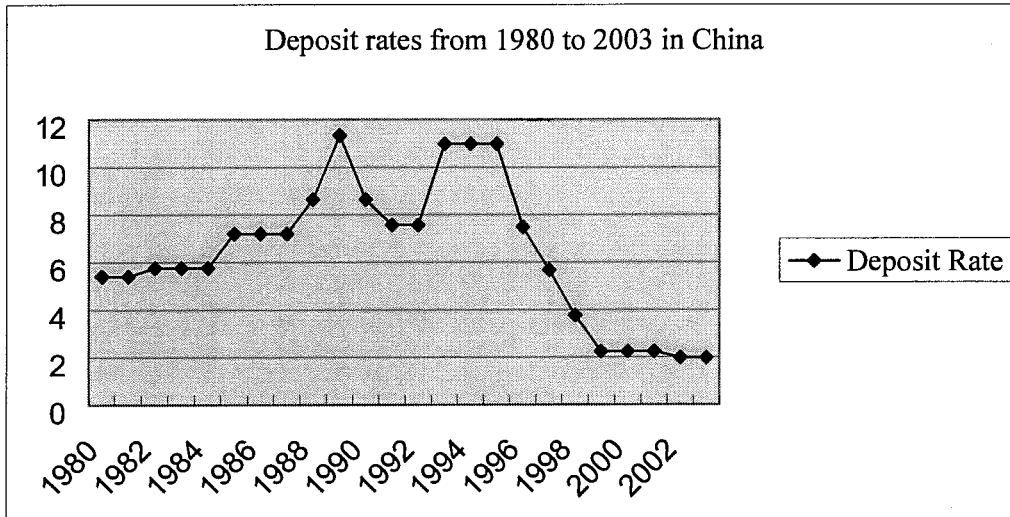
In this paper, we compare the Compensation thesis with the Mundell-Fleming mechanism. The former regards the claims to commercial banks as an endogenous variable while the latter regards it as an exogenous one. We take China as an example, showing that the compensation thesis correctly reveals the endogenous automatic process, while there is no exogenous sterilization policy. Inflows could also be compensated by an increase in central bank bills issued by the central bank, as the central bank of China does nowadays. In accord with the empirical analysis, it is interesting to note that there is no dramatic increase in the monetary base over the recent period in response to the substantial influx of foreign reserves. This is no doubt due to the endogenous compensation mechanism, either as the advances granted to the domestic banking sector offsets part of the increased foreign reserves or as new issues of central bank bills rein in part of the increase in foreign exchange. The econometric evidence is very clear. There exists a negative long-run relationship between foreign reserves and advances to commercial banks, and there exists a positive long-run relationship between foreign reserves and the issues of central bank bills. The VECM analysis also supports the causality imbedded into the compensation thesis, since both central bank bills and advances to commercial banks adjust in maintaining the cointegration relation, while foreign reserves do not. Furthermore, there is no long-run relationship whatsoever between foreign reserves and the monetary base.

As a result of this, it cannot be emphasized enough that so far as full employment is a primary goal of public policy in a world where growth is demand-determined,

countries with external surpluses should have no hesitation in pursuing expansionary policies (Lavoie, 2001, p. 238).

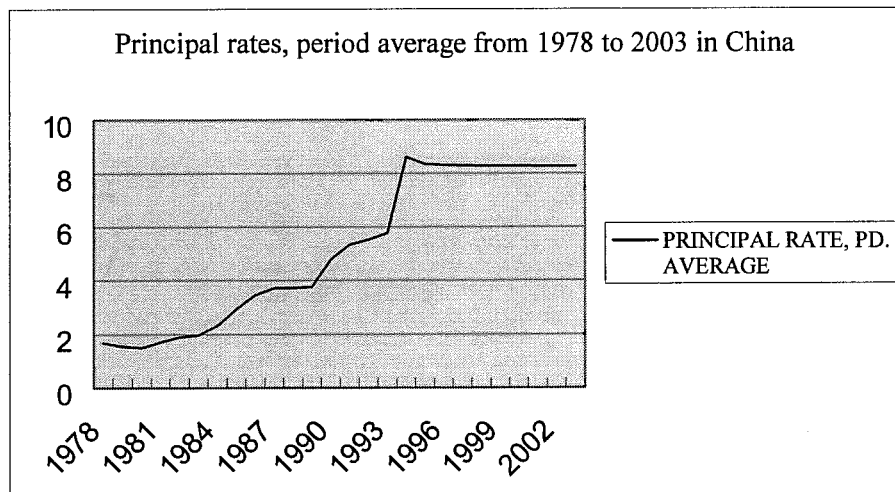
APPENDIX

Figure 3.1: Deposit rates from 1980 to 2003 in China (unit: percent)



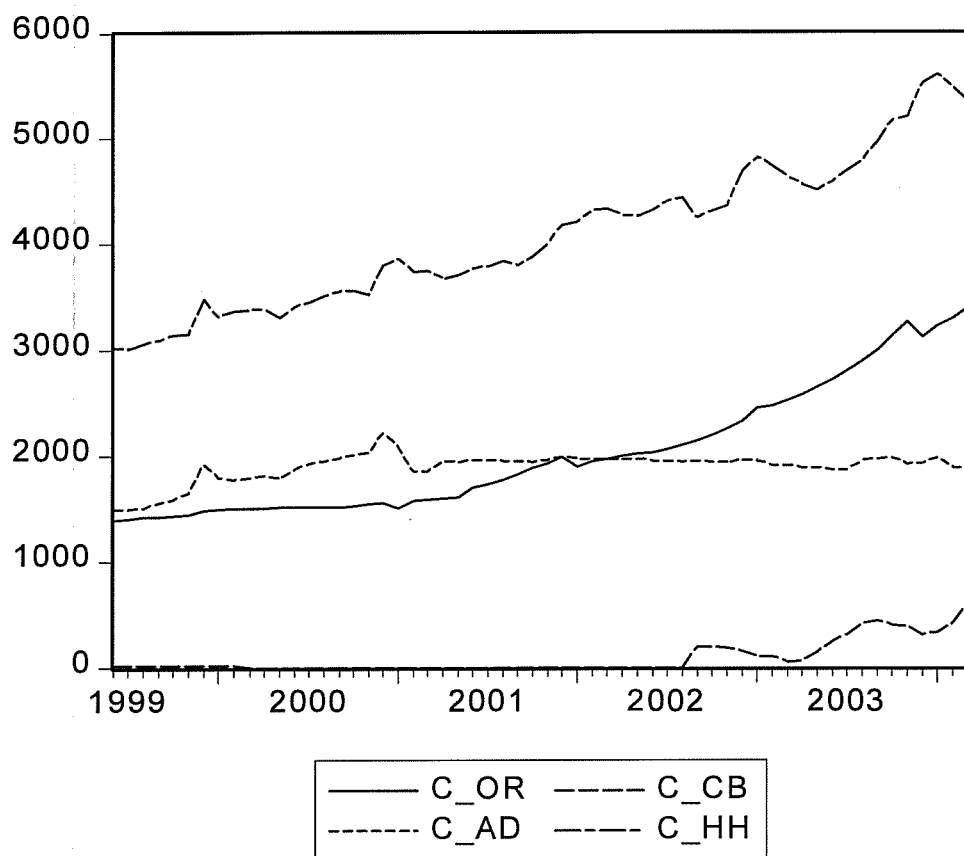
Source: IMF, International Financial Statistics.

Figure 3.2: Principal exchange rates, period average from 1978 to 2003 in China (unit: RMB/US)



Source: IMF, International Financial Statistics.

Figure 3.3: Nominal variables from June 1999 to March 2004 in China (unit: billion yuan)



where

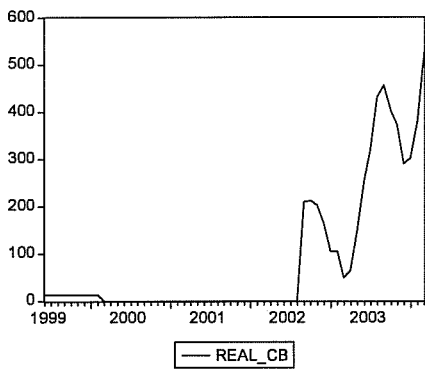
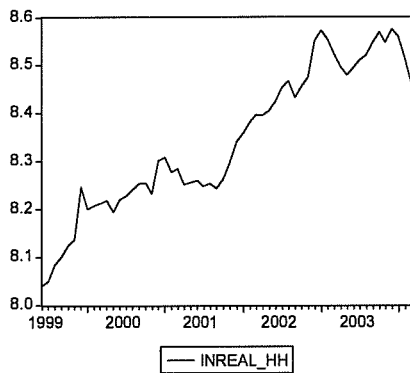
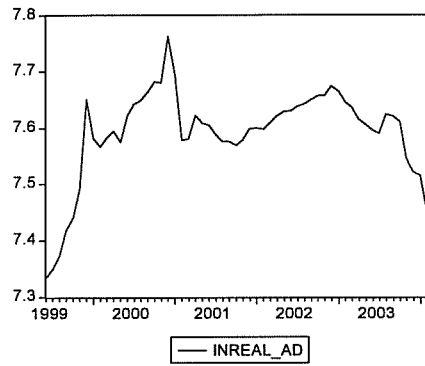
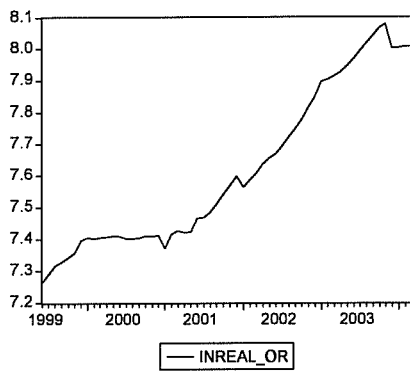
c_{or} = the nominal value of foreign reserves

c_{ad} = the nominal value of advances to private banks

c_{cb} = the nominal value of central bank bills

c_{hh} = the nominal value of the monetary base

Figure 5.2.1: Time series in levels



where

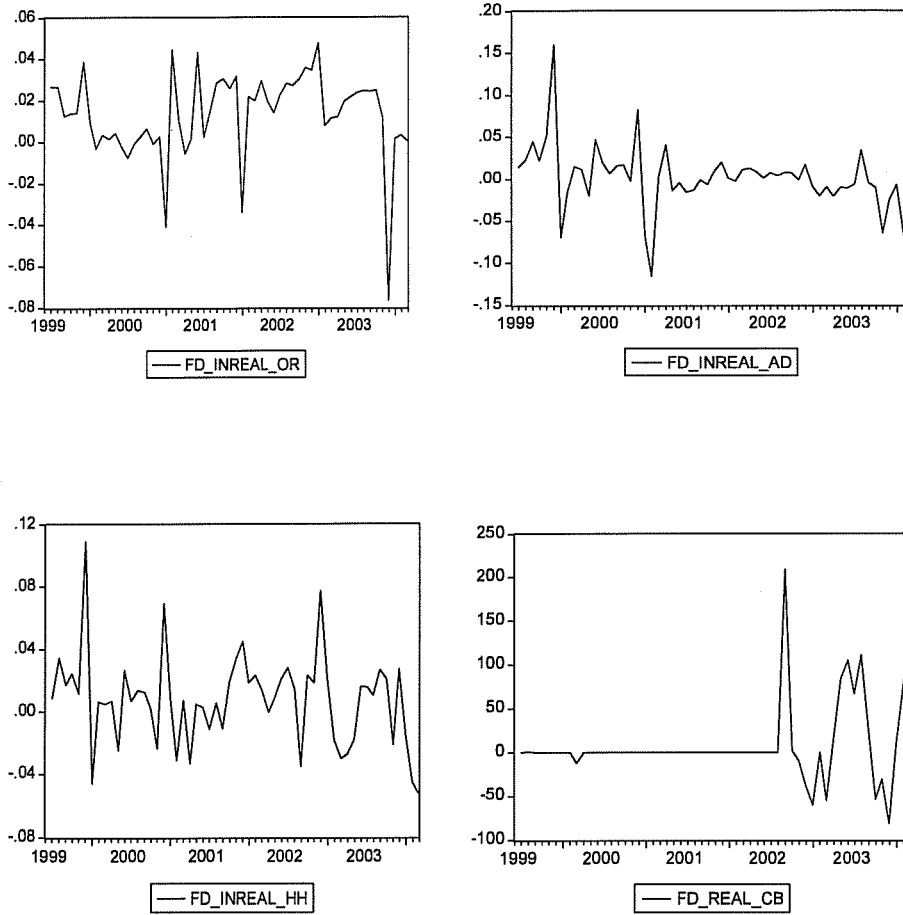
$inreal_or$ = the natural logarithm form of real foreign reserves

$inreal_ad$ = the natural logarithm form of real advances to private banks

$inreal_hh$ = the natural logarithm form of the real monetary base

$real_cb$ = the real value of central bank bills

Figure 5.2.2: Time series in first differences



where

fd_inreal_or = the first difference in natural log form of real foreign reserves

fd_inreal_ad = the first difference in natural log form of real advances to private

banks

fd_inreal_hh = the first difference in natural log form of the real monetary base

fd_real_cb = the first difference in real central bank bills

Table 5.2.1: Unit root tests for variables in levels

Variables	Automatical lag		Automatical lag	
	length	ADF test	length	DF-GLS test
inreal_or	0	-1.214	0	-1.122
inreal_ad	2	-2.096	3	-0.998
inreal_hh	0	-1.872	0	-1.855
real_cb	5	0.563	9	-0.720

Notes:

- 1.***indicates statistically significant at the 1 percent level, ** indicates statistically significant at the 5 percent level and * indicates statistically significant at the 10 percent level.
2. The critical values of the Augmented Dickey Fuller (ADF) test are based on Mackinnon(1996). The critical values of the Elliott, Rothenberg and Stock (DF-GLS) test are based on Elliott-Rothenberg-Stock (1996).
3. Exogenous variables including in the test equation are constant and linear trend.

Table 5.2.2: Unit root tests for variables in first differences

Variables	Exogenous: None		Exogenous: Constant		Exogenous: None		Exogenous: Constant	
	Lag length	ADF test	Lag length	ADF test	Lag length	ADF test	Lag length	ADF test
fd_inreal_or	1	-3.287***	1	-4.319***	2	-2.422**	2	-3.282**
fd_inreal_ad	1	-5.375***	1	-5.318***	2	-3.474***	2	-3.403**
fd_inreal_hh	1	-4.065***	1	-4.267***	2	-3.492***	2	-3.744***
fd_real_cb	1	-3.480***	1	-3.628***	2	-4.063***	2	-4.276***

Variables	Exogenous: Constant		Exogenous: Constant	
	Lag length	DF-GLS test	Lag length	DF-GLS test
fd_inreal_or	1	-3.937***	2	-2.926***
fd_inreal_ad	1	-5.280***	2	-3.325***
fd_inreal_hh	1	-4.312***	2	-3.785***
fd_real_cb	1	-3.689***	2	-4.313***

Notes:

1. *** indicates statistically significant at the 1 percent level, ** indicates statistically significant at the 5 percent level and * indicates statistically significant at the 10 percent level.

2. The critical values of the Augmented Dickey Fuller (ADF) test are based on Mackinnon (1996). The critical values of the Elliott, Rothenberg and Stock (DF-GLS) test are based on Elliott-Rothenberg-Stock (1996).

Table 5.2.3: The Johansen Cointegration test for the whole case

Johansen Cointegration test

Sample(adjusted): 1999:10 2004:03

Included observations: 54 after adjusting endpoints

Trend assumption: Linear deterministic trend

Series: INREAL_OR INREAL_HH INREAL_AD REAL_CB

Lags interval (in first differences): 1 to 3

Hypothesized No. of CE(s)	H ₁	Trace Statistic	Trace Statistic (corrected)	Hypothesized No. of CE(s)	H ₁	Max-Eigenvalue
r = 0	r ≥ 0	57.875**	45.691***	r = 0	r = 1	30.435*
r ≤ 1	r > 1	27.44	21.663	r = 1	r = 2	15.652
r ≤ 2	r > 2	11.788	9.306	r = 2	r = 3	11.738
r ≤ 3	r > 3	0.050	0.04	r = 3	r = 4	0.050

Notes:

1. **, ** and *** denote rejection of the hypothesis at the 5%, 1% and 10% level. The critical values are based on Osterwald-Lenum (1992).

2. Trace test indicates 1 cointegrating equation(s) at both 5% and 1% levels.

Max-eigenvalue test indicates 1 cointegrating equation(s) at the 5% level.

Max-eigenvalue test indicates no cointegration at the 1% level.

3. (Corrected) denotes that the statistic includes a finite sample correction according to Reimers (1992)

Vector Error Correction Estimates

1 Cointegrating Equation(s):

Normalized cointegrating coefficients

INREAL_OR	INREAL_HH	INREAL_AD	REAL_CB	C
1	1.178859	-2.749172	-0.003089	3.681763

Adjustment coefficients

D(INREAL_OR)	D(INREAL_HH)	D(INREAL_AD)	D(REAL_CB)
0.046434	0.007045	0.051284	126.2847

Table 5.2.4: The restricted VEC model for the whole case

Cointegration restriction	χ^2	P-value	Conclusion
Without inreal_hh	0.355	0.551	Do not reject H_0
Without inreal_ad	7.255	0.007	Reject H_0
Without real_cb	12.799	0.0003	Reject H_0

Table 5.2.5: The cointegration test for the first subcase

Johansen Cointegration test

Sample(adjusted): 1999:07 2004:03
 Included observations: 57 after adjusting endpoints
 Trend assumption: Linear deterministic trend
 Series: INREAL_OR INREAL_HH
 Lags interval (in first differences): No lags

Hypothesized No. of CE(s)	H ₁	Trace Statistic	Trace Statistic (corrected)	Hypothesized No. of CE(s)	H ₁	Max-Eigenvalue
r = 0	r ≥ 0	7.441	7.180	r = 0	r = 1	7.385
r ≤ 1	r > 1	0.056	0.054	r = 1	r = 2	0.056

Note:

1. *,** and *** denote rejection of the hypothesis at the 5%,1% and 10% level. The critical values are based on Osterwald-Lenum (1992).
2. Trace test indicates no cointegration at both 5% and 1% levels.
3. Max-eigenvalue test indicates no cointegration at both 5% and 1% levels.

Table 5.2.6: The pairwise Granger causality test for the first subcase

Pairwise Granger Causality Tests
 Sample: 1999:06 2004:03
 Lags: 2

Null Hypothesis:	Obs	F-Statistic	Probability
FD_INREAL_HH does not Granger Cause FD_INREAL_OR	55	0.08884	0.91514
FD_INREAL_OR does not Granger Cause FD_INREAL_HH		1.44404	0.24564

Table 5.2.7: The restricted VEC model for the second subcase

Vector Error Correction Estimates

Sample (adjusted): 1999:10 2004:03

Included observations: 54 after adjusting endpoints

Cointegration Restrictions:

$$\begin{array}{lll} B(1,1)=1 & B(1,2)=0 & B(1,3)=0 \\ A(2,1)=0 & A(3,1)=0 & \end{array}$$

Cointegrating Eq:	CointEq1			
INREAL_OR(-1)	INREAL_HH(-1)	INREAL_AD(-1)	REAL_CB(-1)	C
1	0	0	-0.001505	-7.504537
Error Correction:	D(INREAL_OR)	D(INREAL_HH)	D(INREAL_AD)	D(REAL_CB)
CointEq1	0.04732	0	0	181.6944

Table 5.2.8: The restricted VEC model for the third subcase

Vector Error Correction Estimates

Sample(adjusted): 1999:10 2004:03

Included observations: 54 after adjusting endpoints

Cointegration Restrictions:

$$\begin{array}{lll} B(1,1)=1 & B(1,2)=0 & B(1,4)=0 \\ A(2,1)=0 & A(4,1)=0 & \end{array}$$

Cointegrating Eq:	CointEq1			
INREAL_OR(-1)	INREAL_HH(-1)	INREAL_AD(-1)	REAL_CB(-1)	C
1	0	2.658771	0	-27.84904
Error Correction:	D(INREAL_OR)	D(INREAL_HH)	D(INREAL_AD)	D(REAL_CB)
CointEq1	-0.007746	0	-0.033594	0

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