The Renminbi Exchange Rate Revaluation: Theory, Practice and Lessons from Japan

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Abstract

For the past several years, the revaluation of the renminbi has been a hot topic among policymakers and economists as well as market participants inside and outside the PRC against the background of internal and external disequilibrium of the PRC economy. This monograph is a collection of papers dealing with various issues concerning the renminbi, which originally appeared as ADB Institute research papers and Policy Briefs, combined with related background information and materials. It reviews the history of the exchange rate system and current arguments made by various stakeholders, and surveys different theoretical approaches for determining the exchange rate. Based on these observations, a two-country general equilibrium model to determine exchange rate is developed and an empirical test is introduced to identify the current degree of misalignment of the renminbi compared to its estimated equilibrium rate. Finally, the experience of the ever-higher Japanese yen is reviewed and its implications for the PRC or lessons to be learned are identified.
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<td>Asset Management Companies</td>
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<td>BEER</td>
<td>Behavioral Equilibrium Exchange Rate</td>
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<td>CIRP</td>
<td>Covered Interest Rate Parity</td>
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<td>FDI</td>
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<td>PBOC</td>
<td>People’s Bank of China</td>
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<td>PCP</td>
<td>Producer’s Currency of Production</td>
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<td>PPP</td>
<td>Purchasing Power Parity</td>
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<td>PRC</td>
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<td>SOEs</td>
<td>State-owned Enterprises</td>
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<td>UCIRP</td>
<td>Uncovered Interest Rate Parity</td>
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<td>USD</td>
<td>United States dollar</td>
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<td>VAR</td>
<td>Vector Auto Regression</td>
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<td>VEC</td>
<td>Vector Error Correction</td>
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Introduction

Toshiki Kanamori and Zhijun Zhao

For the past few years, there have been a number of arguments about the level of the renminbi exchange rate as well as its regime. Arguments on this issue have been made not only by economists and politicians in the countries concerned, but they have also attracted the attention of ordinary people since many major developed countries, and in particular the United States, have intensified pressure on the authorities of the People’s Republic of China (PRC) to revalue the renminbi and change its US dollar(USD)-pegged exchange rate regime to a more flexible one.

One important step was taken on 21 July 2005, when the People’s Bank of China (PBOC) “unexpectedly” announced a 2.1 percent revaluation of the renminbi. We can make the following observations regarding this announcement. The first relates to the timing. While many concerned experts and media saw the announcement as abrupt and surprising, careful examination shows that this was not necessarily the case. There was no doubt that the PRC authorities were constantly watching various economic indicators such as balance of payment, foreign reserves and short-term capital inflow, watching for the timing for the revaluation. Still, the PRC had difficulty revaluing the currency because it did not want to give the impression that external pressure from other industrialized countries had forced it to do so. The timing of the recent revaluation seems to have been felt to be best by the PRC authorities, because the external pressure was somewhat mitigated by the appreciation of

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USD, to which the renminbi was pegged. Considering the political and economic importance of its relationship with the United States, we could also have predicted that the PRC would demonstrate some measures to the United States before the meeting of their two leaders.

Secondly we should note that the PBOC carefully stated in its announcement that the renminbi exchange rate would be adjusted “based on market supply and demand with reference to a basket of currencies.” It is not so clear yet what kind of currency basket is to be introduced and how it will be operated. In fact, the details of the basket have not yet been clarified and the actual renminbi exchange rate since July 21st has fluctuated within a relatively narrow range centering on the new 8.11 RMB rate (8.095–8.115). Although the announcement allows a fluctuation range of 0.3 per cent, the PBOC seems to be intervening significantly in foreign exchange and is trying to contain the fluctuation of the renminbi as much as possible. Considering this, it is interesting to note that after the announcement in July, the PBOC firmly denied the possibility of another revaluation (meaning a change from the 8.11 rate) for the time being.

The third observation relates to the second point. Although other countries and experts mostly welcomed the announcement as a first step, there is concern that compared with the previous USD-pegged regime, the system has become less transparent: “with reference to a basket of currencies” is rather vague and the PRC may now more freely manipulate the exchange rate by foreign exchange intervention.

Fourthly, ultimately this announcement seems to be another example of the PRC’s traditional gradualist approach, starting with a very limited scope on an experimental base and then carefully examining its impact before slowly expanding the scope. Overall the core of the announcement seems to be a modest first step toward a more flexible exchange system, and the appreciation of the renminbi

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2 On 10 August 2005, the Governor of PBOC stated that taking account of the trade relationship with other countries, major currencies in the basket are the US dollar, euro, Japanese yen and Korean won at this stage, but that the currencies of Singapore, UK, Malaysia, Russia, Australia, Thailand and Canada are also very important. The respective weights are not yet clear.
based on the announcement is still far from our current estimated equilibrium rate.

This research project started well before the PBOC’s announcement on 21 July and most of the analyses, suggestions and conclusions in this paper were prepared under the background of the earlier USD-pegged exchange rate regime. However, we note that those analyses and suggestions basically depend on the theoretical framework and empirical studies. In addition, we note that even after the announcement, the appreciation of the renminbi has still taken place in a very narrow range, and is far from the current equilibrium rate. In view of this, the authors believe that the suggestions and analyses of this paper basically remain relevant and are not changed by the July 2005 announcement. Of course the announcement is undoubtedly a significant first step, and it may turn out that this was a historical turning point. Therefore we must carefully follow the developments in the renminbi exchange rate and the next steps the PRC authorities take in the near future. In fact, soon after the revaluation, the PBOC issued circulars on an expansion of forward forex trading and to allow renminbi and foreign currency swap transactions. Also, in late September 2005, the PBOC announced, on the occasion of the G7 summit, that it would widen the renminbi’s trading band against non-USD currencies from a maximum plus or minus 1.5 per cent to 3 per cent (although this is just a technical adjustment and only has the impact of limiting arbitrage opportunities between currencies). These measures clearly indicate that the PBOC envisages greater fluctuation of the renminbi exchange rate in the foreseeable future and feels the need to provide market participants with more risk hedge instruments or at least trigger speculation by market participants on further policy changes.

This monograph is a compilation of research outputs that originally appeared in the ADBI research paper series or as Policy Briefs, combined with other related background information and analyses. It consists of the following. Chapter 1 introduces how the renminbi exchange rate regime has developed historically over the past 50 years, and identifies three phases. We highlight the fact that the evolution of the exchange rate regime has been closely related to
the development of the economic structure in the PRC, particularly the opening-up and economic reform policy started in the late 1970s.

Chapter 2 summarizes recent arguments on the renminbi revaluation and renminbi exchange rate regime made by various stakeholders including economists, foreign as well as the PRC government and international organizations, and relates these arguments to various internal and external factors as well as the somewhat complicated particular interests of certain groups. It is stressed that differing views are expressed by different groups based on different theoretical frameworks, giving confusing signals to the PRC authorities. Chapter 3 surveys major theoretical approaches for determining exchange rate starting from partial equilibrium such as PPP (purchasing power parity) and IRP (interest rate parity) to general equilibrium and disequilibrium and hybrid models. Chapter 4 attempts to develop a two-country general equilibrium, taking particular account of the implications of price rigidity for the policy independence of each country. Chapter 5 deals with some empirical test and tries to identify the degree of misalignment of the renminbi exchange rate for recent years. Chapters 4 and 5 are based on papers that originally appeared as part of the ADB Institute Research Paper series. Chapter 6 introduces Japan’s experiences in the early 1970s and late 1980s, when the Japanese yen sharply appreciated, in order to identify the lessons to be learned from that experience. This chapter originally appeared as an ADB Institute Policy Brief.
Chapter 1. The Evolution of the Renminbi Exchange Rate Regime

The exchange rate regime of the Chinese currency (or renminbi with unit the yuan) has experienced three historical development phases, i.e. a single official rate regime, dual track rate regime and a market-based managed floating regime.

During the early stage of the foundation of the PRC, the exchange rate of the renminbi was adjusted frequently during the period from 1949 to 1952, followed by a relatively stable period from 1953 to 1970. After a drastic currency reform, which transferred 10,000 yuan of old currency to one new yuan, a fixed official rate against the U.S. dollar (USD) was established in January 1970 (World Currency Yearbook, 1984). With the suspension of the convertibility of the USD into gold on 15 August 1971 (Gowa, J. 1983), the renminbi began to appreciate against the USD. Then the PRC began to list an effective rate for the renminbi against the USD from April 1972. After collapse of the Bretton Woods System, the official renminbi rate remained pegged to a basket of 15 currencies until 1980.

The most important progress in the exchange rate regime reform was made after the PRC launched its economic reform and opening up policy. In 1980, the renminbi was placed on a dual track system, i.e., the coexistence of the official rate and trade-related settlement rate, and coexistence of the official rate and swap market rate, respectively, during 1981–1985 and 1985–1993. Following that, the Chinese currency was pegged to the USD and allowed to float with a narrow band between 827 yuan and 862 yuan per hundred USD for more than one decade.

1.1 The Dual Track Exchange Rate Regime

The evolution of the renminbi exchange rate regime and determination of the exchange rate are closely related to the economic regime of the PRC as a whole. Before 1978, the PRC had a Soviet Union style socialist system. Under this system, the relationship
between the PRC and major capitalist countries was not so close. This is one of the reasons why its economy lagged behind western countries and why trade and capital flows with overseas were so scarce. To improve this situation, the PRC government had to advocate a spirit of self-independence and hard work. Since there were in practice no foreign exchange markets at the time, the exchange rate existed only as a calculation unit and seems unlikely to have reflected supply and demand relations.

On 5 January 1980, The State Council issued a decree prohibiting the use of foreign exchange as a means of payment within the territory of the PRC. On 1 April 1980, foreign exchange certificates (also called Waihui Quan), which were equal in value to the renminbi at its effective rate, were issued in exchange for hard currency and put into circulation for use by nonresidents only, for paying hotel bills, transportation fares and for purchases at the friendship stores (Youyi Shangdian).

On 1 January 1981, a multiple rate structure for the renminbi was created with the introduction of a trade-related internal settlement rate. For internal settlements under the foreign exchange allotment quota, the rate was set at RMB2.80 per USD. Generally speaking, this rate was formed by adding to the effective rate an “equalization price” for balancing export and import profits and losses, and was applied to all national enterprises and corporations engaging in trade. It was also applied to receipts and expenditures in foreign exchange for trade-related transactions in invisibles, such as shipping and insurance.

The trading business was done under an experimental trading system for foreign exchange, which was established by the Bank of China in a few areas, such as Beijing, Guangdong, Hefei, Shanghai, and Tianjin. National enterprises holding foreign exchange earned through the system of retention quotas were permitted to sell it to other national enterprises that had a quota for spending foreign exchange. For dealings under the foreign exchange retention scheme, the Bank of China acted as a broker, charging 0.1–0.3 per cent. This indicates that the market mechanism was introduced into the
exchange rate forming process, and a breakthrough was made in the reform of the exchange rate mechanism.

On 1 January 1985, the trade-related internal settlement exchange rate was abolished and the effective rate came to govern all trade, but a foreign exchange retention quota remained for a portion of export proceeds. On 20 November 1985, authorization was granted for Chinese residents to hold foreign exchange, to open foreign exchange accounts, and to deposit and withdraw funds in foreign currency.

In November 1986, a foreign exchange swap rate was created, based on rates essentially agreed to between buyers and sellers. This became available for foreign investment corporations at over 100 foreign exchange adjustment centers and for Chinese enterprises in the four Special Economic Zones (Shantou, Shenzhen, Xiamen, and Zhuhai) initially, and then in 1988 it was expanded to all domestic entities authorized to retain foreign exchange earnings (World Currency Yearbook 1988–1989). The swap rate and official rate coexisted until the single rate regime was established in 1994.

The transition period of 1985–1993 had two features. First, in accordance with the above statement, the renminbi had two prices vis-à-vis foreign currencies. The official price of the USD was lower than the swap rate, implying that the renminbi was set artificially high. The official rate was basically determined by the exchange cost of export goods plus a certain amount of profit. This is actually a practical application of a theory called tradable goods purchase power parity (Yang Fan, 1999)—a variant of purchase power parity.

Second, the overvaluation of the renminbi made the currency face depreciation pressure, and indeed it followed a path of depreciation. While the official exchange rate and swap market exchange rate were approaching one another before 1992, the economic overheating driven by Deng Xiaoping’s South China Tour speeded up the renminbi depreciation process and widened the difference between the official rate and swap market rate. Simultaneously, the market exchange rate overshot and the renminbi was severely undervalued, as will be shown in an empirical study below (Chart 1.1.). The integration of the dual exchange rate system
in 1994 can be viewed as a continuing effort toward the marketization of the financial market following the price reform in the goods market in 1988.

Chart 1.1. Trends of the Official Rate and Swap Rate

The degree of overvaluation of the renminbi was not only reflected in the comparison of the official rate with the swap rate, but was also reflected in the black market. In 1982, one Hong Kong dollar could be exchanged for 0.38 yuan, a figure about 35 per cent higher than the official rate. In 1984, one HK dollar was equivalent to 0.8 yuan, more than double the official rate. According to an investigation carried out by the Shenzhen subsidiary of the PBOC, more than 60 enterprises were involved in the black dealings, with trading volume at USD148 million, or about 55.8 per cent of the total exports of Shenzhen.3

The pressure of excessive demand for foreign currencies and the overvaluation of the renminbi resulted in a long-term depreciation trend of the renminbi. By the end of 1993, the official exchange rate had had fallen to 5.80 yuan per USD, 73 per cent down from the 1.58 yuan per USD in early 1979.

3 http://www.shenzhenwindow.net/20years/currency.htm.
From the viewpoint of balance of payments, if the capital flow is rigorously controlled, the exchange rate fluctuation should reflect the current account or foreign exchange reserve fluctuation. When an economy faces a trade deficit increase or trade surplus decrease, its currency will face pressure toward depreciation. For example, when the high economic growth and opening-up accelerated in the PRC in 1980, 1985 and 1989, the renminbi experienced drastic depreciations (Chart 1.2.).

Chart 1.2. Relation of the Exchange Rate and the Trade Balance

The first big depreciation appeared in 1981 and 1982, when the renminbi depreciated by 13 and 10 per cent respectively.

A strategy of constructing special economic zones was launched in 1984, leading to high economic growth, and the demand for foreign currencies and imports was so strong that the foreign exchange reserve fell from USD13.8 billion in August 1985 to USD2.6 billion at the end of 1985, and the trade surplus from USD2 billion in 1983 to USD0.014 billion in 1984. Since then, the trade balance was in continuous deficit until 1989. Accordingly, the renminbi was depreciated successively in 1984, 1985 and 1986, from 1.98 yuan per USD in 1983 to 3.72 yuan in 1986, representing a drop of 47 per cent. During 1988 to 1989, signs of overheating appeared in the economy, while the trade deficit remained and the renminbi was
depreciated again. By the end of 1991, the exchange rate of the renminbi had fallen to 5.32 yuan per USD.

Thanks to Deng Xiaoping’s famous South China Tour in 1992, the pace of economic reform and opening up of the market to the outside world accelerated. Meanwhile, this led the economy to overheat once again (Kanamori and Zhao, 2005). One indication of this is that the inflation rate of consumer prices rose sharply by over 20 per cent, and a $10.6 billion trade deficit appeared in the balance of payments. This led to another cycle of depreciation of the renminbi. To accord with the development of trade and opening up policy, the PRC abandoned its long-lasting policy of artificially overvaluing the renminbi and decided to introduce a market-based exchange rate regime. As a result, the swap market exchange rate and official rate were integrated. Eventually, the dual track system was terminated and a market-based managed floating system was adopted.

From the launch of the reform and opening up policy in 1978 to the integration of the exchange rate regime in 1994, the average renminbi exchange rate against major trading partners both in terms of the nominal and real effective exchange rates fluctuated greatly, by 68 per cent and 76 per cent, respectively (Chart 1.3.). However, this depreciation process was not basically completed until the breakout of the 1997 Asia crisis.

The most important message here seems to be that the official rate was politically determined and tended to be overvalued. However, this overvaluation, under an imperfect market, is only meaningful relative to the swap market exchange rate, and not to the fundamental factor-based exchange rate (see Chapter 5). Clearly, the politics behind the overvaluation must be that the government benefited from the overvaluation under the traditional system in the sense that foreign exchange revenue was forcibly sold to the PBOC. The overvaluation of the renminbi meant that the government could buy foreign exchange at a lower price. In other words, the central government was able to get extra “tax” by overvaluing the renminbi.

However, taking a realistic account of the international competitiveness of the PRC economy, the trade related real exchange rate had to be set at a very low level to promote exports. Accordingly
the depreciation pressure on the official rate was intensified.\footnote{One of the authors recalls that the in the 1980s, the Soviet Union authorities determined the ruble’s official rate to be equivalent to about 1.1 USD, a slightly stronger rate than the US currency. At that time the prevailing black market rate was a 20-30 per cent discount. Everybody acknowledged that the socialist Soviet authorities regarded the ruble exchange rate as a politically important figure that should reflect the political power of the nation, while the economic market forces prevailed in the black market. In the 1970s and 1980s, the PRC may have had similar sentiments regarding the exchange rate. It is interesting to note that if the PRC is currently trying to maintain an “undervalued” renminbi, the sentiment regarding the exchange rate must have completely changed, with the PRC authorities only paying attention to the economic implications of the exchange rate to its domestic economy.} This shows that there was a contradiction between foreign trade development and exchange rate policy in the traditional system, which was not very easy to resolve.

**Chart 1.3. Nominal and Real Effective Exchange Rate (2000=100)**

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<th>Year</th>
<th>NEER FROM INS</th>
<th>REER BASED ON REL.CP</th>
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<tr>
<td>1981</td>
<td>400</td>
<td>300</td>
</tr>
<tr>
<td>1983</td>
<td>350</td>
<td>250</td>
</tr>
<tr>
<td>1985</td>
<td>300</td>
<td>150</td>
</tr>
<tr>
<td>1987</td>
<td>250</td>
<td>100</td>
</tr>
<tr>
<td>1989</td>
<td>200</td>
<td>50</td>
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### 1.2 Integration of the Exchange Rate Regime

On 1 January 1994, the PBOC announced a reference rate for the renminbi against the USD, the Hong Kong dollar, and the Japanese yen based on the weighted average price of foreign exchange transactions of the previous day’s trading, marking a new stage for the exchange rate regime. In accordance with the announcement, daily movements of the exchange rate of the renminbi against the USD were limited to 0.3 per cent on either side of the reference rate.
The Renminbi Exchange Rate Revaluation: Theory, Practice and Lessons from Japan

announced by the PBOC. The buying and selling rates of the renminbi against the Hong Kong dollar and the Japanese yen were not permitted to deviate from more than 1 per cent on either side of the reference rate; in the case of other currencies, the deviations should not exceed 0.5 per cent on either side of their respective reference rates (IMF 1997, p.196).

When the renminbi exchange rate and foreign exchange swap market rate were integrated, the official rate was 5.8 and swap market rate 8.6. The integration of exchange rate made the official exchange rate depreciated by 33.3 per cent. Taking account of the fact that 80 per cent of forex transactions at the time were done in the swap market, the real devaluation of the currency was 6.7 per cent.

To elaborate the situation of exchange rate fluctuations after 1994, we divide this period into three different sub-phases: the period of transition after integration from 1994 to 1997; the period of depreciation pressure after the Southeast Asian crisis from 1998–2001 and the period of appreciation pressure afterwards (Table 1.1).

The unified exchange rate terminated the long-standing situation of the renminbi overvaluation and, thereby, reversed a persistent trend of decline. From 1994 to the end of 1997, the renminbi’s nominal exchange rate against the USD appreciated by 4.8 per cent, up to 8.2. Taking into account the rapid increase in domestic prices in the period from 1994 to 1995, the real appreciation of the renminbi against the USD was 39 per cent. Meanwhile, the renminbi’s nominal and real effective exchange rates rose by 10.9 per cent and 30.2 per cent, respectively (IMF, IFS database 2004).

The appreciation of the renminbi during the period from 1994 to 1997 once again led to the expectation of a devaluation. This expectation was further intensified by the Southeast Asia financial crisis of 1998, which incurred a wave of capital flight. To prevent the crisis from spreading further, the PRC government made a commitment to not devalue the renminbi, keeping it at 8.28 yuan per USD and taking other measures to offset the external shocks to

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5 We will show empirically that the renminbi was indeed overvalued after the East Asia crises in 1997.
exports, including, for example, export tax refunds. This was recognized as a significant contribution by the PRC to the economic and financial stability of Asia and the world.

Since the PRC did not devalue the renminbi while most of the other currencies weakened against the USD from 1997 to 2001, the renminbi became one of a few strong currencies in emerging markets. Its nominal and real effective exchange rates rose by 10.9 per cent and 5.5 per cent, respectively.

It must be recognized, however, that the commitment to not devalue the renminbi was not without costs. In fact, one of the costs that the PRC had to bear was deflation. To get rid of deflation, the PRC had to adopt a five-year proactive fiscal policy, which resulted in considerable fiscal deficit. Of course, perhaps thanks to the deflation, which finally strengthened the competitive power of Chinese products, as well as to the proactive fiscal policy, which improved the social infrastructure and investment environment, the PRC economy enjoyed economic prosperity in recent years.

Shortly after primary achievements were made under the nation’s efforts to tackle deflationary pressures came the external shocks from the terrorist attacks of 11 September 2001 and the outbreak of the SARS (severe acute respiratory syndrome) epidemic in the PRC and other Asian countries, and the world economy slowed down. The PRC maintained consistency in its exchange rate policy and continued to keep the renminbi exchange rate within a relatively narrow range (Guo Shuqing, 2004).

Since it was still pegged to USD after 2002, the renminbi exchange rate weakened along with the USD. By the end of 2003, the exchange rate of the euro had risen by 36 per cent, and the Canadian dollar, British Pound, Japanese yen and Korean won by 19 per cent, 17 per cent, 14 per cent and 11 per cent respectively, while the Mexican peso fell by 14 per cent and the Brazilian real by 17 per cent (David Wessel 2003). Accordingly, nominal and real effective exchange rates of the renminbi vis-a-vis other foreign currencies fell by 9.3 per cent and 11.0 per cent, respectively.6 Taking account of the

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6 Our estimate shows that the undervaluation may be larger than the numbers show.
real appreciation of the renminbi between 1998 and 2001, this means the effective exchange rates both in nominal and real terms remain approximately at the level of 1998.

In summary, the renminbi’s nominal exchange rate was basically in a downward trend before 1994, when the exchange rate integration was achieved, but afterwards, it became relatively stable and floated within a narrow band. However, the USD-pegged system forced price adjustments domestically in different directions, which made the exchange rate in real term still fluctuate with the USD to some degree (Chart 1.4).

**Chart 1.4. Real Effective Exchange Rate**

From 1994 to 2003, the nominal and real effective exchange rates of the renminbi vis-a-vis other currencies as a whole rose by 6.7 per cent and 31.5 per cent. In nominal terms, the currency strengthened by 5.1 per cent and 10.3 per cent against the USD and the Japanese yen, respectively, while the real appreciation was 20.1 per cent and 59.1 per cent considering inflation differentials (Guo Shuqing, 2004).
Table 1.1. Evolution of the Renminbi Exchange Rate Regime

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1.3  A Few Findings from the Evolution of the Exchange Rate Regime

From the above fact, we find that the PRC’s exchange rate system evolved with the reform and opening up policy, and the renminbi exchange rate was driven by pressures from the market as well as by external factors.

Before the integration of the official rate and swap rate, the renminbi exchange rate was gradually driven downward by the excessive demand for foreign currencies. It is clear that every sharp adjustment of the exchange rate coincides with extensive reform and opening up policies, which led to high economic growth, high inflation and the trade imbalance.

After the departure from the dual track exchange rate system, the nominal exchange rate remained relatively stable, but the real exchange rate floated upward and downward at a surprising pace compared to the PRC’s trading partners. Through changes in relative prices between the PRC and the rest of the world, the renminbi’s average exchange rate experienced enormous fluctuations. It appreciated by more than 20 per cent in the last 10 years, or nearly 60 per cent if inflation is taken into account.
The response of the exchange rate to the market supply and demand is asymmetric. For example, before the unification of the exchange rate in 1994, the demand for foreign currencies put lasting downward pressure on the renminbi. This was because the demand for foreign currencies was high but the central bank could not satisfy it, leading the price of foreign currencies to rise. However, when the supply of foreign currencies exceeded the demand, the central government was able to absorb excessive foreign currencies by printing paper money if it wished to do so and was ready to take the inflation risk. The underlying factor behind this asymmetry is that the government has full authority to issue domestic currency but no right to issue foreign currency.
Chapter 2. Current Pressure and Debates on the Revaluation of the Renminbi

2.1 Background

The current calls for renminbi revaluation have an internal and external background. Internally, since 2001 the PRC economy has rid itself of the shadows of the 1997 East Asian crisis and recovered from the deflation experienced in 1998 and 1999, and in recent years has achieved 9 per cent annual economic growth; trade volume has continuously grown by over 30 per cent a year; and the PRC has replaced the United States as the largest recipient of foreign direct investment (FDI).

In 2004, the PRC’s total volume of imports and exports was $1,154.8 billion, an increase of 35.7 per cent over the previous year, with the trade surplus at $32 billion, a more than doubling of the total trade volume of $509.6 billion in 2001. Foreign exchange reserves reached $609.9 billion, representing a rise of nearly 50 per cent more than the previous year. Statistics for the first half of 2005 show that foreign exchange reserves reached a record high of over $700 billion. It was reported that the PRC’s rapid accumulation of foreign exchange reserves was a result not only of foreign direct investment and trade, but also of “hot money” speculating on the appreciation of the renminbi.

Externally, the economy of United States was facing great difficulties due to the burst of the “new economy” bubble. Japan was still suffering from deflationary pressure and the European economy was in a relatively weak recovery. In these countries, and particularly Japan and the United States, some interest groups called on their governments to press the PRC government to revalue the renminbi. This eventually led to a hot debate on the revaluation of the renminbi.

Economically, a controversy emerged over whether the PRC should revalue renminbi and whether the USD-pegged exchange rate regime was threatening to the world economy by exporting deflation. In addition, politically, one cannot exclude the possibility
that some interest groups are reluctant to see the emergence of the PRC.

Actually, this was not the first debate on the revaluation of the renminbi after the PRC’s official exchange rate and swap market exchange rate of the renminbi were unified into the USD-pegged system in January 1994. The first debate emerged shortly after the East Asian crisis in 1997. With the sharp depreciation of many East Asian currencies during the crisis, the renminbi faced a great pressure to depreciate.

At the time, there was a heated debate in the PRC on how to assess the impact of a devaluation on the economy. Many PRC as well as foreign economists called on the government to depreciate the renminbi. They argued that the PRC would bear enormous losses in foreign trade if it did not change its fixed exchange rate (Macroeconomic Project Group of the Institute of Economics, CASS, 1999). Some even argued that the renminbi should be devalued by 15–30 per cent to offset the shock from the Asian crisis (Yu Qiao, 1999).

However, there was concern that a devaluation of the renminbi might cause a vicious cycle of currency devaluation in Asian countries, and eventually weaken the devaluation effect of other Asian currencies (Zhao Zhijun, 2001). Given that marketization was not yet full-fledged (Zhang Xiaopu, 1999), the PRC had the option to take alternative measures such as proactive fiscal policy and an enhancement of the value-added export tax rebate to offset the shocks to foreign trade, which might be better than the adjustment of the exchange rate.

After weighing the benefits and costs, the PRC government finally decided not to devalue the renminbi, but to adopt a proactive fiscal policy to increase internal demand and raise the value-added export tax rebate to encourage exports and offset the external shocks from the Asian crisis. In the face of international speculative attacks on the Hong Kong dollar, the PRC government warned international speculators not to speculatively attack the Hong Kong dollar, and stated that it would help Hong Kong, China to keep its currency stable at any cost. The decision was welcomed by other countries,
especially neighboring countries. Subsequent evidence that the PRC achieved continuing growth in international trade and FDI inflows seemed to show that the decisions were proper. Of course, these policies were not without cost. The proactive fiscal policy over a long period of time resulted in a huge budget deficit.

2.2 Voices from Foreign Governments and International Organizations

The current debate on the revaluation of the renminbi can be traced back to August 2001, just three years after the first debate. On 7 August 2001, an article titled “The PRC’s Cheap Money” was published in the Financial Times, followed by the article “Expectation of renminbi appreciation is rising: PRC threat argument is intensifying” (Nihon Keizai Shinbun, 6 September 2001).

Thereafter, some Japanese officials on different occasions urged an appreciation of the renminbi. For example, the article “Time for a switch to global reflation,” published in the Financial Times on 1 December 2002, argued that the PRC was exporting deflation. It was reported that on 22 February 2002, the Japanese Finance Minister asked other G7 countries to jointly put pressure on the PRC to inflate the Chinese currency so as to combat global deflation (Ivan Ko, 9 September 2003). During his visit to Asia in September 2003, the US Secretary of Treasury touched upon this issue explicitly in Tokyo and Beijing. President Bush reportedly raised this issue with premier Wen Jiabao during the latter’s visit to the United States in December 2003. The Governor of the European Central Bank and the European Committee Chairman also expressed similar views in July 2003.

By April 2005, the G7 countries had issued four communiqués, starting in Dubai in September 2003, which stressed the need for greater exchange rate flexibility by countries whose currencies had not yet been floated.

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7 According to Ivan Ko (2003), Japan’s Finance Minister said at the G7 financial minister meeting that “too much importation of China’s [sic] cheap money not only caused the currency constraint in Japan but is also the root cause of the global economic recession.”
The communiqué of the G-7 countries in April 2005, although not specifically mentioning the PRC, emphasized that “more flexibility in exchange rates is desirable for major countries or economic areas that lack such flexibility to promote smooth and widespread adjustments in the international financial system based on market mechanism.” The Financial Times reported on 17 April 2005 that the G7 agreed to call on the PRC to take immediate action to shift to a more flexible currency regime.

It was reported that this time, Japan didn’t necessarily join other industrial countries in urging the PRC to revaluate the renminbi. Japan’s Finance Minister reportedly said it was a matter for the PRC to consider and make a decision.

The reasons for Japan’s reluctance to press the PRC included a show of regional loyalty as well as concerns about anti-Japanese sentiment and protests in the PRC (Andrew Balls and Scheherazade Daneshkhu, 2005). More importantly, Japan not only held four times as much current account surplus as the PRC’s, but also enjoyed a bilateral trade surplus with it.8 In addition, it should be noted that the reason that Japan had urged the PRC to appreciate its currency in the past, the deflation, had disappeared. Another factor may be that Japan seemed to have realized that the high growth of the PRC economy was making an enormous contribution to the recovery of the Japanese economy and the “PRC threat to Japan” argument was rapidly subsiding.

Though the United States, Japan and other industrial countries shared similar views on the revaluation of the renminbi, it seems that they had different concerns.

What Japan was concerned with was the deflationary pressure it faced at the time. According to the then Japanese Finance Minister, the PRC should be blamed for the worldwide deflation. The G7 countries stated that, “the entry of emerging market economies—such as PRC and other East Asian nations—into the global trading system constitutes a strong additional deflationary force. Their combined

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8 There is a discrepancy between Japan’s statistics and the PRC’s statistics. Japan’s BOP statistics show Japan’s small trade deficit with the PRC.
supply capacity is exerting downward pressure on the prices of goods in industrialized economies.”

They further added that without a correction of deflation, a fall in aggregate demand could put further downward pressure on prices, setting off a deflationary spiral. Since the PRC was undergoing price deflation, it was exporting deflation and these effects were not limited to neighboring Hong Kong, China and Taipei, China.

In their view, there were two channels for the PRC to export deflation: export growth and a domestic price deflation under a pegged exchange rate regime. While the US, Europe and Japan had already adopted a series of measures to reflate their economies, they felt it was the PRC’s responsibility to contribute the world economic stability jointly with them, and that eventually this would benefit the PRC as well. To reflate its economy, the PRC had two options: to ease monetary policy or to allow the currency to be appreciated.9

The experience of other countries shows that traditional monetary policy can lose its effectiveness under a deflationary environment. Since the nominal rate cannot fall below zero, a central bank can only lower real interest rates and by doing so provide monetary stimulus through a drastic change in price expectations. Considering that the cost of easing monetary policy may be higher than that of revaluing the exchange rate, Japan’s Finance Minister at the time suggested that the currency appreciation would be a better policy option.

Unlike Japan, what concerned the United States was its large trade deficits with the PRC. In its 2004 Report to the Congress, the US China Economic and Security Review Commission (USCC) pointed out that the dominant feature of the US-PRC economic relationship was the US deficit in trade with goods, which rose by more than 20 per cent in 2003, or a record high of $124 billion. It said that the undervaluation of the PRC currency against the USD gave PRC manufacturers a competitive advantage over US manufacturers

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9 It should be noted that the proactive policy is also an effective measure and in fact the PRC adopted it.
and became one of the three factors contributing to the US deficits with PRC.

The USCC Report indicated that the US trade deficit with the PRC was a major concern because: (1) it contributed to the erosion of manufacturing jobs which could become a bottleneck to the improvement of the overall employment situation in the United States, (2) manufacturing was critical for the nation’s economy and national security, and (3) the deficits had an adverse impact not only on manufacturing but also on other sectors of the US economy. Therefore, the US appeared to recognize that the trade and investment relationship with the PRC, if current trends continued and the deficits expanded, would not be just a trade issue for the United States, but also be a matter of how to ensure the soundness of the economy and how to secure national security in the long run.

2.3 Voices from Economists

Unlike government officials and international organizations, academic scholars express a wide range of differing views. The concerns of scholars are mainly as follows: 1) is the renminbi really undervalued? If the answer is yes, then, 2) by how much is it undervalued? If the renminbi indeed needs to be adjusted, 3) How should it be adjusted, or should it still be pegged to the USD, or allowed to float, are there any other measures? 4) What would be the impact of an adjustment on the PRC economy as well as on the world economy?

Based on their viewpoints on whether the renminbi is undervalued, economists can be classified into three main schools. The first insists that the renminbi should remain pegged to the USD and kept stable. Representatives of this school include Robert Mundell (see China Daily and China Net (中国网), 2003), Ronald McKinnon (2001, 2003) and Paul Krugman (2003). The second school insists that the renminbi is seriously undervalued and it should be urgently appreciated to avoid its negative effects. Fred Bergsten, Morris Goldstein and Nicholas Lardy are categorized in this school. The third school proposes that the PRC should not pay too much
attention to the appreciation or depreciation of the renminbi, but rather make efforts to reform the exchange rate regime.

“The existing pegged exchange rate regime still works well,” stated Nobel Laureate Robert Mundell at the forum of fast-growing enterprises and financial markets at the Sixth Beijing International High-Tech Expo (China Daily, 2003). “There’s never before in history (or never been a situation) that international monetary authorities ... try to press a country with an inconvertible currency to appreciate its currency.” “An appreciation or floating of the renminbi would involve a major change in the PRC’s international monetary policy and have serious implications for the growth and stability of the PRC and the Asia as a whole”.

In his conversation (“Renminbi exchange rate examines state wisdom”) with a correspondent of China Security Daily on 16 July 2003, Mundell repeated his view and stressed that an appreciation of the renminbi would force the PRC to face six challenges. First, since the capital account had not been fully liberalized, the exchange rate of the renminbi was not determined by the market, so a change in the exchange rate would not be meaningful. Second, it would lead to increased deflationary pressure; third, it would have a negative impact on FDI; fourth, it would hurt the PRC’s export sector; fifth, it would cut the profits of PRC enterprises and accordingly increase unemployment pressure; and finally, it might lead to a degradation of the PRC’s fiscal deficits and financial stability.

In responding to the views that the PRC was exporting deflation, McKinnon and Schnabel (2003) warned that it should not be blamed for deflation because this mechanism no longer existed in the world monetary system and that the PRC ought to learn lessons from Japan in its revaluation of the yen, which put Japan into long-term deflation. Firstly, they argued that under the gold standard, the rapid growth of the PRC economy would have induced demand for gold and indeed consumed other countries’ gold, leading possibly to worldwide deflation, as happened in the US and Germany in the late nineteen century. However, at present the global monetary system is on a “dollar standard,” so unless the US Federal Reserve cuts its money supply, there is no monetary shortage. They further pointed out that
the worldwide deflationary pressure came from the burst of the economic bubble in the US in the 1990s. Secondly, they argued that the PRC had no mechanism to export deflation. Since its main trading partners such as Japan and the EU all had floating exchange rate systems, the impact of commodity prices in the PRC on their domestic prices would be mostly absorbed by exchange rate fluctuations. Finally, taking into account the processing trade factor, the exports of the PRC only accounted for 3 per cent of the world economy, and its exports to the US and Japan amounted to just 1-2 per cent of their GDP, respectively. This trade volume would not be large enough to have a significant impact on world market prices. Fourth, the PRC’s inflation rate was not very high, being basically at the same level as the US. Fifth, it seemed clear that the exchange rate peg was contributes to the stability of the exchange rate. Sixth, McKinnon expressed concern that deflation might come if the currency were revalued.

IMF chief economist Kenneth Rogoff (2003) also indicated that although there was strong price pressure in particular sectors in the US, there was insufficient evidence to show that the PRC was exporting deflation, despite the fact that its trade share had increased. However, he hinted that the PRC should consider exchange rate channels for transmitting deflation by integrating its economy into the global economy (it was possible that with an increase of PRC share, PRC’s effect on price levels was increasing). IMF Executive Director Horst Kohler stated that he didn’t think that it was necessary to urge the PRC to appreciate the renminbi.

Guan Zhixiong (关志雄, 2003) argued that Japan’s imports from the PRC accounted for only a marginal portion of its GDP and that considering the tradable goods structure, there was little competition between Japan and the PRC. Thus, he concluded that deflation in the PRC would have no significant impact on Japan’s prices. In addition, since the PRC and Japan were facing a similar

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10 However, in recent years the PRC trade has grown at a speed of over 30 per cent annually, the impact of PRC factor has become larger, and inflation has appeared in the PRC. This issue perhaps should be reconsidered.
deflationary situation, it seemed odd to him that the PRC was being accused of exporting deflation to Japan, rather than the opposite.

Krugman’s criticisms (2003) of Bush’s policy are rather interesting. He wrote, “All the world knows about the Iraq about-face: having squandered our military strength in a war he felt like fighting even though it had nothing to do with terrorism, President Bush is now begging the cheese-eaters and chocolate-makers to rescue him. What may not be equally obvious is that he’s doing the same thing on the economic front. Having squandered his room for economic maneuver on tax cuts that pleased his party base but had nothing to do with job creation, Mr. Bush is now asking China [sic] to help him out.” However, at the same time he pointed out that it would be of no use unless the value of the renminbi rose significantly. “Even if the Chinese did accede to U.S. demands to increase the value of the Yuan, it wouldn’t have much effect unless it was a huge revaluation. And China [sic] won’t agree to a huge revaluation because its huge trade surplus with the US is largely offset by trade deficits with other countries.”

On the other hand, many economists insisted that the renminbi was undervalued and that a revaluation was urgently needed.

One extreme argument on the renminbi exchange rate was made using special forms of PPP. For example, the “Big Mac index,” a light-hearted indicator, can help to tell whether world currencies are at their “correct” levels. According to this indicator, the renminbi was undervalued by 56 per cent as of April 2003. However, according to the “Starbucks Tall Latte index,” the renminbi was undervalued by only one per cent as of 2004 (Funke and Rahn, 2004).

Evidently, this approach has its own limitations. This big difference may be explained by the degree of penetration of the commodity into the domestic market. Thus, it may be that the Big Mac has become quite common for ordinary PRC people and has to compete with other traditional foods, while Starbucks Latte is still uncommon, and may be an exclusive commodity that cannot be substituted by traditional commodities, and therefore is basically priced based on overseas prices. The simple PPP approach, although simple and easy to understand, has this bias.
In an article published in the *Financial Times* (26 August 2003) and the *Asian Wall Street Journal* (12 September 2003), Morris Goldstein and Nicholas Lardy argued that the PRC aggravated the problem by joining the cheap dollar. In 2004, Morris Goldstein repeated this view on the undervaluation of the renminbi. He also worked out a scheme for its adjustment. He argued that: (1) the current renminbi was significantly undervalued, by 15 to 25 per cent; (2) the PRC’s “manipulating” its currency went against the IMF’s rules of the game; (3) For the PRC’s own interest, as well as for the interests of the international community, the PRC should urgently initiate an appreciation of the renminbi, and (4) the PRC need not stay with its existing currency regime nor take a freely floating regime and completely open capital market. Instead, he argued, it could undertake a “two step” currency reform. In the first step, it could switch from a unitary USD-peg system to a basket peg, and appreciate the renminbi by 15 to 25 per cent, widening the margin around the new peg. Existing controls on capital outflows would be either maintained or liberalized only marginally, at least in the short run. As a second step, when its banking system became considerably stronger, it could realize a transition to a “managed float,” along with a significant liberalization of capital outflows.

Bergstein (2003) examined the sustainability of the strong dollar and suggested that the trade-weighted exchange rate of USD should be 10–15 per cent lower. In order to achieve this, the USD should be depreciated mainly against East Asia currencies rather than the euro. He suggested a single-step revaluation of the renminbi by 20 to 25 per cent. His counterargument to the McKinnon’s view included: (1) the PRC’s large and rapidly growing current account surplus, along with its overheated domestic economy, were classic and unambiguous signs of substantial currency undervaluation. The markets clearly expected a rise in the renminbi, as indicated by the huge flows of speculative capital into the PRC. (2) The renminbi had driven the dollar down against virtually all other currencies for three years and the PRC’s trade-weighted average exchange rate had been depreciated by 10 per cent. (3) A sizable revaluation of the renminbi...
would help the PRC reduce its soaring trade surplus and restore price stability.

Regarding the Japanese bubble following the Plaza Accord, Bergstein emphasized, “It was easy monetary policy in Japan, associated with yen weakening and renewed undervaluation, that produced the bubble and subsequent collapse.” He added “that the real lesson for the PRC to learn from Japan was to revaluate the currency soon and to avoid an inflationary bubble that would eventually burst and curtail growth.”

Williams (2003) even argued that Bergstein’s approach might be too conservative. He said the adjustment should be significant enough to convince market participants that the change was complete and that there would be no second step, since otherwise a revaluation might simply lead to more speculative capital inflow. However, he admitted “that none of us has a satisfactory macro-econometric model at our disposal to back up our estimates or guesses.” This indicates that the theoretical foundation for his argument is still very weak.

Applying the Behavioral Equilibrium Exchange Rate (BEER) approach and quarterly data, Wren-Lewis and Bénassy-Quéré (2004) argued that the degree of undervaluation of renminbi was even larger than Goldstein’s estimates. Wren-Lewis’s estimated that the adjustment of the renminbi to the USD should be from the current 8.27 to 6.47, meaning an appreciation of 28 per cent, in order to achieve a balanced current account. If the objective were to balance both current accounts and capital flow in the PRC, they estimated that an even larger appreciation would be needed.

Bénassy-Quéré and her colleagues also develop estimates of bilateral equilibrium exchange rates. Provided that the real equilibrium exchange rate remained at its 2001 level, they estimated that the Chinese currency was undervalued by 47.3 per cent in 2003, or slightly more than the 44 per cent in 2001.

However, adopting a similar method to that used by Wren-Lewis, Michael Funke and Jorg Rahn (2004) found that the renminbi might not be so heavily undervalued. They found the degree of undervaluation to be around 12 per cent at the end of the sample period.
Ellen Hughes-Cromwick (see Bergsten and Williamson, 2004), in their comments on these studies, pointed out that in light of the reliability of the data and capital controls in the PRC, estimates of renminbi misalignment were very difficult, as may be illustrated by the big difference between the results found through different approaches. They concluded that the range of renminbi undervaluation was somewhere from 4.7 per cent to 28–30 per cent.

Eichengreen (2003) suggested that the PRC should abandon the USD peg and adopt a floating system. He also criticized those who regarded the fragility of the PRC banking system, lack of arbitration instruments and immaturity of the capital market as excuses for maintaining a pegged exchange rate regime. He also expressed concern regarding the revaluation of the renminbi. Since purchases of US government bonds by the Central Bank of China are one of the ways the US supports its trade deficits, it would be difficult to imagine what would happen if the PRC exchanged its USD reserves for euros.

He Fan (2004) argued that the current situation of the USD resulted from the strong USD policy in the 1990s. From May 1995 to February 2000, the trade weighted exchange rate for the USD increased by 44 per cent in nominal terms, and 34 per cent in real terms. It was precisely this strong dollar policy that made the US manufacturing sector lose its international competitiveness. Actually, the manufacturing sector itself continued to pressure the US government to abandon the strong dollar policy. With the collapse of economic bubble, the strong dollar policy lost its raison d’etre. At the same time, He Fan recognized that the tremendous trade deficit did create pressure for USD adjustment.

Some Chinese scholars, such as Yongding Yu (2004), paid more attention to the exchange rate regime than to the adjustment of the exchange rate alone. They admitted that there was pressure for the exchange rate of the RMB/USD to appreciate, and suggested that the PRC work hard toward a more flexible exchange rate regime, instead of simply adjusting the level of the exchange rate. However, regarding the timing of the adjustment, it was thought that the best time to adjust would be when no one cared about it. Li Gang-Liu
(2004) suggested that the PRC should allow the renminbi exchange rate to float within a wider range.

Regarding the impact of renminbi adjustment on the world economy, the Gale Group (2003) organized a seminar of 30 economists and conducted a survey on the issue. They found that the economists could be basically classified into two opposite groups. One group thought the renminbi was undervalued (although there were differing views on the extent); the other group thought the renminbi was not undervalued or that the current global problems were not related to renminbi revaluation. The first group was slightly larger than the latter. However, regarding the “threat” of the renminbi’s value and the Chinese economy to the world economy, a wide range of differing views were expressed. For example, Fred Bergsten, John Williamson and Tatsuya Terazawa insisted that the renminbi was seriously undervalued and that without a quick and large appreciation, it would be too little and too late and might end up being a nightmare for the world. On the other hand, Norbert Walter, Wendy Dobson and some others argued that the renminbi was undervalued to some extent, but they didn’t think that the impact on the world economy was significant. Some economists, such as Richard Cooper, Xinxie and Ronald McKinnon, even stated that the renminbi was not undervalued, and that the rapid economic growth of the PRC was good news rather than a nightmare. They emphasized the economic and financial risk as well as political instability in the PRC, and argued that the urgent task for the PRC was not revaluation, but rather reform of the exchange rate system.

2.4 Responses from PRC Authorities

Which suggestion is worth following? In fact, it has been very difficult for the PRC authorities to do anything given the fact that there are so many differing views presented by so many economists. Considering the experience of Russia, whose “big bang” reform was designed by Western economists, and the experiences of the Southeast Asian financial crisis and monetary crisis in Latin America, which were related to inappropriate remedial measures provided by
the IMF, it is understandable that the PRC authorities have been prudent before taking any action.

Unlike economists, the PRC authorities as policymakers have to take responsibility for any consequences that might arise due to policies they undertake. Hence, they need to carefully weigh the benefits, losses and difficulties that might be encountered in implementing reform measures before making any decision. Only if they are sure that the benefits will exceed the losses will they accept reform measures. Otherwise, the best decision would be not to take any action (Huang Da, 2004). On the other hand, nobody has yet succeeded in providing detailed and accurate impacts of RMB/USD exchange rate fluctuations on the PRC economy as well as the world economy. In this sense, it is very important to study where the exchange rate of the RMB/USD will go and what the consequences of this change will be.

The PRC authorities may seem calm in the face of the heated debate, but they have also been actively making preparations for future reform. At the press conference sponsored by the third session of the Tenth National People’s Congress (NPC), Chinese premier Wen Jiabao said that the PRC is a country that takes international responsibility. This means that when its authorities consider the renminbi exchange rate regime, they are ready not only to consider the impact on the nation’s interest, but also on the neighboring countries and the world as a whole. It seems that the PRC aims to adopt a managed floating exchange rate system as suggested by some economists (Yu, 2001), in line with market-oriented economic management. It has already adopted a series of measures to lift foreign exchange controls. Many ministries and research institutions in the PRC are also currently being encouraged to do research on future reform schemes. In the process of the reform of the exchange rate regime, the PRC’s concerns appear to be, first, how to maintain macroeconomic stability and development, and second, how to secure the soundness and stability of the financial sector. What specific measures will be adopted is far from certain at the moment. As for the effects of the exchange rate reform on the PRC economy and enterprises, Premier Wen Jiabao frankly pointed out that though some
people have made strong calls for an appreciation of the renminbi, the consequences might not be fully understood by anyone.

In answer to questions asked by a correspondent from People’s Daily recently, PBOC Governor Zhou Xiaochuan (2005) indicated that the PBOC would closely follow changes in the economic and financial situation by continuously analyzing various economic indicators including prices, so as to judge the appropriateness of continuing to raise interest rates further. Regarding the exchange rate policies, he indicated that the PRC economy was experiencing a transition from a planned economy to a market economy, and that it had not manifested an evident business cycle as mature market economies have done. He said that the PRC would actively and steadily carry out exchange rate reform, and would announce it in a timely manner. He went on to state that of course, since the PRC economy was playing an ever increasing important role in the world economy, it would not only consider the impact of this reform on the region but also on the world as a whole, as Premier Wen Jiabao stated at the NPC. He argued that the exchange rate policies would be decided taking account of various domestic factors and the balance of payment, and not the trade relation with any particular country. Regarding the balance of payments, he emphasized that the current account surplus actually was not so large. The main task faced by the PRC in future would be building a mechanism for the regulation of the renminbi exchange rate, and not simply to adjust the level of the exchange rate.

2.5 Summary Review

The current debate on the revaluation of the renminbi has continued since August 2001. The primary argument is that the PRC is exporting deflation. This argument originated from Japan. However, along with the disappearance of deflation in the PRC, Japan’s economy has begun to show signs of recovery and the trade surplus between the PRC and Japan increasing (there is discrepancy between the statistics of the two countries), and voices from Japan calling for the revaluation of the renminbi are weakening. On the other hand, the
pressure from the United States is strengthening. The United States complains that its economy had suffered from trade deficits with the PRC and its unemployment problem has become serious.

In the eyes of economists who insisted that the renminbi was undervalued, the appreciation of the renminbi was not only a good prescription for the US economy, but also for the PRC itself. An appreciation of this could encourage the PRC to avoid the mistake of being called “too late and too little.” However, some economists believed that the economic difficulties the US was facing were not necessarily attributable to the RMB/USD exchange rate, but rather to the US economy itself. The problem of US economy mainly resulted from the collapse of the bubble economy, the expansion of military expenditures associated with the Iraq war and the war on terrorism along with the tax cuts. These resulted in a tremendous fiscal deficit. Therefore, following the logic of these economists, the US should review its own domestic policy instead of blindly condemning the PRC. These economists believe that even if the renminbi were undervalued, it would still be premature to adjust it upward. They emphasize that the exchange rate mechanism is more important than appreciation itself.

Looking at the problems faced by PRC authorities, some economists have suggested that it will be best to keep the exchange rate unchanged, since changing it could result in speculative bidding for renminbi, leading to economic chaos, especially under the circumstances where the PRC is facing serious unemployment pressure, the restructuring of state-owned banks (SOBs), capital market reforms and tax cuts accompanying its accession to the WTO. The lessons from Japan’s experience may be useful in this regard.

Since many economists, policymakers and international organizations have presented so many divergent views and suggestions, it is very difficult for the PRC authorities to make any decision at this juncture. It should be noted that no one has given the PRC authorities certain information on what impacts of the appreciation of the renminbi can really be predicted: positive or negative or neutral?
In our view, the reason for this lies in the fact that different people adopt different theoretical frameworks such as partial equilibrium, general equilibrium or a framework with political factors, and belong to different schools, such as classical, monetary, or Keynesian. Even for those adopting general equilibrium theory, there is also the problem of how to choose variables to put into the model. Furthermore, one economic issue may have different explanations or solutions, such as monetary policy, fiscal policy and exchange rate policy. To achieve a better solution, we think, it is necessary to create a general equilibrium model that contains as many main factors as possible.
Chapter 3. Existing Theories of Exchange Rate Determination

We have seen that existing studies have produced a number of different estimates of the exchange rate of the renminbi. The reason behind the difference is that different theories, data and econometric methods are used. It is clear that not all the theories that are actually used are suitable for forecasting the movement of exchange rate. Some may be better than others. Thus, it is very important for researchers who study exchange rates to choose or create a better model with micro foundations for an empirical study. In this Chapter, we investigate existing theories, their preconditions, implications and advantages and disadvantages, which will be helpful to the modeling efforts to be made in the next part.

The exchange rate theories investigated in this part can be classified into three kinds: partial equilibrium models, general equilibrium models and disequilibrium or hybrid models. Partial equilibrium models include relative PPP and absolute PPP, which only consider the goods market; and covered interest rate parity (CIRP) and uncovered interest rate parity (UCIRP), which only consider the assets market, and the external equilibrium model, which states that the exchange rate is determined by the balance of payments. General exchange rate equilibrium models include the Mundell-Fleming model, which deals with the equilibrium of the goods market, money market and balance of payments, but lacks micro-foundations to some extent; the Balassa-Samuelson model, which is built on the maximization of firms profit; the Redux model, which was developed by Obstfeld and Rogoff, and the PTM (Pricing to Market) model, created on the maximization of consumer’s utility; A simple monetary model with price flexibility and the Dornbusch model (or Mundell-Fleming-Dornbusch model), are actually obtained by combining the monetary equilibrium with the adjustment of price and the adjustment of output toward their long run equilibrium, and can be called hybrids of monetary equilibrium with PPP or UCIRP. The balance of payments is covered in this investigation since many
studies regards it as a foundation of equilibrium exchange rate determination.

### 3.1 Purchasing Power Parity

The starting point of exchange rate theory is purchasing power parity (PPP), which is also called the inflation theory of exchange rates. PPP can be traced back to sixteen-century Spain and early seventeen-century England, but Swedish economist Cassel (1918) was the first to name the theory PPP. Cassel once argued that without it, there would be no meaningful way to discuss over-or-under valuation of a currency.

Under this model, let $P_i$ and $P_i^*$ denote, respectively, the price level of good $i$ in the home currency and foreign currency. Letter “$S$” denotes the nominal exchange rate that expresses the price in foreign currency in terms of the domestic currency. According to the “law of one price,” the price of one good should be equal at home and abroad, say, $P_i = S P_i^*$. If the prices of each good are equalized between the two countries and if the goods baskets and their weights in the two countries are the same, then, then absolute PPP holds:

$$P = SP^* \quad (3.1)$$

Absolute PPP theory was first presented to deal with the price relationship of goods with the value of different currencies. The theory requires very strong preconditions. Generally, Absolute PPP holds in an integrated, competitive product market with the implicit assumption of a risk-neutral world, in which the goods can be traded freely without transportation costs, tariffs, export quotas, and so on.

However, it is unrealistic in a real society to assume that no costs are needed to transport goods from one place to another. In the real world, each economy produces and consumes tens of thousands of commodities and services, many of which have different prices from country to country because of transport costs, tariffs, and other trade barriers.

Absolute PPP is generally viewed as a condition of goods market equilibrium. Under absolute PPP, both the home and foreign market are integrated into a single market. Since it does not deal with
money markets and the balance of international payments, we consider it to be only a partial equilibrium theory, not the general one.

Perhaps because absolute PPP require many strong impractical preconditions, it fails in explaining practical phenomenon, and signs of large persistent deviations from Absolute PPP have been documented.\footnote{See Froot and Rogoff (1995) for a survey of the empirical evidence on PPP.}

Although absolute PPP may contradict practical data, this does not imply market failure. It may simply reflect the inability, without expenses, to instantaneously move goods from one place to another. Thus, a more general version of PPP, called the relative purchasing power parity, was introduced to describe the relationship of prices with the exchange rate in different economies. Generally, relative PPP can be derived by assuming that transaction costs are proportionately related to price level. For example, assuming that a commodity’s home price at time $t$ is $P_t$, and the transport cost is $kP_t$, where $k$ is constant, the foreign price of the commodity is equal to the price of foreign currency multiplied by the exchange rate $(1+k)P_t$ in terms of home currency, that is

$$(1+k)P_t = S_t P_t^*$$ \quad (3.2)$$

By taking the logarithm and then carrying out a differential operation on each side of equation (3.2) with regard to time $t$, we get relative PPP expressed by

$$\frac{\Delta E_t}{E_t} = \frac{\Delta P_t}{P_t} - \frac{\Delta P^*_t}{P^*_t},$$

(3.3) states that the relative change of the exchange rate equals the difference of the inflation rate between the two economies.

Assuming that $\ln S_t = s_t$, $\ln P_t = p_t$, $\ln P^*_t = p^*_t$, (3.3) can be re-expressed as

$$s_t = p_t - p^*_t$$ \quad (3.4)
(3.3) Can also be derived by taking the logarithm and differential operation directly from (3.1). If the real exchange rate is denoted by the ratio of national price levels, \( q_t = \frac{S_t P^*_t}{P_t} \), if absolute PPP holds, the real exchange rate equals one. If relative PPP holds, the real exchange rate should be a constant, but is not necessarily equal to one. If an economy adopts a fixed exchange rate regime, the relative PPP model forecasts that the home prices change at the same speed as foreign prices. Conversely, if the inflation rates in the two economies are the same, according to relative PPP, the exchange rate should be constant. Mundell has in fact taken the fact that the PRC and the US experience the same inflation rate as a rationale for supporting a renminbi peg to the dollar.

It is clear that absolute PPP is built on the assumption of a perfect market setting with high information efficiency in both foreign exchange and goods markets. Allowing for transport costs, tariffs and trade barriers, absolute PPP may not hold. Many empirical studies show that neither absolute nor relative PPP holds in the short run, since the adjustment is a time-consuming process. Though controversies over PPP remain, it seems that only relative PPP can hold in the long run (Pippenger, 1993). This may explain why PPP was thought by some to be a long-run equilibrium condition, instead of a casual relationship (Pongsak Hoontrakul, 1999). Relative PPP implies that the real exchange rate is constant. However, this theory itself does not explain why the real exchange rate should remain constant over a particular period of time.

Empirically, evidence against PPP may be caused by inaccuracy of the price index measuring the inflation rate for the countries studied (Frenkle, 1978; Genberg, 1978; and Thurow, 1997), the statistical procedure, or the problem of simultaneous determination of both price and exchange rate (Levi, 1976).

Theoretically, deviations of the PPP from its practical value may also be caused by differences in production technology and consumer’s preferences toward risk and uncertainty. For example, the
Balassa-Samuelson model argues that a rise in the productivity rate in the home country relative to a foreign country can lead to a real appreciation of the home currency against the foreign currency. Many other models (Liu, Zhao and Ma, 2002) state that the real exchange rate is associated with the preferences of consumers. In addition, tax or tariff policy may also change the real exchange rate. For example, to offset the effect of the East Asia crisis, the PRC increased export tax refunding after 1998, and this had a similar impact as the real depreciation of home currency. Also, currently, the PRC plans to increase the tariff on textile exports to avoid sanctions by European countries, and this is equivalent to a real appreciation of home currency.\(^{12}\)

As for whether PPP holds in the PRC, Chou and Shih (1998) showed that the renminbi was overvalued after the economic reform was launched in 1979, but that purchasing power parity holds in the long run. Using the ADF-test and Engle-Granger unit root test and integration test, Hu Yuancheng (2003) concluded that the real exchange rate of the renminbi was not stationary, and thus that at least in the short run, PPP does not hold.

### 3.2 Interest Rate Parity

As early as the period of the gold standard, monetary policymakers found that exchange rates were influenced by changes in monetary policy. The rise of the home interest rate is usually followed by the appreciation of the home currency, and a fall in the home interest rate is followed by a depreciation of the home currency. This indicates that the price of assets plays a role in exchange rate variations. The interest rate parity condition was developed by Keynes (1923), as what is called interest rate parity nowadays, to link the exchange rate, interest rate and inflation. The theory also has two forms: covered interest rate parity (CIRP) and uncovered interest rate parity (UCIRP). CIRP describes the relationship of the spot market and forward market exchange rates with interest rates on bonds in two economies.

\(^{12}\) This policy was finally abandoned before it was put into practice.
UCIRP describes the relationship of the spot and expected exchange rate with nominal interest rates on bonds in two economies.

### 3.2.1 Covered Interest Rate Parity

Under this model, assume that the home country denotes the PRC and the foreign country denotes the US. The nominal interest rate at time \( t \) in the PRC is \( i_t \) and that at time \( t \) in the US is \( i_t^* \), the spot exchange rate is \( S_t \) and the forward exchange rate at time \( t+1 \) is \( S_{t+1} \). If an investor in the PRC deposits one yuan in Chinese currency, he will get a return of \( i_t \) at time \( t+1 \), and the sum of his principal and interest rate at time \( t+1 \) is \( 1 + i_t \). If this investor exchanges his one yuan renminbi into USD at time \( t \) and then deposits it in a US bank with interest rate \( i_t^* \), the sum of his principal and interest in dollar terms is \( (1 + i_t^*)/S_t \). However, since the forward change rate is \( S_{t+1} \), this sum of the principal and interest in yuan terms is \( (1 + i_t^*)S_{t+1}/S_t \). In a perfectly competitive market, it is generally recognized that it is less likely for the gap between the renminbi’s yield and that of the USD to persist for any length of time. In other words, the return from depositing renminbi in the PRC must be the same as the return from depositing USD in US. This relation can be expressed using the covered interest rate parity condition:

\[
1 + i_t = (1 + i_t^*)S_{t+1}/S_t
\]

or

\[
1 + i_t/1 + i_t^* = S_{t+1}/S_t
\]

(3.6) is the precise form of the covered interest rate parity condition. CIRP can also be derived directly from the Fisher condition and PPP. Under the Fisher condition, the real interest rates at home and abroad are, respectively

\[
(1 + i_t)P_{t+1}/P_t = (1 + r_t)
\]

\[
(1 + i_t^*)P_{t+1}^*/P_t^* = (1 + r_t^*)
\]

Since the real interests rates are equal, the following formula holds:

\[
(1 + i_t)P_{t+1}/P_t = (1 + i_t^*)P_{t+1}^*/P_t^*
\]
Assuming \( P_t = S_t P_t^* \) or PPP holds, we again obtain the CIRP condition
\[
(1 + i_t) = (1 + i_t^*) S_{t+1}^+ / S_t.
\]

To simplify the model, we introduce the sign:
\[
1 + f_{t+1} = S_{t+1}^+ / S_t,
\]
where \( f_{t+1} \) is defined as the forward premium (discount), the proportion by which the forward exchange rate exceeds (falls below) its spot rate.

Using (3.7), (3.6) can be rewritten as
\[
1 + i_t = (1 + i_t^*)(1 + f_{t+1}) = 1 + f_{t+1} + i_t^* f_{t+1}
\]
(3.8)

Since \( i_t^* f_{t+1} \) is such a small number that it can be omitted, (3.8) can be written approximately as
\[
i_t = f_{t+1} + i_t^*
\]
(3.9)

This is the normal form of the covered interest rate parity, which states that the domestic interest rate must be higher than the foreign interest rate by an amount equal to the forward premium (discount) on domestic currency. According to CIRP, if the exchange rate of, say, the renminbi against the USD is fixed, the interests of the two countries should be equal. Thus, a small country with a pegged exchange rate regime cannot carry out monetary policy independently.

Empirically, using weekly observations from Jan. 1962 to Nov. 1967, Frenkle and Levich (1975) confirmed that CIRP held. Later (1977) they extended their studies into three periods: 1962–67, known as the “tranquil peg”; 1968–69, the “turbulent peg”; and 1973–1975, the managed float, and strengthened the findings of their previous study that CIRP still holds during these periods even when the effect of transaction costs is taken into account. Levi (1990) indicated that deviations from CIRP might occur due to four major reasons: (1) transaction costs, (2) political risk, (3) potential tax advantages, and (4) liquidity preference.
3.2.2 Uncovered Interest Rate Parity

However, investors face uncertainty over future events. In a rational expectation framework, the forward exchange rate may be strongly influenced by the market expectations about the future exchange rate if new information is taken into consideration. In an uncertain environment, an un-hedged interest rate parity condition may hold. Given that all other variables’ symbols do not change but that the forward exchange rate \( S_{t+1} \) is substituted by the expected exchange rate \( E(S_{t+1}) \), the UCIRP condition can be written as

\[
1 + i_t / 1 + i_t^* = E(S_{t+1} / S_t)
\]  

(3.10)

This is the precise form of uncovered interest rate parity. Like PPP, the UCIRP does not allow for investor’s preferences. In other words, (3.10) is derived under the condition that investors are risk neutral. This means that agents are indifferent between an investment yielding a completely secure return, on the one hand, and one offering the prospect of an identical return on average, but with the possibility of a much higher or lower return, on the other hand. In other words, they are concerned only with average returns.

Similarly, using the following approximate expression:

\[
e^t S_{t+1} = 1 + \Delta s_t^e
\]  

(3.11)

where \( \Delta s_t^e \) is the expected rate of appreciation of foreign currency, and then substituting (3.11) into (3.10) and ignoring the smaller number as we did previously, we get the formal uncovered interest rate parity condition:

\[
i_t = i_t^* + \Delta s_t^e
\]  

(3.12)

Formula (3.12) states that the domestic interest rate must be higher than the foreign interest rate by an amount equal to the appreciation rate of foreign currency.

As with PPP, uncovered and covered interest rate parity conditions are derived under the assumption of no transaction barriers, a perfectly competitive capital market and no arbitrage opportunities at equilibrium. Obviously, this kind of equilibrium is still partial, because only the assets market is considered.
Very few empirical studies support UCIRP. For example, using a K-step-ahead forecasting equation and overlapping techniques on weekly data of seven major currencies, Hansen and Hodrick (1980) reject the market efficiency hypothesis for exchange.

We have indicated above that the Fisher Open condition can be a basis for covered interest rate parity. This condition implies that the expected real interest rates are equal in different countries, with the real interest rate defined as the nominal interest rate divided by the sum of one plus the expected inflation rate. The Fisher Open condition implies approximately that the difference of nominal interest rates equals the difference of expected inflation rate between two countries. Empirically, little evidence supports the Fisher Open hypothesis (Cumby and Obstfeld 1981, 1984). When the Fisher Open hypothesis is denied, real interest rate parity cannot hold.

3.3 The Mundell-Fleming Model

Money is important, because it serves as a medium of exchange, ruler of value, and means of storage. As a modern invention, paper money or currency plays an important role in reducing transaction costs. However, this role was not included in the previous section. Thus, the effect on the nominal exchange rate of monetary policy is not clear from previous models. The Mundell-Fleming model is developed by extending the IS-LM model to the case of an open economy, and thus provides understanding of how the exchange rate is determined. The IS-LM model considers three markets: goods, money and assets, and is mainly used to analyze the impacts of monetary policy and fiscal policy. When the goods market is not in full employment equilibrium level, it shows how to use fiscal policy and monetary policy to adjust an economy to a new full employment equilibrium. Since only two of the three markets are independent, the IS-LM model only establishes a linkage between the money market and goods market. In the Mundell-Fleming model, the balance of international payments is considered another equilibrium condition in addition to the money market and goods market.

Let us first define the goods market equilibrium as the IS curve
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\[ Y = C + I + G + (X - M) \]  \quad (3.13)

where \( Y \) denotes domestic national income; \( C = C(Y) \) denotes consumption which is a function of income; \( I = I(i) \) denotes investment, which is a decreasing function of nominal interest rate \( i \); \( G \) denotes government spending; \( X = X(Y^*, q) \) denotes exports, which is an increasing function of foreign national income and real exchange rate. \( M = M(Y, q) \) denotes imports, an increasing function of domestic income and decreasing function of the real exchange rate. The real exchange rate is defined by \( q = \frac{SP^*}{P} \), where \( S \) is the nominal exchange rate; \( P, P^* \) denote, respectively, domestic and foreign prices.

Second, we define the money market equilibrium through the LM curve. Let \( \frac{M^d}{P} = L(Y, i) \) represent money demand, which is an increasing function of domestic income and decreasing function of the interest rate, and \( M^s \) represent money supply. The money market equilibrium condition can be expressed as

\[ \frac{M^s}{P} = L(Y, i). \]  \quad (3.14)

Finally, the external equilibrium is denoted by the BP equation:

\[ BP = CA + KA = 0 \]  \quad (3.15)

where, current account
\[ CA = PX - SP^* M \]
and capital account
\[ KA = K(i - i^* - \Delta s^e) \]

One of the most important issues addressed by the model is the so-called trilemma, which states that perfect capital mobility, monetary policy independence and a fixed exchange rate regime cannot be achieved simultaneously. Specifically, it argues that a country cannot sustain monetary policy independence in a fixed exchange rate regime with perfect capital mobility. However, this argument is made in a small country setting, and it is not necessarily true in a bigger economy, say, the PRC. What we have seen in the PRC is that it is not so small and is maintaining certain capital control and its monetary policy has seemed to be independent so far. The
model also forecasts that the exchange rate level is perfectly correlated with the level of monetary supply in the long run, and thus that monetary policy may only play a trivial role. Another important implication is that devaluation may lead to further devaluation if fiscal discipline, inflation and balance of payments are not well managed or if the assets market produces a self-fulfilling bubble. Finally, the impact of devaluation on the improvement of the current account may be weakened if an economy is heavily reliant on the re-export processing industry.

3.4 Exchange Rate and Productivity: The Balassa-Samuelson Model

From the discussion above, we conclude that PPP and CIRP (and UCIRP) only express forms of partial equilibriums and do not clearly relate producer behavior and consumer behavior. However, price levels are determined by the interaction between supply and demand. Since the supply of and demand for products are associated with producer and consumer’s behavior, a starting point for studying the determinants of the real exchange rate is to investigate producer’s behavior and consumer’s behavior, which are associated with the microeconomic foundations of exchange rate theory. In this section, from the angle of producer behavior, we investigate the Balassa-Samuelson model (Balassa, 1964; Samuelson, 1964). It allows us to see the role that productivity plays in the real exchange rate.

The standard version of the B-S model is presented using a single-factor aggregate production function in Obstfeld and Rogoff (1996). For simplicity, this model assumes that the production functions of tradable (T) and nontradable goods take the following form:

\[ Y_T = A_T L_T \]
\[ Y_N = A_N L_N \]
\[ Y_T^* = A_T^* L_T^* \]
\[ Y_N^* = A_N^* L_N^* \]

where \( Y \) is production, \( A \) is a constant describing technology, and \( L \) is labor force. Foreign economies employ the same kind of
technology as the domestic economy, but may differ from it in the value of the technological parameter, \( A \). The subscript \( T \) denotes the tradable sector, and the subscript \( N \) the nontradable sector.

This model also assumes that the law of one price holds for tradable commodities and that the world price of tradable commodities is equal to one without a loss of generality. In addition, perfect labor mobility is assumed between sectors within an individual economy, but zero mobility of labor is assumed between economies. The mobility of labor insures that the wage rates \( w \) are equal in other sectors of the same economy. We define the price index as the weighted geometric average of prices of tradable and nontradable goods:

\[
P = (p_T)^\gamma (p_T)^{1-\gamma} = (p_T)^{1-\gamma} = \left( \frac{A_T}{A_N} \right)^{1-\gamma}
\]

where \( \gamma \) is the share of tradable goods in total outputs. If this share is the same at home as abroad, the relative price vis-a-vis the outside world is

\[
\frac{P}{P^*} = \left( \frac{A_T}{A_N} \right)^{1-\gamma}
\]

the nominal GDP per employee can be expressed as

\[
GDP_{nom} = A_T.
\]

So the relative price can be transformed into

\[
\frac{P}{P^*} = \frac{GDP_{nom}}{GDP_{nom}^*} \left( \frac{A_N}{A_N^*} \right)^{1-\gamma} \quad (3.16)
\]

This formula states that the relative price is determined by relative GDP and the relative technological level or productivity in nontradable sector of the two economies. Given a level of productivity at home and abroad, a higher nominal GDP growth in home than abroad leads to an appreciation of the real exchange rate. On the other side, given an economic growth rate, higher productivity of nontradables in the home country than the foreign country will lead to depreciation of the real exchange rate.

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This simplified model can be easily extended to a more general one that includes two production factors: labor and capital. Let us consider a small economy that produces two composite goods: tradables and nontradables. We assume that the production functions are functions of capital and labor with constant return to scale:

\[ Y_T = A_T F(K_T, L_T), \]
\[ Y_N = A_N F(K_N, L_N), \]

where \( K \) denotes capital. The other variables are the same as above. Through some manipulation, the log-differentiation of the relative price of tradable goods and nontradable goods can be expressed as

\[
\hat{P} - \hat{P}^* = (1 - \gamma) \left( \frac{\mu_{LN}}{\mu_{LT}} (\hat{A}_T - \hat{A}_T^*) - (\hat{A}_N - \hat{A}_N^*) \right)
\]

(3.17)

where \( \mu_{LT} = wL_T / Y_T \) and \( \mu_{LN} = wL_N / pY_N \) are respectively the labor share of the income generated in the tradable and nontradable goods sectors.

Provided that nontradables are relatively labor intensive, meaning \( \frac{\mu_{LN}}{\mu_{LT}} \geq 1 \), the model forecasts that the domestic economy will experience real appreciation if its productivity-growth advantage in tradables exceeds its productivity growth advantage in nontradables.

The Balassa-Samuelson model is one of the cornerstones of the traditional theory of the real equilibrium exchange rate. The key empirical observation underlying the model is that countries with higher productivity in tradables compared with nontradables tend to have high price levels. The B-S model hypothesis states that productivity gains in the tradable sector allow real wages to increase commensurately and, since wages are assumed to link the tradable to the nontradable sector, wages and prices also increase in the nontradable sector. This leads to an increase in the overall price level in the economy, which in turn results in an appreciation of the real exchange rate.
During the starting period of economic reform and opening up, productivity in both tradable and nontradable goods production in PRC was very low compared with developed countries. With the opening up and economic reform, the lag in the economic and technological level allowed the PRC to enjoy three advantages over developed countries, namely, cheap labor, high productivity growth and spillover effects of foreign direct investment. These advantages have allowed the PRC to enjoy much faster growth in productivity in the tradable sector than the nontradable sectors and at home than in foreign markets. According to the B-S model, this should result in the PRC experiencing real depreciation, and thus incurring nominal appreciation pressure in the long run.

However, the shortcomings of this model are clear. First, it assumes that the tradable price at home is the same as that abroad. This is clearly an unrealistic special form of PPP, but for tradable goods only. Under this setting, how the prices of tradables are determined remains unknown. Second, since it says nothing about the demand side, it is criticized by the Keynesian school, which regards price to be rigid or sticky. Third, without considering the behavior of consumers, or the demand side, it is difficult to interpret how market prices are formed. Last and most importantly, this model does not deal with the role of money; it can at best explain partly how the real exchange rate is determined.

Integrating the model with a model of accumulation of capital and with the demand side of the economy, Tomáš Holub and Martin Čiháč (2003) claimed that the predictions of their model were generally consistent with empirical findings for Central and Eastern European countries. But the extended model still does not have room for money and the nominal exchange rate. This implies that money is assume out of this kind of model and that prices are assumed to be flexible enough to adjust to supply and demand.
3.5 A Simple Monetary Exchange Rate Model with Price Flexibility

Unlike the Mundell-Fleming model, which involves the balance of international payment, a simple monetary model was originally created in a frictionless world with only one good and one bond (Mussa, 1976, Frenkle, 1976), in which money market equilibrium, PPP and UCIRP are reached. This model includes three blocks.

The first block is the money market equilibrium equation given by

\[ m_t - p_t = -\eta i_t + \phi y_t \]  

(3.18)

Where \( p \) is the log price level, \( i \) is nominal interest rate, \( y \) is the log of real output and \( m \) is the log of money supply.

The second block is purchasing power parity. Let \( e \) be the log of the nominal exchange rate, defined as the price of foreign currency in terms of home currency; \( p^* \), \( p \) denote the log of the world foreign currency price of the goods basket and the log of the home currency price level. The purchasing power parity in log terms is

\[ e_t = p_t - p_t^* \]  

(3.19)

The third block is uncovered interest parity, which can be approximately expressed in the forms of logs:

\[ i_t = i_t^* + E_t e_{t+1} - e_t \]  

(3.20)

Substituting (3.19) and the uncovered interest rate parity approximation equation (3.19) into money market equilibrium equation (3.18), we have

\[ e_t = \frac{1}{1+\eta} \sum_{s=t}^{\infty} \left( \frac{\eta}{1+\eta} \right)^{s-t} E_t \{ m_t - \phi y_t^* + \eta i_t^* - p_t^* \} \]  

(3.21)

Given money supply, foreign interest rate and price, this simple monetary model demonstrates that the exchange rate depends on both current values as well as expected future values of related variables; that an increase in the domestic money supply and foreign interest rate raises both the domestic price level and nominal exchange rate level; and that changes in real domestic income and the foreign price level have a negative effect on the domestic level and nominal interest rate.
In the extreme case of a fixed exchange rate regime, the domestic interest rate and price level are equal to their foreign counterparts. The money supply is endogenously determined by domestic output, the foreign interest rate and foreign price level:

\[ m_s = \phi y_s - \eta I^*_s + P^*_s. \]

### 3.6 The Dornbusch Overshooting Model

Many studies document the fact that deviations from the law of one price are highly correlated with nominal exchange rate changes (for example, Isard, 1977; Giovannini, 1988). Evidence also shows that real exchange rates always seem much less volatile when nominal exchange rates are fixed than when they are floating (Mussa, 1986). During the Bretton Woods period up until December 1971, the nominal exchange rate of the lira to the French franc was relatively fixed and real exchange rate volatility was fairly low. During the periods when the relative value of the two currencies was not effectively fixed (the early 1970s through 1987), real exchange rate movements were much more volatile and short-run real changes virtually mirrored short-run changes in the nominal exchange rate. This indicates that the choice of exchange rate regime can have important effects on real variables.

Such forms of evidence motivate a sticky price extension of the flexible exchange rate monetary model above, namely the Dornbusch Overshooting model, which was presented in the influential masterpiece “Expectations and exchange rate dynamics” by Rudiger Dornbusch (1976) (Kenneth Rogoff, 2002).

Under the Dornbusch model, uncovered interest rate parity and the money equilibrium of the simple monetary model are retained. However, the assumption of flexible prices is replaced by sticky prices. Similarly, The first condition in Dornbusch’s model is monetary equilibrium:

\[ m_t - p_t = -\eta y_{t+1} + \phi \nu_t \]  

(3.22)

where \( m \) is the money supply, \( p \) is the domestic price level, and \( y \) is domestic output, all in logarithms; \( \eta \) and \( \phi \) are positive parameters. (3.22) implies that higher interest rates raise the opportunity cost of
holding money and thereby lower the demand for money; on the other hand, a higher interest rate also means high costs of speculation, which lowers the demand of money as well. Conversely, an increase in output raises the transaction demand for money. Finally, the demand for money is positively related to the level of prices.

The second condition is uncovered interest rate parity, which can be rewritten as

$$i_{t+1} = i^* + E_t(e_{t+1} - e_t) \quad (3.23)$$

where $e$ is the logarithm of the exchange rate (home currency price of foreign currency), and $E_t$ denotes market expectations based on information at time $t$. $i_{t+1} = \log(1 + i_{t+1})$ and $i^* = \log(1 + i^*)$ are approximately correct. The foreign interest rate $i^*$ is taken as a given exogenous variable. In accordance with uncovered interest rate parity, the home interest rate must be equal to the foreign interest rate $i^*$ plus the expected depreciation rate of the home currency, $E_t(e_{t+1} - e_t)$.

Unlike under the perfectly flexible price model, the prices of goods are sticky and cannot adjust immediately to clear the market in the Dornbusch model. With sticky prices, an adjustment mechanism is needed for an economy to converge to its equilibrium path in which full employment is realized. Given the magnitude of the real exchange rate’s departure from its long-term equilibrium, the force to pull it back to equilibrium will increase. Dornbusch assumes that if the real exchange rate rises over its long-term equilibrium level, or if the foreign currency is overvalued or the domestic currency is undervalued, the demand for domestic goods will increase; contrarily, if the real exchange rate falls below its long-term equilibrium level, or the foreign currency is undervalued or domestic currency is overvalued, then the demand of domestic goods will fall. In this connection, the third condition is an adjustment mechanism of the demand for domestic goods, which can be expressed as

$$y^d_t = \bar{y} + \delta(e_t + p^* - p_t - \bar{q}) = \bar{y} + \delta(q_t - \bar{q}), \quad (3.24)$$

Where $p$ and $p^*$ are, respectively, logarithms of the domestic price level $P$ in domestic currency and foreign price levels $P^*$ in foreign currency, $\delta$ is a constant greater than zero,

$$q_t = \log(E_t P^*/P) = e_t + p^* - p_t \quad (3.25)$$
is the real exchange rate at time $t$, and $\bar{y}$ and $\bar{p} = \log(EP^*/P) = e + p^* – p$, respectively, denote the exogenous long-term equilibrium output and real exchange rate, at which full employment is realized.

The last or fourth condition is the price adjustment equation. Keynes assumed that the domestic price level $p$ does not move instantaneously in response to unanticipated monetary disturbances, but adjusts only slowly over time. However, under Dornbusch’s model the feature of sticky prices is different from that in the Mundell-Flemming model where the domestic price level is basically assumed to be fixed.

Using the price adjustment mechanism proposed by Mussa (1982), which is better suited than Dornbusch’s original formulation to dealing with more complex exogenous shocks, the sticky-price adjustment process can be described as

$$ p_{t+1} = p_t + \psi(y^d_t - \bar{y}) + (e_{t+1} - e_t) \quad (3.26) $$

The Dornbusch model is well known for its overshooting phenomenon, which states that one permanent change in the money supply must lead to a proportionate change in the price level and the exchange rate in the long run. But in the short run, the price level is fixed and the nominal exchange rate must overshoot its long-run equilibrium. That is, any initial disturbance of money supply will cause an even larger unanticipated rise in the instant exchange rate than in the long-term exchange rate.

Another significant conclusion of the Dornbusch model is that the impact on the exchange rate of a monetary shock is greater when prices are sticky than when they are flexible.

The third conclusion is that the exchange rate converges to its flexible-price equilibrium value following an initial overshooting after a shock and that the nominal exchange rate is more volatile than the real exchange rate when $\psi\delta < 1$.

Fourth, the Dornbusch model tells not only a story of overshooting, but it has important policy implications for the exchange rate regime. A central conclusion of the model is that with sticky prices and flexible exchange rates, purely monetary shocks will
have significance for the real economy, leading to large changes in prices and output and prolonged adjustment. If the exchange rate is fixed, the real effects of money demand shocks can be eliminated by setting money supply to money demand (so-called nonsterilized foreign exchange intervention).

The model also states that the exchange rate policy is to some extent inconsistent with the independence of monetary policy. When a real shock occurs, say a long-run rise in the real exchange rate, buffeting the economy, the model forecasts that a new full employment equilibrium adjustment will occur immediately under a floating exchange rate regime, and need not change the price level. If the exchange rate were fixed, in order to recover the real economy to equilibrium, the entire burden would have to be borne by the prices of goods. But because these prices are sticky, it is a time-consuming process for the economy to reach equilibrium.

Dornbusch’s model is not without deficiencies. For example, it is unable to deal adequately with the current account and fiscal policy dynamics or, more fundamentally, with welfare issues, because it lacks a micro foundation. In addition, it is premised on the assumption that capital is perfectly mobile and the market is clear. In cases where capital mobility is imperfect, or where capital control is stringent, as happened in the PRC and other developing countries, there is a lot of room for the model to be improved. Finally, a fixed exchange rate regime may not be a viable option in the long run, given the limited ability of an economy to endure pervasive speculative attacks on a fixed exchange rate.

It is worth mentioning that the above arguments are obtained in the context of a small country model. For a big economy, further studies are needed to determine whether these conclusions are applicable.

### 3.7 The Obstfeld and Rogoff Model

Probably from the awareness that previous models have an inadequate micro foundation, and are unable to deal adequately with current accounts and balances of international payments, economists
have made considerable efforts to explore a new setup for exchange rate determination.

The modern models of Obstfeld and Rogoff were set up based on simple PPP, which implicitly assumes that nominal prices are producer’s currency of production (PCP). As a result, the exchange rate changes “pass-through” one hundred per cent to consumer prices and a flexible exchange rate is a perfect substitute for flexible goods price. In their pioneering work, based on PCP, Obstfeld and Rogoff (1995) developed a perfect-foresight two-country equilibrium monetary model with preset prices.

Their model assumes that the world is inhabited by a continuum of individual monopolistic producers, indexed by \( z \in [0,1] \), each of which produces a single differentiated good, also indexed by \( z \). All producers reside in one of two countries, home or abroad. The home consists of producers on the interval \([0,n]\), whereas foreign producers are on interval \((n,1]\). But this model revolves around the endogeneity of output of good \( z, y_z(z) \).

One of the important contributions of the model is that it introduces a utility function consumer \( j, j \in [0,1] \), which depends on the consumption index, real money balances, and effort made in production:

\[
U_t^j = \sum_{t=1}^{\infty} B_t^{-\gamma} \left[ \log C_t^j + \gamma \log \frac{M_t^j}{P_t} - \frac{k}{2} y_z(j)^2 \right],
\]

(3.27)

Here, the real consumption index for individual \( j \) is defined as

\[
C_t^j = \left[ \int_0^1 c^j(z)^{\theta-1} \, dz \right]^{\frac{1}{\theta-1}}
\]

(3.28)

where \( c^j(z) \) is the \( j \)-th home individual’s consumption of good \( z \), and \( \theta > 1 \).

Let \( p(z) \) be the home-currency price of good \( z \). Then the home money price level is

\[
P = \left[ \int_0^1 p(z)^{1-\theta} \, dz \right]^{\frac{1}{1-\theta}}
\]

(3.29)
Let \( p^*(z) \) be the home-currency price of good \( z \). Then the foreign money price level is
\[
P^* = \left[ \int_0^1 \int \frac{p^*(z)^{-\theta}}{dz} \right]^{1-\theta} \tag{3.30}
\]

The law of one price holds for individual goods, and the home and foreign price levels are related by purchasing power parity. That is \( P = eP^* \).

An individual’s budget constraint
\[
P_t^j B_{j,t+1} + M_{j,t}^j = P_t^j (1 + r_t) B_{j,t}^j + M_{j,t-1}^j + p_t^j(j) y_t^j(j) - P_t C_t^j - P_t \tau_t,
\]
\[
\tag{3.31}
\]

\( r_t \) denotes the real interest rate on bonds between t-1 and t, \( y_t(j) \) is the output of good \( j \), and \( p_t(j) \) is its domestic currency price. Because there is production differentiation, \( p_t(j) \) need not be the same for all \( j \). The \( M_{j,t}^j \) is agent \( j \)’s holdings of nominal money balances entering period t, and \( \tau_t \) denotes lump-sum taxes.

Compared with the Dornbusch model, the Obstfeld and Rogoff model has four advantages. First, it was developed on a firm micro foundation that maximizes the welfare of consumers. Second, though money the demand functions in the Dornbusch model and Obstfeld and Rogoff model have similar forms, the output variable in the former was substituted by consumption in the later. Third, a goods differential is allowed in the Obstfeld and Rogoff model, but Dornbusch’s model revolves around the market structure and the endogeneity of output. Fourth, in the Obstfeld and Rogoff model, a comparison of the impact of external shocks on consumer’s welfare is allowed, but it isn’t in Dornbusch model.

According to Obstfeld and Rogoff (1995, 1998, 2000a), the flexibility of the exchange rate is desirable in the PCP setting, because: (1) flexible exchange rates are a perfect substitute for flexible nominal prices. Relative price adjustment is achieved by exchange rate flexibility under PCP pricing; (2) the policy that achieves the flexible price allocation is a constrained Pareto optimum; (3) this optimal policy is completely self-oriented. No policy
coordination across countries is required or desirable. In this sense, perfectly flexible exchange rates are optimal (Engle, 2002).

### 3.8 Price to Market and the Exchange Rate Regime

The modern models of Dornbusch and Obstfeld and Rogoff are based on simple PPP, which implicitly assumes that nominal prices are PCP. As a result, the “pass-through” of exchange rates to consumer prices is one hundred per cent and flexible exchange rates are a perfect substitute for flexible goods prices. However, a number of empirical studies and experiences of Japan (Chapter 6) indicate that in the short run, nominal exchange rate changes only partly pass through to consumer prices. To reflect this phenomenon, Devereux and Engle (2003) put forward another type of price-stickiness: prices are preset in the consumer’s currency (denoted by local currency pricing or LCP).

Under LCP, the short-run responses of consumer prices to exchange rate changes are very small. When prices are not very responsive to exchange rate changes, the monetary policymaker cannot rely on the exchange rate to provide the necessary adjustment to real shocks. Since consumers do not interpret exchange rate changes as relative price changes in the short run, it is not easy to control the relative demand for domestic goods and foreign goods through exchange rate changes. In the absence of strong expenditure-switching effects, the benefits of floating exchange rate are diminished. This implies that an optimum monetary rule would not utilize exchange rate movements at all and that welfare-maximizing monetary policies may entail a fixed exchange rate (Engle and Devereux 2003).

This theoretical framework can be viewed as a major challenge to the Friedman case for exchange rate flexibility, according to which floating exchange rates are helpful in cushioning national economies from real idiosyncratic shocks, and one that is applicable to industrial rather than emerging economies.

Otstfeld (2004) improved on the model of Devereux and Engle in two ways. First, he modeled the monetary policy as a choice of the
nominal interest rate rather than a monetary aggregate. Second, he introduced non-traded goods in the LCP framework. However, his conclusion challenges that of Devereux and Engle. He declared that even when the exchange rate plays no role, countries may wish to have flexible exchange rates in order to free the domestic interest rate as a stabilization tool.

3.9 Balance of Payments Equilibrium and Exchange Rate Misalignment

Ronald Macdonald (2000) made an overview of the concepts for calculating equilibrium and discussed the advantages and disadvantages of various approaches to the estimating equilibrium exchange rate, such as BEERs (Behavioral Equilibrium Exchange rates), PEERs (Permanent and Transitory Decompositions of Real Exchange Rates), and FEERs (Fundamental Equilibrium Exchange Rates). All the approaches regard the balance of payments as a starting point. According to Ronald Macdonald, the standard balance of payments equilibrium condition holds under floating exchange rates in the absence of intervention in the foreign exchange market:

$$ ca_t + ka_t = 0 $$

(3.32)

where $ca_t$ and $ka_t$ denote, respectively, the current account and capital accounts of the balance of payments. Ignoring some minor components, the current account is determined by:

$$ ca_t = nx_t + i_nfa_t $$

(3.33)

where $nx_t$ denotes net exports and $i_nfa_t$ represents net interest payments on net foreign assets.

This model does not assume PPP to be true in all cases, but assumes that the real exchange rate or term of trade as a measure of competitiveness have an impact on net exports and the current account. It also assumes that a rise in domestic income worsens net exports through its effect on imports, while a rise in foreign income improves the net export position through its influence on domestic exports. Thus, net exports are determined by a standard relationship:

$$ nx_t = \alpha_1(s_t + p_x^* - p_t) - \alpha_2 y_t + \alpha_3 y_t^* $$

(3.34)
where $s_t$ is the log of the spot exchange rate, $p_t$ is the log of the domestic price level, $y_t$ is the log of domestic income, $p_t^*$ is the log of the foreign price level and $y_t^*$ is the foreign income. $\alpha$'s are elasticities.

In practice, the international capital markets are not necessarily perfect, and thus the uncovered interest parity may not hold everywhere. However, when the capital markets are not in equilibrium, a mechanism for adjusting the flows of capital will take effect. In other words, if other things are equal, a rise in the domestic interest rate raises capital inflow, while a rise in the foreign interest rate lowers capital inflow, leading to a rise in the expected exchange rate (domestic currency depreciation), which will encourage capital outflow.

$$ka_t = \mu(i_t - i_t^* - \Delta s_{t+k}^e)$$

(3.35)

where $i_t$ denotes an interest rate yield of domestic deposits, and $i_t^*$ an interest rate yield of foreign deposits, and $\Delta s_{t+k}^e$ is the expected change in the exchange rate. Substituting (3.34) into (3.33) and the resulting expression, along with (3.35) into (3.32) we obtain the balance of payments exchange rate equation:

$$s_t = p_t - p_t^* - \left(\frac{\alpha_2}{\alpha_1}\right)y_t + \left(\frac{\alpha_3}{\alpha_1}\right)y_t^* - \frac{1}{\alpha_1}(i_t^* n f a_t) - \left(\frac{\mu}{\alpha_1}\right)(i_t - i_t^* - \Delta s_{t+k}^e)$$

(3.36)

This formula is usually thought to be a general expression of an equilibrium exchange rate in that it satisfies the balance of payments equilibrium under floating exchange rates.

It is clear that $u \to \infty$ means that UCIRP is satisfied and $\alpha_1 \to \infty$ means that PPP is satisfied.

Combining (3.36) and the definition of the real exchange rate

$$q_t = s_t + p_t^* - p_t,$$

(3.37)

The real exchange rate at time $t$ can be rewritten as:

$$q_t = -\left(\frac{\alpha_2}{\alpha_1}\right)y_t + \left(\frac{\alpha_3}{\alpha_1}\right)y_t^* - \frac{1}{\alpha_1}(i_t n f a_t) - \left(\frac{\mu}{\alpha_1}\right)(i_t - i_t^* - \Delta s_{t+k}^e)$$

(3.38)
3.10 Summary of Model Implications

In this section, we provide a brief review of exchange rate determination theories and their policy implications. This review demonstrates that each theory holds in a particular setting and explains some macroeconomic phenomena. No single theory contains all the factors that may have an impact on foreign exchange rates.

Purchasing power parity (PPP) theory, which is classified into two types (absolute PPP and relative PPP) is covered in this review as a starting point for understanding how exchange rates are determined in the goods market. It builds linkage between the exchange rate and prices of goods in two economies. This is why it is called the “inflation theory of exchange rates.” Since it deals only with the goods market, and not the assets market, it is a partial equilibrium theory. The minimum preconditions for absolute PPP include: (1) same production technology for individuals, (2) neutral-risk preferences, (3) perfectly competitive goods markets in two different economies, (4) no trader barriers such as transport costs, tariffs and trade quotas, and so on. It is established on the “law of one price.” Actually, the preconditions for absolute PPP do not hold since transport costs, tariffs, and technological and preferential differences exist at all times and places. Absolute PPP is rejected by most empirical surveys. Relative PPP allows exchange rates to deviate from absolute PPP. It is equivalent to the real exchange rate being constant. Empirically, both absolute PPP and relative PPP in the short run are rejected, but some studies find that relative PPP seems to hold in the long run.

Another popular partial equilibrium exchange rate theory, interest rate parity, examines how the exchange rates are determined in financial markets. Since interest rates change frequently in the short run, interest rate parity is thought of as “short run exchange rate theory.” Interest rate parity also has two types, CIRP and UCIRP, both of which are based on the assumption that asset markets are frictionless and that there is no arbitrage. A lot of evidence supports CIRP as a forward exchange rate pricing model. However, variations in monetary policy, degree of risk aversion, political risks, barriers to
capital mobility, and microstructure variations in the market may cause persistent variations in the risk premium over time. UCIRP and the Fisher open condition are also covered in this review, but both lack support from empirical studies.

Three monetary models are presented to introduce the impact of monetary factor and real factor shocks on the exchange rate. The first model, known as the simple monetary model in the setting of flexible prices, forecasts how the exchange rate and price level change with current and expected future values of related variables, such as money supply, foreign interest rate, and income level.

The second model, the Mundell-Fleming model, is extended from a closed IS-LM model. Unlike the simple monetary model, in which prices are viewed as flexible, it assumes that prices are preset in the short run. In addition to the internal monetary market equilibrium, goods market equilibrium, and external equilibrium condition, the balance of payments is also considered in the Mundell-Fleming model. Thus, it can be viewed as a general equilibrium model. One of the most important forecasts of the model is the so-called trilemma, which states that perfect capital mobility, monetary policy independence and a fixed exchange rate regime cannot be achieved simultaneously. In the long run, the exchange rate level is perfectly correlated with the level of monetary supply, and monetary policy may only play a trivial role in economic growth. Another important forecast is that devaluation may lead to further devaluation if fiscal discipline, inflation and the balance of payments are not well managed, because a self-fulfilling bubble may be produced. Finally, the impact of devaluation on current account improvement may be weakened if an economy is heavily dependent on the re-export processing industry.

The third monetary model, Dornbusch model, loosens the condition that prices must be preset, but allows for slow price adjustments. A famous insight into policy implication of this model is the overshooting of the nominal exchange rate over its long-run equilibrium, when an economic system is shocked with monetary supply. This character is regarded as an advantage of a fixed exchange rate regime over a floating one. This model shows that once
a real economic shock happens, markets may move to equilibrium either through a flexible exchange rate or change of prices. The difference between the two is mainly that in the latter, adjustment may consume more time and be less risky than in the former. If prices are relatively flexible and inflation can be controlled in a moderate range, a fixed change rate regime is desirable.

These models were criticized frequently for their lack of micro foundations, and for their failure to elucidate the effect of the balance of payment on the determination of the exchange rate. However, their clear implications for policymakers should not be underestimated.

The Ballasa-Samulson model partly addressed the issue of the lack of a micro foundation in modeling work by incorporating productivity differentials or technological changes in production into a one-factor production technology model, which was then extended to a two-factor model. The main contribution of this kind model is that they built linkages between productivity, output and the real exchange rate (terms of trade) through the rational behavior of producers. However, they fail to incorporate paper money or nominal exchange rate and the behavior of the demand side that might have important impacts on the exchange rate.

The latest important development in exchange rate studies is the pioneering work in 1995 of Obstfield and Rogoff (Redux), whose model incorporates the demand side. However, this model still relied on PPP and price presetting. Though it allows the welfare effects of different shocks to be compared, it merely seems to be a Dornbusch model based on maximization behavior. There are still many deficiencies in the model. First, it does not consider investment and producer’s behavior; second, it regards absolute PPP as a precondition, but this has not been supported by empirical studies.

To address the unsuitability of PPP, recent modeling efforts have been formulated in the setting of consumer’s currency pricing or LCP. In the LCP setting, some implications are found to be different from that in the PCP setting, especially regarding the choice of the exchange rate regime. In PCP, perfectly flexible exchange rates are to some extent optimal. However, some economists argue that the LCP setting is more practical than PCP, at least in the short run. In the LCP
setting, an optimum monetary rule does not utilize exchange rate movements at all and welfare-maximizing monetary policies may entail a fixed exchange rate. However, Otstfeld argues that if substituting interest rate for aggregate money demand in LCP, even when the exchange rate plays a trivial role, countries may wish to have flexible exchange rates in order to free the domestic interest rate as a stabilization tool.

Existing exchange rate models have done little regarding the role of fiscal policy and income policy in dealing with trade surpluses and deficits. For a perfect market economy, this may not be a problem, because fiscal policy and income policy are usually regarded as non-market measure and may cause distortions of the market. But for a country that is undergoing reform and marketization, structural factors may play a key role in the balance of trade and payments. PRC already had some experiences in this regard. For example, when it was suffering shocks from the Southeast Asian crises in 1998, many researchers forecasted that the PRC would have to devaluate the RMB, but in the end it decided to raise export tax rebates, which had a similar effect as a devaluation. Presently, though the PRC has a trade surplus and a large amount of foreign exchange reserves, it faces structural issues, involving social security funds, pensions, health insurance, labor security, implicit fiscal deficits, and an inefficient banking system, which are challenging policymakers. Thus, all those factors mentioned here may have an impact on government decisions. However, the following modeling work will start mainly from the macro aspect.
Chapter 4. The General Equilibrium Exchange Rate Model

The shortcomings of existing theories in explaining the phenomenon occurring in the PRC prompts us to make efforts to build a more general framework. To analyze the factors that influence the exchange rate and exchange rate regime, in this part we create a general equilibrium model, which includes two countries and three sectors, namely final product producers, consumers and import firms. The first section deals with the equilibrium of the firm producing the final product firm, the second section deals with the equilibrium of intermediate import business and the third section deals with the equilibrium of consumer behavior. In the fourth section, the general equilibrium conditions for the import goods market equilibrium, export goods equilibrium and equilibrium of international payments are investigated. Finally, we summarize the main policy implications of the model.

4.1 The Behavior of Final Product Producers

Unlike a closed economy in which capital input is formed from domestic investment only, in an open economy, the capital input can be formed either from domestic investment or from foreign investment. Taking this into consideration, we assume that a representative final goods producer uses two kinds of capital, one from domestic investment and the other from foreign investment. They differ in quality (one of the reasons for the PRC to introduce more FDI from foreign countries is perhaps because it is better in quality than that from the PRC itself) and thus they cannot be perfectly substituted without a loss of generality. We adopt Cobb-Douglass production technology, in which foreign capital goods is

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13 This chapter is based on ADB Institute research Paper No. 70, which originally appeared in December 2005.

14 Because of the product quality difference, FDI enjoys some preferential tax treatment. The United States also imposes various restraints on the export of high technology, also indicating the importance of the difference in goods quality.
treated as intermediate goods produced and processed by an import company to embody the role that tariffs, transport costs and monopolistic import power plays in final product pricing. We will see that the price of intermediate goods is jointly determined by their price in foreign currency, transport costs, tariffs, and monopolistic power.

The production function of a representative domestic final good producer is defined as

\[ Y_{h,t} = A_{h,t} \left( K_{hh,t}^{\alpha} K_{hf,t}^{\phi} \right) L_{h,t}^{1-\alpha-\phi} \] (4.1)

Where the lowercase \( t \) stands for time, \( h \) represents the home country and \( f \) represent the foreign country. The meanings of the symbols in function (4.1) are defined as follows:

- \( Y_{h,t} \) : domestic final aggregate output,
- \( K_{hh,t} \) : demand for capital goods by home firms produced by home firms,
- \( K_{hf,t} \) : demand for capital goods by home firms produced by foreign firms,
- \( L_{h,t} \) : labor force used in production,
- \( A_{h,t} \) : total factor productivity of domestic production,
- \( \alpha \) : The share of home capital
- \( \phi \) : The share of foreign capital

Dividing both sides of equation (4.1) by \( L_{h,t} \), and letting

\[ y_{h,t} = Y_{h,t} / L_{h,t} , \quad k_{hh,t} = K_{hh,t} / L_{h,t} , \quad k_{hf,t} = K_{hf,t} / L_{h,t} \], which represent variables in per capita terms, we have

\[ y_{h,t} = A_{h,t} \left( k_{hh,t}^{\alpha} k_{hf,t}^{\phi} \right) \]

Since our main focus is mainly on the goods and capital flow across countries, the labor forces of both domestic and foreign firms are assumed to be inelastic and to grow exogenously at a constant rate:

\[ \left( A_{h,t} - A_{h,t-1} \right) / A_{h,t-1} = a_h \], \( \left( A_{h,t} - A_{h,t-1} \right) / A_{h,t-1} = a_h \), and

\[ \left( L_{h,t} - L_{h,t-1} \right) / L_{h,t-1} = n_h \], (4.2)
The objective of the firm is to maximize profits:
\[ \Pi_t = \frac{P_{h,t+1}}{P_{h,t}} A_{h,t} (k_{hh,t}^{\alpha} k_{hf,t}^{\phi}) - P_{h,t} k_{hh,t} r_{h,t} - P_{hf,t} k_{hf,t} r_{f,t} - W_{h,t} L_{h,t} \] (4.3)

where \( W_{h,t} \) is the nominal wage rate, \( r_{h,t} \), \( r_{f,t} \) denotes respectively nominal interest rate controlled by the central bank\(^{15}\), \( P_{h,t} \) is the price of home goods in the home currency, and \( P_{hf,t} \) is the price of foreign goods in the home currency. Different capital returns to domestic capital goods and foreign capital goods are assumed because the required returns for foreign and home investors are different. The first order conditions for the firm to maximize its profits are expressed in (4.4) and (4.5):
\[ \alpha P_{h,t+1} A_{h,t} (k_{hh,t}^{\alpha-1} k_{hf,t}^{\phi}) = P_{h,t} r_{h,t} \] (4.4)
\[ \phi P_{h,t+1} A_{h,t} (k_{hh,t}^{\alpha} k_{hf,t}^{\phi-1}) = P_{h,t} r_{h,t} \] (4.5)

From (4.4) and (4.5), the domestic demand for per capita capital, output and the wage rate are:
\[ y_{h,t} = A_{h,t} \left( \frac{\alpha \pi_{h,t+1}}{r_{h,t}} \right)^{\frac{\alpha}{1-\alpha-\phi}} \left( \frac{\phi P_{h,t+1}}{r_{f,t} P_{hf,t}} \right)^{\frac{\phi}{1-\alpha-\phi}} \] (4.6)
\[ k_{hh,t} = A_{h,t} \left( \frac{\alpha \pi_{h,t+1}}{r_{h,t}} \right)^{\frac{1}{1-\alpha-\phi}} \left( \frac{\phi P_{h,t+1}}{r_{f,t} P_{hf,t}} \right)^{\frac{\phi}{1-\alpha-\phi}} \] (4.7)
\[ k_{hf,t} = A_{h,t} \left( \frac{\alpha \pi_{h,t+1}}{r_{h,t}} \right)^{\frac{1}{1-\alpha-\phi}} \left( \frac{\phi P_{h,t+1}}{r_{f,t} P_{hf,t}} \right)^{\frac{1}{1-\alpha-\phi}} \] (4.8)
\[ W_{h,t} = \frac{W_{h,t}}{P_{h,t}} = (1 - \alpha - \phi) \pi_{h,t+1} y_{h,t} \] (4.9)

where the new symbol \( \pi_{h,t+1} = \frac{P_{h,t+1}}{P_{h,t}} \) represents one plus the expected inflation rate at time \( t \). Equation (4.6)–(4.9) indicate that from the angle of producers, the output of final goods and the demand

\(^{15}\) Here we ignore the difference between the lending rate and deposit rate for simplicity. If we take monopolistic competitive commercial banks into consideration, the lending rate and deposit rate will be different (Zhao and Ma etc, 2002). But this may not influence the conclusion of the paper.
for domestic and foreign capital decrease when the domestic and foreign nominal interest rates increase. The output of final goods and the demand for domestic and foreign capital increases when expected prices increase or the present price level decreases.

By symmetry, assuming the foreign production function to be

\[ Y_{f,t} = A_{f,t}(K_{f,t}^{\alpha}, K_{h,t}^{\delta})L_{f,t}^{1-\alpha-\delta}, \] (4.10)

The foreign demands for per capita capital, foreign wage rate and output can be expressed as

\[ k_{f,t} = A_{f,t}^{\frac{1}{1-\alpha-\delta}} \left( \frac{\alpha' \pi_{f,t+1}}{r_{f,t}} \right)^{1-\alpha-\delta} \left( \frac{\phi P_{f,t+1}}{r_{h,t} P_{h,t}} \right)^{\frac{\delta}{1-\alpha-\delta}} \] (4.11)

\[ k_{h,t} = A_{f,t}^{\frac{1}{1-\alpha-\delta}} \left( \frac{\alpha' \pi_{f,t+1}}{r_{f,t}} \right)^{\alpha} \left( \frac{\phi P_{f,t+1}}{r_{h,t} P_{h,t}} \right)^{1-\alpha-\delta} \] (4.12)

\[ w_{f,t} = \frac{W_{f,t}}{P_{f,t}} = (1 - \alpha' - \phi') \pi_{f,t+1} y_{f,t} \] (4.13)

\[ y_{f,t+1} = A_{f,t}^{\frac{1}{1-\alpha-\delta}} \left( \frac{\alpha' \pi_{f,t+1}}{r_{f,t}} \right)^{\frac{\alpha'}{1-\alpha-\delta}} \left( \frac{\phi' P_{f,t+1}}{r_{h,t} P_{h,t}} \right)^{\frac{\delta}{1-\alpha-\delta}} \] (4.14)

Where the implications of the new symbols in equation (4.11)–(4.14) are given as follows

- \( k_{f,t} \): per capita capital goods used and produced in foreign firms at time \( t \),
- \( k_{h,t} \): per capita capital goods used in foreign firms and produced by home firms at time \( t \),
- \( w_{f,t} \): real term of foreign wage rate at time \( t \), and
- \( y_{f,t} \): per capita foreign output at time \( t \).

\( \pi_{f,t+1} = P_{f,t+1}/P_{f,t} \): one plus the inflation rate of the foreign economy.
A parameter with the uppercase symbol ‘ represent the corresponding foreign production parameter. For example, $\alpha'$ is the foreign capital share corresponding to home firm parameter $\alpha$.

### 4.2 The Behavior of Import Firms

In order to make clear the roles played by transport costs, tariffs and import monopolistic power in exchange rate determination, we introduce import firms with monopolistic power in the pricing of imported capital goods. Since our main purpose in this part is to build a theoretical framework to elucidate the variables and channels by which the variables influence the exchange rate, rather than accurate relations between the variables, we ignore the pricing of consumption goods. Given demand functions for domestic final goods, import firms decide the quantity and price of domestic demand for import goods according to the demand curve. We can rewrite (4.8) as the inverse demand function for capital goods in (4.15):

$$P_{hf,t} = A_{h,t}\left(1 - \frac{1 - \alpha}{1 - \phi} \left(\alpha \pi_{h,t+1} r_{h,t}\right)^{1 - \alpha - \phi} \left(\frac{\phi P_{h,t+1} K_{hf,t}}{r_{f,t} L_{h,t+1}}\right)^{1 - \alpha - \phi} \right)^{-1 - \alpha}$$

(4.15)

This is the foreign demand curve faced by foreign import firm with constant demand elasticity with respect to the interest rate, implying that if prices increase by 1 per cent, the demand for capital goods $K_{hf,t}$ will decrease by $(1 - \alpha)/(1 - \alpha - \phi)$%. We further assume the domestic tariff rate to be $\tau_h$ and the coefficient for transport costs to be $\theta > 1$, which means that transport costs take a $\theta - 1$ part of the import goods price. The objective function of the import firm can be written as:

$$\Pi_m = P_{hf,t} K_{hf,t} - \varepsilon_i P_{f,t} (1 + \tau) \theta K_{hf,t}$$

$$= A_{h,t}\left(1 - \frac{1 - \alpha}{1 - \phi} \left(\frac{\phi P_{h,t+1}}{r_{f,t} \pi_{h,t+1}}\left(L_{h,t+1}\right)^{1 - \alpha - \phi} \left(K_{hf,t}\right)^{\phi} \right)^{1 - \alpha - \phi} - \varepsilon_i P_{f,t} (1 + \tau) \theta K_{hf,t}\right)^{-1 - \alpha}$$

(4.16)

where $\varepsilon_i$ is the nominal exchange rate, or the domestic currency price of foreign currency. According to the first order condition for
optimization problem (4.16), the domestic price of imported foreign capital goods is

$$P_{hf,t} = \frac{e_t P_{f,t} (1 + \tau_h) \theta(1 - \alpha)}{\phi} = \varphi e_t P_{f,t}$$ (4.17)

where $$\varphi = \frac{(1 + \tau_h) \theta (1 - \alpha)}{\phi} > 0$$. (4.17) indicates that the domestic price of import capital goods depends on four factors: their price in the foreign country, the transport costs, the level of tariffs and the capital share ratio $$\phi/(1 - \alpha) < 1$$. Thus, after taking into account transport costs, tariffs and monopolistic power, the domestic price of imported goods is greater than their foreign price.

Substituting (4.17) into (4.6)–(4.9), we obtain:

$$k_{hh,t} = A_{h,t} \frac{1}{1 - \alpha - \phi} \left( \frac{\alpha \pi_{h,t+1}}{r_{h,t}} \right)^{1 - \phi} \left( \frac{\phi \pi_{h,t+1}}{r_{f,t}} \right) \frac{1}{\varphi q_t}$$ (4.18)

$$k_{hf,t} = A_{h,t} \frac{1}{1 - \alpha - \phi} \left( \frac{\alpha \pi_{h,t+1}}{r_{h,t}} \right)^{1 - \phi} \left( \frac{\phi \pi_{h,t+1}}{r_{f,t}} \right) \frac{1}{\varphi q_t}$$ (4.19)

$$w_{h,t} = \frac{W_{h,t}}{P_{h,t}} = (1 - \alpha - \phi) y_{h,t}$$ (4.20)

$$y_{h,t+1} = A_{h,t} \frac{1}{1 - \alpha - \phi} \left( \frac{\alpha \pi_{h,t+1}}{r_{h,t}} \right)^{1 - \phi} \left( \frac{\phi \pi_{h,t+1}}{r_{f,t}} \right) \frac{1}{\varphi q_t}$$ (4.21)

Similarly, the demand for capital, the wage rate and the output supply for foreign firms can be deduced from (4.12)–(4.14) as follows (4.21)–(4.25).

$$k_{ff,t} = A_{f,t} \frac{1}{1 - \alpha - \phi} \left( \frac{\alpha' \pi_{f,t+1}}{r_{f,t}} \right)^{1 - \phi'} \left( \frac{\phi' \pi_{f,t+1}}{r_{h,t}} \right) \frac{q_t}{\varphi'}$$ (4.22)

$$k_{fh,t} = A_{f,t} \frac{1}{1 - \alpha - \phi} \left( \frac{\alpha' \pi_{f,t+1}}{r_{f,t}} \right)^{1 - \phi'} \left( \frac{\phi' \pi_{f,t+1}}{r_{h,t}} \right) \frac{q_t}{\varphi'}$$ (4.23)
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\[ w_{f,t} = \frac{W_{f,t}}{P_{f,t}} = (1 - \alpha' - \phi')\pi_{f,t+1}y_{f,t} \]  

(4.24)

\[ y_{f,t+1} = A_{f,t} \frac{1}{1 - \alpha' - \phi'} \left( \frac{\alpha' \pi_{f,t+1}}{r_{f,t}} \right)^{1 - \alpha' - \phi'} \left( \frac{\phi' \pi_{f,t+1}}{r_{h,t}} \right)^{\phi'} \]  

(4.25)

In (4.22)–(4.25), the real exchange rate is introduced to reflect the impact of the exchange rate on output and investment. They indicate that the real appreciation of foreign currency has a negative impact on domestic investment and output, but a positive impact on foreign investment and output, if other things are held equal. The increase of domestic transport costs and tariffs raises domestic investments and output as well.

4.3 The Behavior of Consumers

We assume that a representative household has two generations at time \( t \). Each generation lives for two periods: youth and old age. The generation born at \( t \) is denoted with a subscript \( t \). the young work and earn a wage, and decide how much to deposit for their old age. The old do not work, but spend the money they deposited and the interest on the deposit when they are old. In an open economy, the consumption goods of a home consumer consist of two parts: one produced in the home country, the other imported from the foreign country. The aggregate consumption at time \( t \) is the sum of consumption of the young generation and old generation.

Since the quality of foreign and domestic goods is different, we assume that they are imperfect substitutes. The imperfect substitution between consumption goods originates from their different physical utility, liquidity, preferential tax treatment, preferences, and so on. Actually, some exchange rate models have already adopted imperfect substitution between assets and consumption goods (Chen, 2004; Zhao and Liu, 2002). In this model, we allow different consumption goods to go into the utility function to deal with the current account and capital account more practically, making the model more persuasive.
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Following Calvo (1980), Chen (2004) and Zhao and Liu et al. (2002), the representative consumer in the home country with rational expectations is assumed to maximize the present value of his life utility $U_{h,t}$:

$$
U_{h,t} = \left( \frac{C_{hh,t}^{1-\delta}}{C_{hf,t}^{1-\delta}} \right)^{-\sigma} + \beta \left( \frac{C_{hh,2t+1}^{1-\delta}}{C_{hf,2t+1}^{1-\delta}} \right)^{-\sigma} \frac{1}{1 - \sigma}
$$

(4.26)

Subject to

$$
P_{h,t} C_{hh,t} + \epsilon_{r1} P_{f,t} C_{hf,t} + D_{h,t} = W_{h,t} L_{h,t}
$$

(4.27)

and

$$
P_{h,t+1} C_{hh,t+1} + \epsilon_{r1} P_{f,t+1} C_{hf,t+1} = (1 + r_{h,t}) D_{h,t}
$$

(4.28)

Where $W_{h,t} L_{h,t}$ is the aggregate income for the young generation at time $t$, $C_{hh,t}$ stands for the home consumption demand for home produced goods of the young generation at time $t$; $C_{hh,2t}$ stands for the home consumption demand of the old generation for home-produced goods at time $t$; $C_{hf,t}$ stands for the home consumption demand of the young generation for imported goods at time $t$, and $C_{hf,2t}$ stands for the home consumption demand for imported goods of the old generation at time $t$. $D_{h,t}$ is the deposit balance at time $t$. $\beta$ is the subjective time discount rate. Combining equation (4.27) and (4.28), the budget constraints for the young and old generation at time $t$ can be rewritten as:

$$
P_{h,t} C_{hh,t} + \epsilon_{r1} P_{f,t} C_{hf,t} + \left( P_{h,t+1} C_{hh,t+1} + \epsilon_{r1} P_{f,t+1} C_{hf,t+1} \right) / (1 + r_{h,t}) = L_{h,t} W_{h,t}
$$

(4.29)

Solving this optimization problem, we obtain the following consumption function:

$$
C_{hh,t} = \left( \frac{\delta L_{h,t} W_{h,t}}{1 + \beta \sigma \left( \frac{\pi_{h,t+1}}{(1 + r_{h,t})} \right)^{-\frac{\sigma}{\sigma}} \left( \frac{q_{t+1}}{q_t} \right)^{\frac{1}{\sigma}} \left( 1 - \delta \times \sigma - 1 \right)} \right).
$$

(4.30)
\[ C_{h,t} = \frac{(1 - \sigma)L_{h,t}w_{h,t}}{q_t + \beta^{\frac{1}{\sigma}}q_t \left( \frac{\pi_{h,t+1}}{(1 + r_{h,t})} \right)^{\frac{1}{\sigma}} \left( \frac{q_{t+1}}{q_t} \right)^{\frac{1}{\sigma}}} \]  

\[ C_{h,t,2t+1} = \frac{\delta L_{h,t}w_{h,t}}{(1 + r_{h,t}) + \beta^{\frac{1}{\sigma}} \left( \frac{\pi_{h,t+1}}{(1 + r_{h,t})} \right)^{\frac{1}{\sigma}} \left( \frac{q_{t+1}}{q_t} \right)^{\frac{1}{\sigma}}} \]  

\[ C_{h,t,2t+1} = \frac{(1 - \delta)L_{h,t}w_{h,t}}{q_{t+1} \left( \frac{\pi_{h,t+1}}{(1 + r_{h,t})} \right)^{\frac{1}{\sigma}} + \beta^{\frac{1}{\sigma}} q_{t+1} \left( \frac{\pi_{h,t+1}}{(1 + r_{h,t})} \right)^{\frac{1}{\sigma}} \left( \frac{q_{t+1}}{q_t} \right)^{\frac{1}{\sigma}}} \]  

\[ D_{h,t} = \frac{L_{h,t}w_{h,t}}{1 + \beta^{\frac{1}{\sigma}} \left( \frac{\pi_{h,t+1}}{(1 + r_{h,t})} \right)^{\frac{1}{\sigma}} \left( \frac{q_{t+1}}{q_t} \right)^{\frac{1}{\sigma}}} \]  

By symmetry, foreign consumer’s consumption can be expressed in (4.35)–(4.38) as

\[ C_{ff,t} = \frac{\delta' L_{f,t}w_{f,t}}{1 + \beta^{\frac{1}{\sigma}} \left( \frac{\pi_{f,t+1}}{(1 + r_{f,t})} \right)^{\frac{1}{\sigma}} \left( \frac{q_{t+1}}{q_t} \right)^{\frac{1}{\sigma}}} \]  

\[ C_{fh,t} = \frac{(1 - \delta')L_{f,t}w_{f,t}}{q_t + \beta^{\frac{1}{\sigma}} q_t \left( \frac{\pi_{f,t+1}}{(1 + r_{f,t})} \right)^{\frac{1}{\sigma}} \left( \frac{q_{t+1}}{q_t} \right)^{\frac{1}{\sigma}}} \]  

\[ C_{ff,2t+1} = \frac{\delta' L_{f,t}w_{f,t}}{\frac{\pi_{f,t+1}}{(1 + r_{f,t})} + \beta^{\frac{1}{\sigma}} \left( \frac{\pi_{f,t+1}}{(1 + r_{f,t})} \right)^{\frac{1}{\sigma}} \left( \frac{q_{t+1}}{q_t} \right)^{\frac{1}{\sigma}}} \]
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\[ C_{fh,2t+1} = \frac{(1 - \delta')L_{f,t}w_{f,t}}{q_{t+1}} \left( \frac{\pi_{f,t+1}}{(1 + r_{f,t})} \right) + \beta' \frac{1}{\sigma} \frac{1}{q_{t+1}} \left( \frac{\pi_{f,t+1}}{(1 + r_{f,t})} \right) \left( \frac{q_{t+1}}{q_t} \right)^{1 - \delta} \]

(4.38)

Which is derived from the foreign utility function

\[ U_{f,t} = \left( C_{ff,t}^{\frac{1}{1-\delta}} C_{ff,t}^{\frac{1-\delta}{\sigma}} \right) \left( C_{hh,t}^{\frac{1}{1-\delta}} C_{hh,t}^{\frac{1-\delta}{\sigma}} \right) \]

(4.39)

Subject to

\[ P_{f,t} C_{ff,t} + (P_{h,t}/\epsilon_t) C_{fh,t} + D_{f,t} = W_{f,t} L_{f,t} \]

(4.40)

and

\[ P_{f,t+1} C_{ff,2t+1} + (P_{h,t+1}/\epsilon_{t+1}) C_{hh,2t+1} = (1 + r_{f,t}) D_{f,t} \]

(4.41)

4.4 Equilibrium Conditions

The above studies on the behavior of consumers, producers and imported firms produce the functions of consumption, investment, output supply, import demand and supply of both home and abroad, from which related variables are further defined as follows:

Export goods supply of home firms:
\[ X_{h,t} = Y_{h,t} - (C_{hh,t} + C_{hh,2t} + K_{hh,t}) \]

Import goods demand of home firms:
\[ M_{h,t} = C_{hf,t} + C_{hf,2t} + K_{hf,t} \]

Export goods supply of foreign firms:
\[ X_{f,t} = Y_{f,t} - (C_{ff,t} + C_{ff,2t} + K_{ff,t}) \]

Import goods demand of home firms:
\[ M_{f,t} = C_{fh,t} + C_{fh,2t} + K_{fh,t} \]

To reach the general equilibrium for a two-country open economy model, three equilibrium conditions, i.e., the equilibrium of the import goods market, equilibrium of the export goods market and international payment equilibrium, should be fulfilled:
1. **Export goods market equilibrium**: Under this equilibrium, the domestic supply of export goods (the left-hand-side of the following formula) and the foreign demand for these export goods (the right-hand-side) are made equal.

\[ X_{h,t} = M_{f,t} \]  

(4.42)

2. **Import goods market equilibrium**: This equilibrium condition implies that the foreign supply of import goods (the left-hand-side of the following formula) and domestic demand for these import goods (the right-hand-side) are identical:

\[ X_{f,t} = M_{h,t} \]  

(4.43)

3. **International payment equilibrium**: Under a flexible exchange rate regime, equilibrium in the balance of payments is attained when the trade balance, balance of services account and capital account add up to zero:

\[ (C_{f,t} + C_{f,t,2t} + K_{f,t} - q_t(C_{h,t} + C_{h,t,2t} + K_{h,t})) + (q_t(K_{h,t} - K_{f,t}) + (K_{f,t}r_{h,t} - q_tK_{h,t}r_{f,t})) = 0 \]  

(4.44)

Where \( CA = (X_{h,t} - M_{h,t}) = (C_{f,t} + C_{f,t,2t} + K_{f,t}) - q_t(C_{h,t} + C_{h,t,2t} + K_{h,t}) \) represents net exports or the current account balance; \( KA = (q_tK_{h,t} - K_{f,t}) \) is the net capital flow or capital account balance; and \((K_{f,t}r_{h,t} - q_tK_{h,t}r_{f,t})\) is the net gain from foreign investment.

### 4.4.1 Short Run Equilibrium

Under our model, “short-run” equilibrium refers to the situation where the current exchange rate price or interest rates are adjusted to equalize the demand to supply in the goods and deposit markets, given the previous and future variables, including policy variables.
fixed at exogenous levels. Equations (4.42), (4.43) and (4.44) are combined into a complex nonlinear dynamic difference equation system including five types of variables, i.e., domestic and foreign inflation, interest rates and exchange rates of the past, present and future. Generally, the solution of this system cannot be expressed clearly in elementary mathematical functions. However, in the short run, the equations imply that current interest rates and the real exchange rate should be functions of the past, present or expected value of inflation rates, exchange rates and interest rates:

\[ r_{ht} = f_1(\pi_{ht-1}, \pi_{ht}, \pi_{ht+1}; \pi_{fht-1}, \pi_{fht}, \pi_{fht+1}; r_{ht-1}, r_{fht-1}, q_{ht-1}, q_{ht+1}; \tau_{ht}, \tau_{fht}; \theta \ldots) \]  
\( (4.45) \)

\[ r_{fht} = f_2(\pi_{ht-1}, \pi_{ht}, \pi_{ht+1}; \pi_{fht-1}, \pi_{fht}, \pi_{fht+1}; r_{ht-1}, r_{fht-1}, q_{ht-1}, q_{ht+1}; \tau_{ht}, \tau_{fht}; \theta \ldots) \]  
\( (4.46) \)

\[ q_{ht} = f_3(\pi_{ht-1}, \pi_{ht}, \pi_{ht+1}; \pi_{fht-1}, \pi_{fht}, \pi_{fht+1}; r_{ht-1}, r_{fht-1}, q_{ht-1}, q_{ht+1}; \tau_{ht}, \tau_{fht}; \theta \ldots) \]  
\( (4.47) \)

where ‘‘\( \theta \ldots \)’’ denotes \( \theta \) and other exogenous parameters. From (4.45)–(4.47), the real exchange rate as well as domestic and foreign interest rates are endogenously determined given past and expected future inflation rates, interest rates and exchange rates, and especially the current inflation. Like under the Tailor rule (Tailor, 1993), monetary policy needs to respond to the inflation rate and other variables, but the form is not necessarily the same.

Since \( q_t = \frac{e_t}{P_{fht}} \), rewriting (4.47), we have

\[ e_t = \frac{f_3(\pi_{ht-1}, \pi_{ht}, \pi_{ht+1}; \pi_{fht-1}, \pi_{fht}, \pi_{fht+1}; r_{ht-1}, r_{fht-1}, q_{ht-1}, q_{ht+1}; \tau_{ht}, \tau_{fht}; \theta \ldots)}{P_{fht}} \]  
\( (4.48) \)

Thus, expression (4.48) implies that the nominal exchange rate is determined by past and expected future inflation, interest and exchange rates, and especially the current inflation. This indicates that the exchange rate is endogenously determined and that a floating exchange regime in both countries is desirable to clear the markets.
Taking an extreme case in which the prices are constant (the viewpoint of the Keynesian school), and where the inflation rates are all zero, (4.45)–(4.47) can be rewritten as
\[
r_h = f_1(r_{h,t-1}, r_{f,t-1}, q_{t-1}, q_{t+1}; \tau_h, \tau_f; \theta \ldots)
\]  
(4.49)
\[
r_f = f_2(r_{h,t-1}, r_{f,t-1}, q_{t-1}, q_{t+1}; \tau_h, \tau_f; \theta \ldots)
\]  
(4.50)
\[
q_t = f_3(r_{h,t-1}, r_{f,t-1}, q_{t-1}, q_{t+1}; \tau_h, \tau_f; \theta \ldots)
\]  
(4.51)

This demonstrates that the real exchange rate and interest rates and other variables interact, and that neither country can perform monetary policy independently.

Another case is where the interest rates in both countries are controlled by monetary policy. In this case, the interest rates of both countries are regarded as exogenous variables. Under this circumstance, prices have to be adjustable to clear the markets, so we can derive
\[
\pi_h = f_1(\pi_{h,t-1}, \pi_{h,t-1}, \pi_{f,t-1}, \pi_{f,t-1}; r_{h,t-1}, r_{f,t-1}, r_{f,t-1}, r_{f,t-1}; q_{t-1}, q_{t+1}; \tau_h, \tau_f; \theta \ldots)
\]  
(4.52)
\[
\pi_f = f_2(\pi_{h,t-1}, \pi_{h,t-1}, \pi_{f,t-1}, \pi_{f,t-1}; r_{h,t-1}, r_{h,t-1}, r_{f,t-1}, r_{f,t-1}; q_{t-1}, q_{t+1}; \tau_h, \tau_f; \theta \ldots)
\]  
(4.53)
\[
e_t = f_3(\pi_{h,t-1}, \pi_{h,t-1}, \pi_{f,t-1}, \pi_{f,t-1}; r_{h,t-1}, r_{f,t-1}, r_{f,t-1}, r_{f,t-1}; q_{t-1}, q_{t+1}; \tau_h, \tau_f; \theta \ldots) P_{h,t}
\]  
(4.54)

(4.52)–(4.53) imply that if both countries control interest rates independently to realize market equilibrium, the inflations and nominal exchange rate have to adjust endogenously. In other words, under a pegged exchange rate regime, market equilibrium will not realized in general unless at least one of the countries gives up its monetary policy independence.

Generally speaking, the PRC, as a bigger country, may be reluctant to give up the independence of its monetary policy. In this connection, no matter how price levels change, general equilibrium may not be reached in the absence of a flexible exchange rate regime.
Under general conditions, a clear analytical expression of (4.51) is not available and the real exchange rate is not constant. Thus, we have actually demonstrated that purchase power parity and interest rate parity do not hold in the short run.

To see how the exchange rate affects the balance of international payments, we write the balance of international payment-output ratio into

\[
\frac{BP_{h,t}}{Y_{h,t}} = \frac{(1 - \alpha - \phi)(1 + g_{h,t})}{(1 + \alpha - \phi)(1 + q_{h,t})},
\]

\[
1 + \beta \sigma \left( \frac{\pi_{h,t+1}}{(1 + \sigma r_{h,t})} \right)^{\frac{1}{\sigma}} \left( \frac{q_{h,t}}{q_{t-1}} \right)^{\frac{1}{\sigma}} - 1 + \beta \sigma \left( \frac{\pi_{h,t}}{(1 + r_{h,t})} \right)^{\frac{1}{\sigma}} \left( \frac{q_{h,t}}{q_{t-1}} \right)^{\frac{1}{\sigma}}
\]

We have

\[
\frac{\partial q_{t+1}}{\partial \left( \frac{BP_{h,t}}{Y_{h,t}} \right)} < 0, \quad \frac{\partial \pi_{t+1}}{\partial \left( \frac{BP_{h,t}}{Y_{h,t}} \right)} < 0, \quad \frac{\partial \pi_{t}}{\partial \left( \frac{BP_{h,t}}{Y_{h,t}} \right)} > 0,
\]

\[
\frac{\partial \left( \frac{BP_{h,t}}{Y_{h,t}} \right)}{\partial g_{h,t}} < 0, \quad \frac{\partial \left( \frac{BP_{h,t}}{Y_{h,t}} \right)}{\partial r_{h,t}} < 0, \text{ when } \sigma < 1^{17}. \]

This demonstrates that with an increase in the ratio of the balance of payments to output, more pressure will be put on current home inflation, as well as expected real appreciation of the home currency and future deflation. For the home country, whether or not to maintain a fixed exchange rate depends on if it can tolerate a high inflation rate. Presently, the PRC inflation rate is not so high, and the PRC government may be willing to take the pressure. In addition, raising the interest rate may also help to lower the balance of international payments. The balance of payments may benefit from rapid growth. Once the economy cools down, the balance of payments may fall and even disappear.

\[17 \sigma < 1 \text{ is a condition for the existence of a saddle point equilibrium in the case of a fixed exchange rate. When } \sigma > 1, \text{ the steady state is not stable.}\]
A great deal of evidence has shown that the exchange rate is flexible. Theoretically, it is likely that the exchange rate is determined by conditions (4.42), (4.43) and (4.44). Chen (2004) studied a special case of the framework here qualitatively, in which the output is assumed to be constant, and concluded that the exchange rate may move explosively away from its balance track when the parameters of the model fail in some specific regions. This implies that it is necessary to impose some control on the fluctuation of the exchange rate.

4.4.2 The Long-Run Steady State

As we have stated previously, some economists have worked out some schemes to revalue the renminbi to a certain level by a sufficient appreciation to prevent speculative attacks. Is this kind of scheme practicable? This question is related to whether the long-run steady state exchange rate exists and what conditions are needed to maintain exchange rate stability. A long-run steady state means that the exchange rate and price levels change at a constant speed, but that the growth rate of and the ratio between aggregate economic variables are constant. If a steady-state exchange rate exists, a fixed exchange rate regime can be maintained for long; if not, one cannot expect that the issue of renminbi revaluation can be resolved by just once appreciation. To answer this question, let us focus on the international payment equilibrium condition (4.44), from which the exchange rate at time $t$ can be determined.

Substituting the domestic and foreign consumption and investment function into (4.44), the international payment equilibrium condition can be rewritten as:
Chapter 4. The General Equilibrium Exchange Rate Model

\[
(1 - \delta')(1 - \alpha' - \phi')(1 + g_{f,t})
\]
\[
\frac{1}{q_t} + \beta' \sigma' \frac{1}{q_t} \left( \frac{\pi_{f,t+1}}{q_{t+1}} \right)^{1-\sigma'} \left( \frac{q_{t+1}}{q_t} \right)^{\sigma'} (1 - \delta')(1 - \alpha' - \phi') + \phi' q_t \pi_{f,t+1} (1 + g_{f,t})
\]
\[
\frac{1}{q_t} \left( \frac{\pi_{f,t}}{1 + r_{f,t-1}} \right) + \beta' \sigma' \frac{1}{q_t} \left( \frac{\pi_{f,t}}{1 + r_{f,t-1}} \right)^{1-\sigma'} \left( \frac{q_{t-1}}{q_t} \right)^{\sigma'} (1 - \delta')(1 - \alpha - \phi') + \phi \pi_{h,t+1} (1 + g_{h,t})
\]
\[
\frac{1}{q_t} \left( \frac{\pi_{h,t}}{1 + r_{h,t-1}} \right) + \beta' \sigma' \frac{1}{q_t} \left( \frac{\pi_{h,t}}{1 + r_{h,t-1}} \right)^{1-\sigma'} \left( \frac{q_{t-1}}{q_t} \right)^{\sigma'} (1 - \delta')(1 - \alpha - \phi') + \phi \pi_{h,t+1} (1 + g_{h,t})
\]
\[
= \begin{pmatrix}
Y_{h,t-1} \\
Y_{f,t-1}
\end{pmatrix}
\]
\[
(4.55)
\]

Since the inflation rate, interest rate and exchange rate do not change with time in a steady state, (4.55) implies that the existence of a steady state exchange rate \((q_t)\) is constant, that is, \(Y_{h,t} = Y_{h,t-1}\) and \(Y_{f,t} = Y_{f,t-1}\) for any \(t\).

According to (4.2), (4.21) and (4.25), we have

\[
\frac{Y_{h,t}}{Y_{f,t}} = \frac{A_{h,t}^{1-\alpha'-\phi'} \left( \frac{\alpha \pi_{h,t+1}}{r_{h,t}} \right)^{1-\alpha'-\phi'} \left( \frac{\pi_{h,t+1}}{q_t} \right)^{\phi'} \phi}{A_{f,t}^{1-\alpha'-\phi'} \left( \frac{\alpha \pi_{f,t+1}}{r_{f,t}} \right)^{1-\alpha'-\phi'} \left( \frac{\pi_{f,t+1}}{q_t} \right)^{\phi'} \phi} L_{h,t}
\]

\[
= \frac{A_{h,t}^{1-\alpha'-\phi'} \left( \frac{\alpha \pi_{h,t+1}}{r_{h,t}} \right)^{1-\alpha'-\phi'} \left( \frac{\pi_{h,t+1}}{q_t} \right)^{\phi'} \phi}{A_{f,t}^{1-\alpha'-\phi'} \left( \frac{\alpha \pi_{f,t+1}}{r_{f,t}} \right)^{1-\alpha'-\phi'} \left( \frac{\pi_{f,t+1}}{q_t} \right)^{\phi'} \phi} L_{h,t} \left[ (1 + n_h)(1 + a_h)^{1-\alpha'-\phi'} \right]
\]

\[
= \frac{A_{h,t}^{1-\alpha'-\phi'} \left( \frac{\alpha \pi_{h,t+1}}{r_{h,t}} \right)^{1-\alpha'-\phi'} \left( \frac{\pi_{h,t+1}}{q_t} \right)^{\phi'} \phi}{A_{f,t}^{1-\alpha'-\phi'} \left( \frac{\alpha \pi_{f,t+1}}{r_{f,t}} \right)^{1-\alpha'-\phi'} \left( \frac{\pi_{f,t+1}}{q_t} \right)^{\phi'} \phi} L_{f,t} \left[ (1 + n_f)(1 + a_f)^{1-\alpha'-\phi'} \right]
\]

then,
\[
\begin{align*}
\left(\frac{1}{1 + n_h}(1 + a_h) \frac{\alpha}{\alpha'} \left(1 - \alpha - \phi\right)\right)^t' &= \left(\frac{1}{1 + n_h}(1 + a_h) \frac{\alpha}{\alpha'} \left(1 - \alpha - \phi\right)\right)^{t-1} \\
\left(\frac{1}{1 + n_f}(1 + a_f) \frac{\alpha}{\alpha'} \left(1 - \alpha - \phi\right)\right)^t' &= \left(\frac{1}{1 + n_f}(1 + a_f) \frac{\alpha}{\alpha'} \left(1 - \alpha - \phi\right)\right)^{t-1}
\end{align*}
\]

(4.56)

and

\[
(1 + n_h)(1 + a_h) \frac{\alpha}{\alpha'} \left(1 - \alpha - \phi\right) = (1 + n_f)(1 + a_f) \frac{\alpha'}{\alpha} \left(1 - \alpha - \phi\right)
\]

(4.57)

The left side of (4.57) is the home economic growth rate and the right side is the foreign economic growth rate. Thus, (4.57) indicates that the two economic growth rates are equal. We denote them with \( g \).

Defining \( M_h = \beta (1 + r_h) \frac{1}{\sigma} \) and \( M_f = \beta (1 + r_f) \frac{1}{\sigma} \), in a steady state where \( q_{f,t} = q_{h,t} = 1; r_{h,t} = r_h; r_{f,t} = r_f; q_t = q_{t+1} = q \), for all \( t \), the exchange rate can be expressed as:

\[
q^{1-\frac{\phi}{\alpha} + \frac{\phi'}{\alpha'} + \frac{1}{\alpha^*} - \frac{1}{\alpha'^*}} = \left[ \left( A_{h,0} \right)^{\frac{1}{\alpha - \phi}} \left( \frac{\alpha}{r_h} \right)^{\frac{\phi}{\alpha - \phi}} \left( \frac{\phi}{r_f} \right)^{\frac{\phi'}{1 - \alpha - \phi}} L_{h,0} \right]
\]

\[
= \left( A_{f,0} \right)^{\frac{1}{\alpha' - \phi}} \left( \frac{\alpha'}{r_f} \right)^{\frac{\phi'}{\alpha' - \phi}} \left( \frac{\phi}{r_h} \right)^{\frac{\phi}{1 - \alpha - \phi}} L_{f,0}
\]

\[
= \left[ \left( 1 - \delta \right)(1 - \alpha - \phi)(1 + g ) \right] \left( 1 + M_h \right) + \left( 1 - \delta' \right)(1 - \alpha - \phi) \left( 1 + M_f \right) + \phi \left( 1 + g \right)
\]

(4.58)

Where the implication of some of the variables are as follows.

- \( q \): real exchange rate at steady state
- \( r_h \): home interest rate at steady state
- \( r_f \): foreign interest rate at steady state
\[ \pi_h : \text{one plus the inflation rate of the home country at steady state} \]
\[ \pi_f : \text{one plus the inflation rate of the foreign country at steady state} \]

From (4.58) we conclude that a necessary condition for the existence of a steady-state exchange rate is that the two economies have identical long-run economic growth rates. This implies that only in the long run can relative PPP (\(q\) is constant) hold, and that absolute PPP, (equivalently \(q=1\)) requires even stronger conditions, that is, every variable concerned at home must be equal to its counterpart abroad, for example, \(\alpha = \alpha', \beta = \beta', r_h = r_f, \cdots\), and so on.

A necessary condition for (4.58) to hold is that the two economies concerned have identical long-run economic growth rates\(^{18}\) (as indicated in (4.57)). In other words, there will be no long-run steady-state exchange rate between two countries that have different long-run steady-state economic growth rates.

The PRC, US, Japan and other developed countries lie in different development phases, and their long-run economic growth rates are generally viewed as different. Thus, there is no long-run constant exchange rate between the USD and the renminbi, and we have reason to say that it is impossible to resolve the issue of the renminbi through only one appreciation. To the contrary, to keep an independent monetary policy and balance of international payments, a flexible exchange rate regime is needed.

This model can explain why both absolute and relative purchase power parity do not receive support from empirical studies, but that relative power parity does in the long run. From (4.58), only if the interest rates, economic growth rates, starting period labor and technology levels and all parameters in the production and utility functions between the two countries concerned are equal can the real exchange rate be equal to one, or equivalently, can absolute PPP hold. In addition, given exogenous variables and the steady-state growth

\(^{18}\) Though this conclusion may be obtained from some simple existing model, we have not seen that such conclusion can be ever obtained from a more general and complicated system like this.
rate of the two countries being equal, (4.58) implies that relative PPP holds in the long run.

### 4.5 Implications of the Model

We have created a two-country general equilibrium model in which each country has three sectors. The inclusion of import firms allows us to examine the roles that transport costs, tariffs and monopoly power play in the determination of the exchange rate. The model also allows us to consider exchange rate determination in a framework for a “large” country, which differs from a small country model in that a small country model takes foreign monetary policy and prices as given, as it is too small to affect foreign policy and economic variables, whereas big countries can influence one another. Thus, conclusions gained from a small country model may not hold for a large country model. Then, what can we draw from the model?

1) The equilibrium condition derived from the model is a complex nonlinear dynamic second order difference equation system based on the inflation rate, exchange rate, interest rate, transport costs, tariffs, monopoly power and some of their lag values. Considering that big countries like the PRC and US are reluctant to give up monetary policy (represented by the interest rate) independence, the system tells us that prices and the exchange rate are endogenously determined by production and preference parameters and interest rate when both exchange rate and prices are flexible. If both countries want to maintain the independence of their monetary policy and internal and external balance, a floating exchange regime is desirable.

2) On the other hand, under circumstances where prices are preset (such as in the Mundell-Fleming model) or sticky (such as in the Dornbusch model), it is difficult to achieve a general equilibrium without changing the interest rate; This means that the monetary policy of each country cannot be performed independently, and the exchange rate fluctuates endogenously. Otherwise, a general equilibrium cannot be realized.
3) Under a fixed exchange rate regime, at least one of the two countries cannot carry out an independent monetary policy, in contrast to the small country model in which small countries cannot perform independent policies.

4) One necessary condition for the existence of a long-run steady-state exchange rate is that the two economies have identical economic growth rates. In other words, if the two countries have different long-run economic growth rates, the long-run steady-state exchange rate does not exist. Since there are different economic growth rates among the PRC and US, Japan and other developed countries, it is difficult for the PRC to maintain the renminbi’s exchange rate stable in the long run. Thus, it is impossible to resolve the issue of the renminbi by a single revaluation.

5) We show theoretically that under general conditions, neither absolute nor relative PPP holds. Relative PPP may hold only in the long run if the two economies have identical economic growth. The condition for PPP is that everything concerned in the model be equal between home and abroad.

6) Considering that the exchange rate may move explosively under external shocks, it is necessary to allow the exchange rate to float in a relatively narrow band around its equilibrium level.
Chapter 5.  Misalignment of the Renminbi Exchange Rate and Its Adjustment

5.1 Introduction

In the previous chapter, a general theoretical equilibrium model of exchange rate determination has been created to show how the exchange rate interacts with the inflation rate, interest rate and balance of payments, as well as some other exogenous technical and preference parameters. This model is nonlinear, and clear expressions of the model’s solutions are usually not available. However, some special forms of the model have been studied qualitatively. For example, in the case of small countries and constant output (ignorance of the production sector), Shi Kuan Chen (2004) demonstrated that the exchange rate is endogenously determined and the fluctuation of the exchange rate depends on the preference parameter of consumers. Under some specific conditions, exchange rates perform smoothly and a long-run steady state can be achieved, but at a certain time the exchange rate may change explosively. However, the theory itself does not tell us where the preference parameters are. Thus, whether exchange rate becomes explosive is an issue of empirics rather than theory. However, the results of empirical studies are usually more or less removed from theoretical studies. A general way to handle a nonlinear mode is the linearization of a nonlinear model. The linearized model forms the basis for the Behavioral Equilibrium Exchange Rate (BEER). Based on the BEER, one can estimate BEER and the misalignment of the renminbi exchange rate. This allows an assessment of the consequences of external shocks to exchange rates, which obviously has implications for the revaluation of renminbi and can be a useful reference for policymakers.

19 This chapter is based on ADB Institute research Paper No.70, originally published in December 2005.
The rest of this chapter is organized as follows: section 5.2 is a description of the model and the data of relevant variables. Section 5.3 presents the empirical results. Finally, the implications are discussed in Section 5.4.

5.2 Model Selection and Data

Through linearization, the nonlinear theoretical general equilibrium model can be transformed into a vector auto regression (VAR) model that includes five variables: the exchange rate, domestic and foreign inflation rates, and domestic and foreign interest rates. Taking into consideration the institutional feature of the PRC, that capital flows are controlled rigorously and that mercantilism—the tendency to accumulate trade surpluses and related foreign reserves—dominates the ideas of the PRC government, a lasting positive trade surplus can be an acceptable condition for the external balance. Thus we put the trade surplus-GDP ratio of the PRC with the rest of the world into the model. As a result, six macroeconomic variables (the nominal exchange rate, domestic inflation rate, foreign inflation rate, domestic interest rate and foreign interest rate, and trade balance-GDP ratio) are incorporated into the VAR, where the change of the domestic interest rate and foreign interest rate represent changes of monetary policies.

The deposit rate of the PRC is viewed to be exogenous, just because the deposit rate has not been liberalized and is controlled by the PBOC. As for foreign interest rates, there is no unified world interest rate policy, but the United States, the biggest economy in the world, has an exceptional impact on other economies, especially those of small countries or regions whose currencies are pegged to the USD. Thus, we think that US federal interest can be viewed as a benchmark and as a substitute for foreign interest rate and put into the model as a policy instrument.20

20 Though the PRC deposit rate and US federal interest rate are viewed by some as endogenous variables, with the federal interest rate being seen to follow Taylor’s rule, for example, this proposition is still controversial. In our view, they are at most partly endogenously determined because they are controlled by the government and do not respond very flexibly to inflation and other variables. For the sake of simplicity and the constraints on the length of data in the PRC, we regard them as exogenous variables.
We take the GDP deflators of the PRC and US as indexes of inflation indicators. Generally, the GDP deflator is a better index than the change of consumer prices, since it is a more comprehensive price indicator of various goods. Another reason for us to choose the GDP deflator as an index of inflation indicators is that other indicators, such as export and import price and consumer price of the PRC before 1985 are either unavailable or too short-term for this study. The data used in this study are yearly data from 1980 to 2004. Most of them are from International Financial Statistics (IFS) June 2005 edition and China Statistical Yearbook 2004.

Before setting the vector error correction (VEC) model, we define the relevant variables as below:

- C-NEER: nominal effective exchange rate.
- C_DEFG: per cent change of PRC deflator.
- C_DRATE: deposit interest rate.
- US_DEFG: per cent change of US deflator.
- C_TRADE: trade balance of the PRC versus the rest of world.

\[
Y_t = \begin{pmatrix} NEER, \ C\_DEFG, \ US\_DEFG, \ C\_TRADE \end{pmatrix}^\prime : \text{ an endogenous variable vector.}
\]

\[
X_t = \begin{pmatrix} C\_DRATE, \ US\_FRATE \end{pmatrix}^\prime : \text{ an exogenous variable vector.}
\]

Unrestricted VAR (k) can be expressed as

\[
Y_t = \sum_{i=1}^{k} A_i Y_{t-i} + \sum_{i=1}^{k} B_i X_{t-i} + E_t, \quad (5.1)
\]

where, \( A_1, A_2, \ldots, A_k \) are all \( 4 \times 4 \) parameter matrices, \( B_i \) is a \( 4 \times 2 \) parameter matrix, \( U_t \) is a \( 4 \times 1 \) random residual vector, \( O \) is a \( 4 \times 1 \) zero vector, and \( \Omega \) is a \( 4 \times 4 \) covariance matrix. If necessary, the shifts and trends and dummy variable can also be included in this model. Since the specific VAR here is derived from the linearization of the nonlinear general equilibrium model around its equilibrium, in fact we have already assumed that there is an equilibrium force that pulls

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\(^{21}\) Theoretically, the lag \( k \) of the model in this paper should be 2.
Chapter 5. Misalignment of the Renminbi Exchange Rate and Its Adjustment

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the economic variables toward their equilibrium state. In other words, there are integration relationships among the endogenous variables. However, the existence of the integration has to be studied empirically, or the integration equations have to be tested, and the distance of the economic variables from their equilibrium level has to be estimated. An efficient tool for dealing with this issue is the restricted VAR model or VEC model. Rewriting the VAR model (5.1), we have the standard form of the VEC model (5.2):

\[
\Delta Y_t = \Pi Y_{t-1} + \sum_{i=1}^{k-1} \Gamma_i \Delta Y_{t-i} + \sum_{j=1}^{k} B_j X_{t-j+1} + U_t
\]

(5.2)

where \( \Gamma_i = -\sum_{i=1}^{k} A_i, \quad i = 1, 2, \ldots, k-1 \), \( \Pi = \left( \sum_{i=1}^{k} A_i - I \right) \), \( I \) is a unit 4 \times 4 matrix.

Statistically, to avoid spurious regressions, one need to test if the relevant time series in (5.2) are stationary or cointegrated. If \( Y_t \) is not stationary, and is say, \( Y_t \sim I(1) \) without loss of generality, we have \( \Delta Y_t \sim I(0) \). This means all of the endogenous terms in (5.2) except \( \Pi Y_{t-1} \) are stationary. If \( \Pi Y_{t-1} \) is not stationary, there are no cointegrations among the elements of \( Y_t \). If \( \Pi Y_{t-1} \) is stationary, there are cointegrations among the elements of \( Y_t \). Granger’s representation theorem asserts that if the coefficient matrix \( \Pi \) reaches reduced rank \( \tau < 4 \), then there exist matrices \( \alpha \) and \( \beta \) each with rank \( \tau \) such that \( \alpha \beta' = \Pi \) and \( \beta Y_{t-1} \sim I(0) \). \( \tau \) is the number of cointegrating relations (the cointegrating rank) and each column of \( \beta \) is the cointegrating vector (Hamilton, 1994).

5.3 Empirical Study and Results

The empirical study include five steps: (1) unit root test of level variables, (2) unit root test of first order difference, and second order difference of level variables if necessary, (3) cointegration test, (4) estimation of cointegration and VEC relations, and (5) impulse-response analysis. The unit root test is used to test if a time series is stationary to determine if a regression is spurious. If the test confirms that a series has a unit root, the series is nonstationary. Different
nonstationary series may have cointegrating relations. Thus, an integration test is needed. If integration relations exist, the next step is a VEC model estimation, which estimates both the long-run integration equations among endogenous variables and the short-run fluctuations. The purpose of impulse and response analysis is to investigate how one variable responds to the impulse of another variable. In the case of the renminbi, we want to understand what takes place once a one-time exchange rate adjustment is made under the pressure of the United States and other countries.

5.3.1 Unit Root Test

The results of the unit root tests listed in Tables 5.1-5.4 demonstrate that the Augmented Dickey-Fuller (ADF) test cannot reject any of the null hypotheses that the endogenous variables C_NEER, C_DEFG, C_TRADE or US_DEFG, has a unit root. Thus, these time series cannot be viewed as stationary.

Secondly, we test if the first differences of these time series are stationary under the Augmented Dickey-Fuller (ADF) tests. The test outcomes are shown in Tables 5.5-5.8. The null hypothesis that the first difference of each variable tested has unit root is rejected. This indicates that the first difference of C_NEER, C_DEFG, US_DEFG and C_TRADE can be viewed as a stationary process.

5.3.2 Cointegration Test

Since the level endogenous variables are not stationary, we need to conduct further cointegration tests. The results are shown in Tables 5.9 and 5.10. Table 5.9 contains two kinds of cointegration rank tests, the trace test and maximum eigenvalue test, with domestic and foreign interest rates as exogenous variables. Both show that there are four cointegration relations. We also conduct an integration rank (trace) test without exogenous variables (see Table 5.10), which shows that this series has two cointegrations. In any case, all the tests demonstrate that cointegrating relations exist among the variables.
5.3.3 Vector Error Correction and Cointegration Estimation

Before conducting VEC analysis, it is necessary to judge the order of the system. The theoretical model shows that the order should be two. The VEC with more than two lags is not available due to data limitations. In addition, a comparison of the statistic of first and second order VEC shows that the second order VEC is better than the first.

There is more than one cointegration statistically, but the cointegration with maximum eigenvalue is generally believed to be more meaningful. The cointegration corresponding to maximum eigenvalue according to a computation with the EVIEWS software is listed in Table 5.1, and represents the equilibrium relation between C_NEER and other factors concerned.

The estimation of the misalignment of C_NEER is shown in Chart 5.1. It indicates that the renminbi has gone through two phases of overvaluations and three phases of undervaluations since 1979. The two phases of overvaluations were before 1986 and during 1998 to 1999. In the period from 1983 to 1986, the renminbi was severely overvalued, from 29 to 66 per cent. Before the East Asia financial crisis broke out in 1997, the renminbi was nearly at its proper level, or was at most slightly overvalued. After the East Asia Financial crisis, most of East Asia currencies depreciated greatly and the renminbi was still pegged to the USD, so it was found to be overvalued by 13 per cent and 32 per cent, respectively, in 1998 and 1999.

The three phases of undervaluations happened during 1989 to 1990, 1993 to 1994, and after 2000. During 1986 to 1988, the renminbi was relatively properly valued, but with the market oriented price reform of 1988, high inflation appeared, at the same time, the renminbi was undervalued by about 28 in 1989 and 33 per cent in 1990. This is the first time it was found to be undervalued. The second time it was undervalued was between 1993 and 1994, following Deng Xiaoping’s South China Tour speech of 1992. His speech indicated that a new round reform and opening up policy to the outside world was being launched. As a result, demand for foreign
exchange increased rapidly, FDI was introduced on a greater scale, and speculative attacks on the renminbi grew in the black and swap market. Under this circumstance, the exchange rate became distorted at a much higher than the official rate. With the shock of reform and opening up, the official exchange rate was finally unified with the market rate in 1994, and the nominal effective exchange rate was considerably undervalued, by approximately 18 per cent in 1993 and 44 per cent in 1994. The issue was eventually resolved through long-time inflation. The third and latest undervaluation started from 2000 and has lasted for five years. The magnitude of the undervaluation has been between 7 per cent and 25 per cent, or 17 per cent on average.

5.3.4 Impulse-Response Analysis

Though the VEC model analysis shows that the renminbi has been undervalued by 17 per cent on average, this does not mean that the nominal exchange rate has to be sharply revalued by 17 to recover its equilibrium. A series of consequences of one time adjustment of exchange rate should also be taken into consideration. The magnitude of the adjustment should take into account the capacity of the PRC economy to bear a sudden adjustment. Chart 5.2 shows that a one-time innovation to the nominal effective exchange rate of the renminbi will be followed by a consecutive appreciation of the nominal effective appreciation if other things are equal, though the appreciation will weaken with time.

Then C_NEER will experience a period of depreciation followed by another appreciation. In summary, it seems that C_NEER has to experience a business cycle before approaching a steady state. Chart 5.2 also shows that the appreciation of the renminbi will cause the inflation rate to experience an increasing cycle and the foreign inflation rate a decreasing cycle. Its impulse on PRC inflation is much larger than on US inflation.\(^{22}\)

\(^{22}\)Theoretically, it is difficult to show if an appreciation of the renminbi will cause inflation or deflation. From the viewpoint of trade balances, an appreciation of the renminbi will hurt Chinese exports and benefit imports, so net import or foreign demand will decrease, which may cause deflation. But from the viewpoint of capital flow, the appreciation of the renminbi will cause foreign investors to hold more renminbi assets, causing more capital inflow. This will result in an increase in investment demand and inflation. Thus, in the appreciation
From the impulse-response analysis, we also find that the exchange rate adjustment can’t be passed through for 100 per cent to the price adjustment. Similar evidence is also observed in Japan (Kanamori and Zhao, 2005), and other countries or regions (Engle and Devereux, 2003). In addition, the positive impulse on the exchange rate lowers the PRC trade surplus, though not by very much.

Policymakers have to consider the accumulated effect that follows a one-time nominal exchange rate shock. According to Table 5.12, the accumulated effects of one unit innovation to C_NEER may reach about three units in three years, and the ratio of the trade balance to GDP is about 0.18 units. On average, the C_NEER is undervalued by 22 units (equivalent to 17 per cent) and the trade balance-GDP ratio is about 2 per cent. Thus, we estimate that the PRC economy could endure as much as a 7 per cent to 11 per cent revaluation without suffering an overvaluation and trade deficit.

5.4 Policy Implications and Exchange Rate Reform

Theoretically, the undervaluation of the renminbi distorts resource allocations across countries. An appreciation of the renminbi helps to correct the distortion. However, there are different views on how much the renminbi should be revaluated. This indicates how difficult it is for an economy to achieve consensus on where the equilibrium level is.

The empirical study in this chapter shows that in terms of the nominal effective exchange rate, the renminbi has been undervalued between 7 per cent and 25 per cent, and on average, 17 per cent, since 2000. Comparing this estimation with the announcement made on 21 July 2005 by the PBOC that the renminbi would be appreciated by some two per cent, we can conclude that a two per cent revaluation is evidently not enough to relieve the pressure of appreciation. This means that the renminbi will continue to face upward pressure and may experience a process of slow appreciation.
On 21 July 2005, the PBOC announced a two per cent revaluation of the renminbi, and allowed it to fluctuate by 0.3 per cent, up or down, in daily trading starting at 19:00 on 21 July 2005, with the closing price becoming the opening price of the following day. It also stated that the PRC would carry out a managed floating exchange rate regime in which the exchange rate would be determined by market supply and demand and adjusted with reference to a basket of currencies. The renminbi would be no longer be pegged to the USD only. This reform soon earned positive reply from outside, with both the US, Japan and European governments expressing support for the decision. Comparing this announcement with our estimation, we have the following comments.

First, the direction of the adjustment is clearly in accordance with the findings of this paper and many others. It is helpful for the exchange rate to move from disequilibrium toward equilibrium. Though the adjustment is not sufficient to make up for our estimated misalignment, it is definitely a positive step toward marketization.

Second, the two per cent revaluation falls below market expectations and our own estimation, and is not enough to remove the pressure of the trade surplus. However, this reform is in line with the gradualist strategy adopted regularly in the past by the PRC. This strategy has been confirmed as successful in comparison to the big bang reform adopted by Russia (Kanamori and Zhao, 2004). Without precisely knowing the consequences of the reform, it is understandable that the PRC government has taken a prudential step.

Third, when making policy decisions, the government has to take into consideration the lagged accumulated effect of the revaluation on the economy. We estimate that a 7-11 per cent appreciation would be acceptable, given that the PRC does not want to suffer from an overvaluation and trade deficit. Since the exchange rate is endogenously determined and may change explosively under certain conditions, it is necessary to keep the exchange rate within a narrow band. This reform allows the exchange rate to fluctuate within 0.3 per cent, helping to prevent excessive speculative action.

Fourth, our estimation shows that the renminbi still faces pressure toward appreciation and may experience a process of slow
appreciation. The magnitude of the appreciation will depend on how much the USD appreciates against other currency, changes in the domestic and foreign interest rates and domestic and foreign inflation rates. We expect that a rise of inflation in the PRC and a fall of inflation in the US will alleviate the pressure on the renminbi.

Finally, traditional wisdom may also be helpful. The gradualist strategy toward marketization adopted regularly in the past by the PRC has been confirmed as successful to some extent compared to the big bang reform adopted by Russia (Kanamori and Zhao, 2004). Because of the flexibility and without precisely knowing the consequences of the revaluation, it is understandable for the PRC government to take prudential steps and give firms and individuals time to adjust their behavior patterns. From this angle, the adjustment, though not sufficient, is definitely a positive step toward marketization.

### Table 5.1. Stationary Test of C_NEER

<table>
<thead>
<tr>
<th>Null Hypothesis: C_NEER has a unit root</th>
<th>t-Statistic</th>
<th>Prob.*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Augmented Dickey-Fuller test statistic</td>
<td>–1.98902</td>
<td>0.2893</td>
</tr>
<tr>
<td>Test critical values:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1% level</td>
<td>–3.73785</td>
<td></td>
</tr>
<tr>
<td>5% level</td>
<td>–2.99188</td>
<td></td>
</tr>
<tr>
<td>10% level</td>
<td>–2.63554</td>
<td></td>
</tr>
</tbody>
</table>

Augmented Dickey-Fuller Test Equation

<table>
<thead>
<tr>
<th>Dependent Variable: D(C_NEER)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variable</td>
</tr>
<tr>
<td>C_NEER(–1)</td>
</tr>
<tr>
<td>D(C_NEER(–1))</td>
</tr>
<tr>
<td>C</td>
</tr>
<tr>
<td>R-squared</td>
</tr>
<tr>
<td>Adjusted R-squared</td>
</tr>
<tr>
<td>S.E. of regression</td>
</tr>
<tr>
<td>Sum squared resid</td>
</tr>
<tr>
<td>Log likelihood</td>
</tr>
<tr>
<td>Durbin-Watson stat</td>
</tr>
</tbody>
</table>

### Table 5.2. Stationary Test of C_DEF\textsubscript{G}

Null Hypothesis: C_DEF\textsubscript{G} has a unit root

<table>
<thead>
<tr>
<th>t-Statistic</th>
<th>Prob.*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Augmented Dickey-Fuller test statistic</td>
<td>–2.33355</td>
</tr>
</tbody>
</table>

Test critical values:
- 1% level: –3.75295
- 5% level: –2.99806
- 10% level: –2.63875

Augmented Dickey-Fuller Test Equation

Dependent Variable: D(C_DEF\textsubscript{G})

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C_DEF\textsubscript{G}(-1)</td>
<td>–0.34985</td>
<td>0.149921</td>
<td>–2.33355</td>
<td>0.0302</td>
</tr>
<tr>
<td>D(C_DEF\textsubscript{G}(-1))</td>
<td>0.357364</td>
<td>0.211831</td>
<td>1.687024</td>
<td>0.1071</td>
</tr>
<tr>
<td>C</td>
<td>1.897115</td>
<td>1.131156</td>
<td>1.677148</td>
<td>0.1091</td>
</tr>
</tbody>
</table>

Other statistics:
- R-squared: 0.237914
- Mean dependent var: 0.035456
- Adjusted R-squared: 0.161705
- S.D. dependent var: 4.240477
- Akaike info criterion: 5.671951
- Schwarz criterion: 5.820059
- F-statistic: 3.121875
- Prob (F-statistic): 0.066076

Table 5.3. Stationary Test of US_DEFG

<table>
<thead>
<tr>
<th>Null Hypothesis: US_DEFG has a unit root</th>
<th>t-Statistic</th>
<th>Prob.*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Augmented Dickey-Fuller test statistic</td>
<td>–2.58452</td>
<td>0.1110</td>
</tr>
<tr>
<td>Test critical values:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1% level</td>
<td>–3.7696</td>
<td></td>
</tr>
<tr>
<td>5% level</td>
<td>–3.00486</td>
<td></td>
</tr>
<tr>
<td>10% level</td>
<td>–2.64224</td>
<td></td>
</tr>
</tbody>
</table>

Augmented Dickey-Fuller Test Equation

Dependent Variable: D (C_DEFG)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>US_DEFG(-1)</td>
<td>–0.27136</td>
<td>0.104995</td>
<td>–2.58452</td>
<td>0.0187</td>
</tr>
<tr>
<td>D(US_DEFG(-1))</td>
<td>0.299398</td>
<td>0.134186</td>
<td>2.231218</td>
<td>0.0386</td>
</tr>
<tr>
<td>D(US_DEFG(-2))</td>
<td>–0.18085</td>
<td>0.113971</td>
<td>–1.58684</td>
<td>0.13</td>
</tr>
<tr>
<td>C</td>
<td>0.591988</td>
<td>0.284672</td>
<td>2.079544</td>
<td>0.0521</td>
</tr>
</tbody>
</table>

R-squared 0.582767, Mean dependent var –0.1815

Adjusted R-squared 0.513228, S.D. dependent var 0.666632

S.E. of regression 0.465103, Akaike info criterion 1.469849

Sum squared resid 3.893772, Schwarz criterion 1.668221

Log likelihood –12.1683, F-statistic 8.380456

Durbin-Watson stat 1.819931, Prob (F-statistic) 0.001067

**Table 5.4. Stationary Test of C_TRADE**

<table>
<thead>
<tr>
<th>Null Hypothesis: C_TRADE has a unit root</th>
<th>t-Statistic</th>
<th>Prob.*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Augmented Dickey-Fuller test statistic</td>
<td>–2.32629</td>
<td>0.1720</td>
</tr>
<tr>
<td>Test critical values:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1% level</td>
<td>–3.72407</td>
<td></td>
</tr>
<tr>
<td>5% level</td>
<td>–2.98623</td>
<td></td>
</tr>
<tr>
<td>10% level</td>
<td>–2.6326</td>
<td></td>
</tr>
</tbody>
</table>

**Augmented Dickey-Fuller Test Equation**

Dependent Variable: D(C_TRADE)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C_TRADE(-1)</td>
<td>–0.37919</td>
<td>0.163004</td>
<td>–2.32629</td>
<td>0.0292</td>
</tr>
<tr>
<td>C</td>
<td>0.467093</td>
<td>0.359459</td>
<td>1.299434</td>
<td>0.2067</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.190472</td>
<td></td>
<td></td>
<td>0.112816</td>
</tr>
<tr>
<td>Adjusted R-squared</td>
<td>0.155275</td>
<td></td>
<td></td>
<td>1.771337</td>
</tr>
<tr>
<td>S.E. of regression</td>
<td>1.628017</td>
<td></td>
<td></td>
<td>3.889221</td>
</tr>
<tr>
<td>Sum squared resid</td>
<td>60.96011</td>
<td></td>
<td></td>
<td>3.986731</td>
</tr>
<tr>
<td>Log likelihood</td>
<td>–46.6153</td>
<td></td>
<td></td>
<td>5.411619</td>
</tr>
<tr>
<td>Durbin-Watson stat</td>
<td>1.799235</td>
<td></td>
<td></td>
<td>0.029173</td>
</tr>
</tbody>
</table>

Chapter 5. Misalignment of the Renminbi Exchange Rate and Its Adjustment

### Table 5.5. Stationary Test of D(C_NEER)

<table>
<thead>
<tr>
<th>Null Hypothesis: D(C_NEER) has a unit root</th>
<th>t-Statistic</th>
<th>Prob.*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Augmented Dickey-Fuller test statistic</td>
<td>–2.54956</td>
<td>0.0132</td>
</tr>
<tr>
<td>Test critical values:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1% level</td>
<td>–2.66485</td>
<td></td>
</tr>
<tr>
<td>5% level</td>
<td>–1.95568</td>
<td></td>
</tr>
<tr>
<td>10% level</td>
<td>–1.60879</td>
<td></td>
</tr>
</tbody>
</table>

Augmented Dickey-Fuller Test Equation

<table>
<thead>
<tr>
<th>Dependent Variable: D(C_NEER,2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variable</td>
</tr>
<tr>
<td>D(C_NEER(-1))</td>
</tr>
<tr>
<td>R-squared</td>
</tr>
<tr>
<td>Adjusted R-squared</td>
</tr>
<tr>
<td>S.E. of regression</td>
</tr>
<tr>
<td>Sum squared resid</td>
</tr>
<tr>
<td>Log likelihood</td>
</tr>
</tbody>
</table>

## Table 5.6. Stationary Test of D(C_DEFG)

<table>
<thead>
<tr>
<th>Null Hypothesis: D(C_DEFG) has a unit root</th>
<th>t-Statistic</th>
<th>Prob.*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Augmented Dickey-Fuller test statistic</td>
<td>–3.89009</td>
<td>0.0004</td>
</tr>
<tr>
<td>Test critical values:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1% level</td>
<td>–2.66936</td>
<td></td>
</tr>
<tr>
<td>5% level</td>
<td>–1.95641</td>
<td></td>
</tr>
<tr>
<td>10% level</td>
<td>–1.6085</td>
<td></td>
</tr>
</tbody>
</table>

Augmented Dickey-Fuller Test Equation

Dependent Variable: D(C_DEFG,2)

Included observations: 23 after adjustments

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>D(C_DEFG(-1))</td>
<td>–0.82427</td>
<td>0.211889</td>
<td>–3.89009</td>
<td>0.0008</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.407107</td>
<td>Mean dependent var 0.142037</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adjusted R-squared</td>
<td>0.407107</td>
<td>S.D. dependent var 5.423217</td>
<td></td>
<td></td>
</tr>
<tr>
<td>S.E. of regression</td>
<td>4.175854</td>
<td>Akaike info criterion 5.739019</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sum squared resid</td>
<td>383.6306</td>
<td>Schwarz criterion 5.788389</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Log likelihood</td>
<td>–64.9987</td>
<td>Durbin-Watson stat 1.924077</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Table 5.7. Stationary Test of D(US_DEFQ)

Null Hypothesis: D(US_DEFQ) has a unit root

<table>
<thead>
<tr>
<th>t-Statistic</th>
<th>Prob.*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Augmented Dickey-Fuller test statistic</td>
<td>-4.96267</td>
</tr>
<tr>
<td>Test critical values:</td>
<td></td>
</tr>
<tr>
<td>1% level</td>
<td>-2.67429</td>
</tr>
<tr>
<td>5% level</td>
<td>-1.9572</td>
</tr>
<tr>
<td>10% level</td>
<td>-1.60818</td>
</tr>
</tbody>
</table>

Dependent Variable: D(US_DEFQ,2)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>D(US_DEFQ(-1))</td>
<td>-0.68501</td>
<td>0.138032</td>
<td>-4.96267</td>
<td>0.0001</td>
</tr>
<tr>
<td>D(US_DEFQ(-1),2)</td>
<td>0.191319</td>
<td>0.123559</td>
<td>1.548399</td>
<td>0.1372</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.552063</td>
<td>Mean dependent var</td>
<td>0.162385</td>
<td></td>
</tr>
<tr>
<td>Adjusted R-squared</td>
<td>0.529666</td>
<td>S.D. dependent var</td>
<td>0.763033</td>
<td></td>
</tr>
<tr>
<td>S.E. of regression</td>
<td>0.523295</td>
<td>Akaike info criterion</td>
<td>1.629166</td>
<td></td>
</tr>
<tr>
<td>Sum squared resid</td>
<td>5.476759</td>
<td>Schwarz criterion</td>
<td>1.728352</td>
<td></td>
</tr>
<tr>
<td>Log likelihood</td>
<td>-15.9208</td>
<td>Durbin-Watson stat</td>
<td>2.23884</td>
<td></td>
</tr>
</tbody>
</table>

Table 5.8. Stationary Test of D(C_TRADE)

Null Hypothesis: D(C_TRADE) has a unit root

<table>
<thead>
<tr>
<th></th>
<th>t-Statistic</th>
<th>Prob.*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Augmented Dickey-Fuller test statistic</td>
<td>–5.16479</td>
<td>0.0000</td>
</tr>
<tr>
<td>Test critical values:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1% level</td>
<td>–2.66936</td>
<td></td>
</tr>
<tr>
<td>5% level</td>
<td>–1.95641</td>
<td></td>
</tr>
<tr>
<td>10% level</td>
<td>–1.6085</td>
<td></td>
</tr>
</tbody>
</table>

Augmented Dickey-Fuller Test Equation

Dependent variable: D(C_TRADE, 2)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>D(C_TRADE(-1))</td>
<td>–1.48704</td>
<td>0.28792</td>
<td>–5.16479</td>
<td>0</td>
</tr>
<tr>
<td>D(C_TRADE(-1),2)</td>
<td>0.411751</td>
<td>0.198563</td>
<td>2.073657</td>
<td>0.0506</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.608117</td>
<td></td>
<td>–0.01857</td>
<td></td>
</tr>
<tr>
<td>Adjusted R-squared</td>
<td>0.589455</td>
<td></td>
<td>2.688374</td>
<td></td>
</tr>
<tr>
<td>S.E. of regression</td>
<td>1.722542</td>
<td></td>
<td>4.008421</td>
<td></td>
</tr>
<tr>
<td>Sum squared resid</td>
<td>62.31019</td>
<td></td>
<td>4.107159</td>
<td></td>
</tr>
<tr>
<td>Log likelihood</td>
<td>–44.0968</td>
<td></td>
<td>2.098737</td>
<td></td>
</tr>
</tbody>
</table>

Table 5.9. Cointegration Test of Related Variables (with exogenous variables)

<table>
<thead>
<tr>
<th>Series: C_NEER C_DEFG C_TRADE US_DEFG</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exogenous series: C_DRATE US_FRATE</td>
</tr>
<tr>
<td>Warning: Critical values assume no exogenous series</td>
</tr>
<tr>
<td>Lag interval (in first differences): 1 to 2</td>
</tr>
<tr>
<td>Unrestricted Cointegration Rank Test (Trace)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Hypothesized Cointegration Rank Test (Trace)</th>
<th>Trace</th>
<th>0.05</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of CE(s)</td>
<td>Eigenvalue</td>
<td>Statistic</td>
</tr>
<tr>
<td>None *</td>
<td>0.994913</td>
<td>207.3066</td>
</tr>
<tr>
<td>At most 1 *</td>
<td>0.883717</td>
<td>91.12402</td>
</tr>
<tr>
<td>At most 2 *</td>
<td>0.701511</td>
<td>43.78609</td>
</tr>
<tr>
<td>At most 3 *</td>
<td>0.542169</td>
<td>17.18763</td>
</tr>
</tbody>
</table>

Trace test indicates 4 cointegrating eqn(s) at the 0.05 level
* Denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

<table>
<thead>
<tr>
<th>Hypothesized Cointegration Rank Test (Maximum Eigenvalue)</th>
<th>Max-Eigen</th>
<th>0.05</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of CE(s)</td>
<td>Eigenvalue</td>
<td>Statistic</td>
</tr>
<tr>
<td>None *</td>
<td>0.994913</td>
<td>116.1825</td>
</tr>
<tr>
<td>At most 1 *</td>
<td>0.883717</td>
<td>47.33793</td>
</tr>
<tr>
<td>At most 2 *</td>
<td>0.701511</td>
<td>26.59845</td>
</tr>
<tr>
<td>At most 3 *</td>
<td>0.542169</td>
<td>17.18763</td>
</tr>
</tbody>
</table>

Max-eigenvalue test indicates four cointegrating eqn(s) at the 0.05 level
* Denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values
### Table 5.10. Cointegration Test of Related Variables (without exogenous variables)

<table>
<thead>
<tr>
<th>No. of CE(s)</th>
<th>Eigenvalue</th>
<th>Statistic</th>
<th>Critical Value</th>
<th>Prob.**</th>
</tr>
</thead>
<tbody>
<tr>
<td>None *</td>
<td>0.972657</td>
<td>79.18477</td>
<td>27.58434</td>
<td>0</td>
</tr>
<tr>
<td>At most 1 *</td>
<td>0.718115</td>
<td>27.85762</td>
<td>21.13162</td>
<td>0.0049</td>
</tr>
<tr>
<td>At most 2</td>
<td>0.421581</td>
<td>12.04404</td>
<td>14.2646</td>
<td>0.109</td>
</tr>
<tr>
<td>At most 3 *</td>
<td>0.162643</td>
<td>3.905095</td>
<td>3.841466</td>
<td>0.0481</td>
</tr>
</tbody>
</table>

Max-eigenvalue test indicates 2 cointegrating eqn(s) at the 0.05 level
* Denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

### Table 5.11. Cointegration Equation with Maximum Eigenvalue

<table>
<thead>
<tr>
<th>Variable</th>
<th>C_NEER</th>
<th>C_DEFG</th>
<th>C_TRADE</th>
<th>US_DEFG</th>
<th>Constant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard deviation</td>
<td>(0.19814)</td>
<td>(0.91071)</td>
<td>(0.98153)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>T-statistic</td>
<td>[ 18.1273]</td>
<td>[ 23.2891]</td>
<td>[–31.0619]</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 5.12. Accumulated Effects on Response to Nonfactorized One-Unit Innovations to the Nominal Effective Exchange Rate

<table>
<thead>
<tr>
<th>Period</th>
<th>C_NEER</th>
<th>C_DEFG</th>
<th>US_DEFG</th>
<th>C_TRADE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.0000</td>
<td>0.0000</td>
<td>0.0000</td>
<td>0.0000</td>
</tr>
<tr>
<td>2</td>
<td>1.800366</td>
<td>0.148614</td>
<td>-0.01659</td>
<td>-0.08008</td>
</tr>
<tr>
<td>3</td>
<td>2.759604</td>
<td>0.191728</td>
<td>-0.04879</td>
<td>-0.1417</td>
</tr>
<tr>
<td>4</td>
<td>3.267964</td>
<td>0.255582</td>
<td>-0.0796</td>
<td>-0.17726</td>
</tr>
<tr>
<td>5</td>
<td>3.493285</td>
<td>0.342185</td>
<td>-0.10834</td>
<td>-0.25966</td>
</tr>
<tr>
<td>6</td>
<td>3.356211</td>
<td>0.498616</td>
<td>-0.13618</td>
<td>-0.35076</td>
</tr>
<tr>
<td>7</td>
<td>3.214566</td>
<td>0.666273</td>
<td>-0.15691</td>
<td>-0.40297</td>
</tr>
<tr>
<td>8</td>
<td>3.120856</td>
<td>0.838798</td>
<td>-0.17214</td>
<td>-0.45877</td>
</tr>
<tr>
<td>9</td>
<td>3.155389</td>
<td>0.985485</td>
<td>-0.18879</td>
<td>-0.5247</td>
</tr>
<tr>
<td>10</td>
<td>3.300548</td>
<td>1.112996</td>
<td>-0.20626</td>
<td>-0.57166</td>
</tr>
</tbody>
</table>

Chart 5.1. Misalignment of the Renminbi NEER (%)
Chart 5.2. Responses to One-Unit Innovations to the Nominal Effective Exchange Rate

Response of C_NEER to C_NEER

Response of C_DEF to C_NEER

Response of US_DEF to C_NEER

Response of C_TRADE to C_NEER
Chapter 6. Japan’s Experience and Its Implications for the PRC

Looking back at Japan’s history, Japan experienced two sharp appreciations of the yen after World War II, followed by hyperinflation or an economic bubble. We should note in particular that after the economic bubble in the late 1980s, Japan underwent a long recession (the so-called “lost decade”).

Not a few Chinese economists, although not identified individually, are worried that if the renminbi is sharply appreciated for a very short period of time, the PRC might follow the old path of recession that Japan experienced in the past. (What local people say: 一些经济学者认为中国人民币如果迅速升值、会重走日本经济不景气的老路子。)

Are there any lessons, then, to be learned from Japan’s experiences for the PRC?

6.1 Development in the Early 1970s

On 15 August 1971, US President Richard Nixon announced a new economic policy, consisting of nine economic measures. The purpose of this policy was threefold: to curb inflationary pressure, stimulate economic activity and increase employment opportunities, and to address the balance of payments (BOP). In particular, in connection with the BOP policy, the US declared a temporary suspension of the convertibility of the USD to gold. It is interesting to know that this became known as the “Nixon Shock” in Japan, in a sense that it shows how Japan was shocked by the announcement and the following sharp appreciation in the value of the Japanese yen (see Table 6.1).

After World War II, the world economy was primarily led by the US for a time. However starting in the mid 1950s, this situation gradually began to change. The background was that Japan and

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23 This chapter is based on ADB Institute Policy Brief No.18, originally appeared in December 2005.
Europe started to recover and even catch up with the US, while the US, in particular, became bogged down in the Viet Nam War in the late 1960s, and the increase in military expenditures put enormous pressure on the US economy. The US was also suffering from serious labor disputes. For all these reasons, the relative international competitiveness of the US economy vis-a-vis Japan and Europe declined and confidence in the USD also declined. The suspension of the convertibility of the dollar to gold in 1971 was a natural consequence of these developments.

Immediately after the US announcement, while European countries closed their foreign exchange markets, Japan kept the market open and tried to maintain a pegged rate system. During the following two weeks, Japan, facing mounting selling pressure on the USD, continued to buy it at a volume that amounted to 2 trillion yen (or 5.2 billion USD at the time). This amount was also almost equal to the Bank of Japan’s total lending outstanding to commercial banks at the time. However, even this large-scale intervention did not achieve the intended goal and in the end the major countries including Japan decided to leave the fixed exchange rate system in August 30. Due to the intervention in the market during those two weeks, Japanese commercial banks were left with excessive yen liquidity and the Bank of Japan exceptionally issued promissory notes in the market and tried to absorb the excessive liquidity.

In December 1971, the G10 Finance Ministers met at the Smithsonian Museum in Washington, DC, and agreed to readjust the exchange rates and resume a fixed exchange system. Under the “Smithsonian Agreement,” the value of gold increased from 35 to 38 USD per ounce, representing a 7.89 per cent increase. At the same time, all the major currencies appreciated significantly vis-a-vis the USD, and in particular the Japanese yen appreciated from previous fixed rate of 360 yen to 308 yen, representing a 16.88 per cent appreciation, the highest among major currencies (see Table 6.2.). In addition, a more flexible wide band was adopted under the Agreement. Under the past fixed rate regime, currencies were allowed to fluctuate only within a very narrow range of plus or minus 1.5 per
cent. The range was widened to 2.25 per cent each under the Smithsonian Agreement.

However even after the new agreement, the confidence in the USD was not fully restored, speculation on the possibility of further readjustment prevailed in the market, and the selling pressure on the USD continued. Finally, in February and March 1973, Japan and other European nations decided to abandon the fixed rate system, and eventually the fixed rate regime came to an end. As of early 1973, the Japanese yen had appreciated to around 260 to the USD.

Table 6.1. JPY/USD Nominal Exchange Rates (1971 July-December)

<table>
<thead>
<tr>
<th>End of month</th>
<th>JPY/USD</th>
<th>Difference</th>
<th>% Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>July</td>
<td>357.37</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>August</td>
<td>339.00</td>
<td>▲18.37</td>
<td>▲5.14%</td>
</tr>
<tr>
<td>September</td>
<td>334.21</td>
<td>▲4.79</td>
<td>▲1.41%</td>
</tr>
<tr>
<td>October</td>
<td>329.30</td>
<td>▲4.91</td>
<td>▲1.47%</td>
</tr>
<tr>
<td>November</td>
<td>327.65</td>
<td>▲1.65</td>
<td>▲0.5%</td>
</tr>
<tr>
<td>December*</td>
<td>314.80</td>
<td>▲12.85</td>
<td>▲3.92%</td>
</tr>
</tbody>
</table>

* JPY/USD under the Smithsonian Agreement (Dec. 1971): 308.00
  JPY/USD when Japan moved to a floating system (Feb. 1973): 260.00

Table 6.2. Readjustment under the Smithsonian Agreement (Dec. 1971)

<table>
<thead>
<tr>
<th></th>
<th>Old rate</th>
<th>New rate</th>
<th>Percentage change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Japanese Yen</td>
<td>360</td>
<td>308</td>
<td>16.88%</td>
</tr>
<tr>
<td>West German M</td>
<td>3.6600</td>
<td>3.2225</td>
<td>13.58%</td>
</tr>
<tr>
<td>French Fr</td>
<td>5.55419</td>
<td>5.11570</td>
<td>8.57%</td>
</tr>
<tr>
<td>UK Pound</td>
<td>2.4000</td>
<td>2.21055</td>
<td>8.57%</td>
</tr>
<tr>
<td>Italian Lira</td>
<td>625.0</td>
<td>581.5</td>
<td>7.48%</td>
</tr>
<tr>
<td>Swiss Fr</td>
<td>4.0841</td>
<td>3.8400</td>
<td>6.36%</td>
</tr>
</tbody>
</table>

Japan’s economy had been experiencing a relatively long period of buoyancy from the mid 1960s. In order to avoid economic overheating, Japanese monetary authority started to adopt a tight monetary policy in 1969. The slowdown of the economy increased the trade surplus. In addition, low interest rates in the US increased
capital inflows from overseas through foreign investors’ investments in Japanese securities and short-term volatile capital inflow into Japan, which also contributed to widening Japan’s BOP imbalance and accumulating foreign reserves (see: Table 6.3.).

In early 1971, Japan’s economy showed signs of recovery, but the “Nixon Shock” and the following Smithsonian Agreement changed entrepreneurs’ sentiments from optimism to pessimism and cut down exports significantly. The Japanese government’s Economic White Paper at that time correctly stated that the radical adjustment of foreign exchange rates in the early 1970s had provided Japan with an important turning point to change its economic growth path. In other words, Japan was no longer able to rely on an increase in exports alone in order to get out of recession.

Table 6.3. BOP Indicators During 1967–72

<table>
<thead>
<tr>
<th>Year</th>
<th>Trade &amp; non-trade balance</th>
<th>Current balance</th>
<th>Long-term capital balance</th>
<th>Foreign reserves</th>
</tr>
</thead>
<tbody>
<tr>
<td>1967</td>
<td>▲ 12</td>
<td>▲ 190</td>
<td>▲ 812</td>
<td>2,005</td>
</tr>
<tr>
<td>1968</td>
<td>1,223</td>
<td>1,048</td>
<td>▲ 239</td>
<td>2,891</td>
</tr>
<tr>
<td>1969</td>
<td>2,300</td>
<td>2,119</td>
<td>▲ 155</td>
<td>3,496</td>
</tr>
<tr>
<td>1970</td>
<td>2,178</td>
<td>1,970</td>
<td>▲ 1,591</td>
<td>4,399</td>
</tr>
<tr>
<td>1971</td>
<td>6,049</td>
<td>5,797</td>
<td>▲ 1,082</td>
<td>15,235</td>
</tr>
<tr>
<td>1972</td>
<td>7,088</td>
<td>6,624</td>
<td>▲ 4,487</td>
<td>18,365</td>
</tr>
</tbody>
</table>

Source: Balance of Payment Statistics, Bank of Japan

6.2 Developments in the Mid-Late 1980s

The second phase when Japan experienced a sharp appreciation of the yen in a very short period of time was from the mid to late 1980s. After the Reagan Administration took office in the US in the early 1980s, the US economy entered a buoyant cycle, which led to strong domestic demand and imports from overseas. This in turn aggravated its trade deficits and intensified protectionist sentiments. On the other hand, inflationary pressure as well as fiscal deficits raised the US interest rate, keeping the value of the USD high.
Under the Plaza Accord of September 1985, the G5 agreed to take coordinated action to address the “overvalued” USD. From that time until the Louvre Accord, the USD dramatically declined by almost 40 per cent in just one year and a half (see Table 6.4. and Chart 6.1).

During this period, Japan’s trade surplus increased significantly and its foreign reserves also accumulated very rapidly (Table 6.5), in a similar way to the early 1970s.

**Table 6.4. The JPY/USD Rate from the Plaza Accord to the Louvre Accord**

<table>
<thead>
<tr>
<th>Prior to 1985</th>
<th>Around 240 JPY</th>
</tr>
</thead>
<tbody>
<tr>
<td>November 1985</td>
<td>200 JPY (16.7%)</td>
</tr>
<tr>
<td>January 1987</td>
<td>150 JPY (37.5%)</td>
</tr>
</tbody>
</table>

**Chart 6.1. JPY/USD Exchange Rate Fluctuations**

Source: Bank of Japan
### Table 6.5. BOP Indicators During 1982–87

(Units: one million USD)

<table>
<thead>
<tr>
<th>Year</th>
<th>Trade &amp; non-trade balance</th>
<th>Current balance</th>
<th>Long-term capital balance</th>
<th>Foreign reserves</th>
</tr>
</thead>
<tbody>
<tr>
<td>1982</td>
<td>8,231</td>
<td>6,850</td>
<td>▲14,969</td>
<td>23,262</td>
</tr>
<tr>
<td>1983</td>
<td>22,348</td>
<td>20,799</td>
<td>▲17,700</td>
<td>24,496</td>
</tr>
<tr>
<td>1984</td>
<td>36,510</td>
<td>35,003</td>
<td>▲49,651</td>
<td>26,313</td>
</tr>
<tr>
<td>1985</td>
<td>50,821</td>
<td>49,169</td>
<td>▲64,542</td>
<td>26,510</td>
</tr>
<tr>
<td>1986</td>
<td>87,895</td>
<td>85,845</td>
<td>▲131,462</td>
<td>42,239</td>
</tr>
<tr>
<td>1987</td>
<td>90,684</td>
<td>87,015</td>
<td>▲136,532</td>
<td>81,479</td>
</tr>
</tbody>
</table>

Source: Balance of Payment Statistics, Bank of Japan

### 6.3 Capital Flows and Regulations on Capital Account Transactions during These Periods

From World War II until the mid 1960s, Japan had imposed strict regulations on various transactions with overseas under the old Foreign Exchange Control Law enacted in 1945. During this period there were almost no money flows between Japan’s private sector and that of overseas. Japan joined the IMF and OECD in 1964 and terminated the regulations on current account transactions, and then gradually started to liberalize capital account transactions. The deregulation measures, taken on a rather ad hoc basis, were all incorporated into the new Foreign Exchange Law of 1980, which marked a turning point for Japan’s foreign exchange control from “the prohibition of transactions in principle” to “the liberalization of transactions in principle.”

In tandem with the deregulation of capital account transactions such as domestic investors’ purchases of foreign securities and loosening of the upper limit on the ratio of foreign securities holding to total assets, long-term capital flows expanded rapidly, in particular after the 1980s. A couple of features can be seen in the development of Japan’s capital flow with overseas. First, the long-term capital account has continuously registered deficits (capital outflows financed by the current account surplus). Second, if we look at the
breakdown of long-term capital flows, while portfolio investment (investment in foreign securities) has been the largest item, FDI increased dramatically from the late 1980s. Third, while portfolio investment showed great volatility, the balance of other items, in particular FDI, continued to be in deficit (Japan’s FDI overseas far exceeds the FDI of other countries in Japan).

Regarding the relationship between the exchange rate system and regulation on capital account transactions, it is widely recognized from past lessons in various countries that liberalizing capital transactions while maintaining an inflexible exchange rate system increases the risk of financial crisis. On the other hand, as shown by the Asian financial crisis in 1997–98, countries with relatively closed capital transactions such as the PRC and India were greatly affected by the crisis. In the case of Japan, as shown from the above observation, the early 1970s, when Japan moved toward a floating exchange rate system, coincides with the period when the liberalization of capital account transactions was underway.

6.4 Policy Responses of Japanese Authorities

6.4.1 Early 1970s

Under the economic expansion during the late 1960s, Japan’s wholesale prices started to rise and concern emerged about inflation. In order to curb inflation, Japan adopted a tight monetary policy in 1969 and 1970. However, this measure only ended up further widening the trade imbalance. Then from mid 1970, Japan began to aim to stimulate the economy and reduce the trade surplus by taking an expansionary monetary and fiscal policy with no effect on the trade imbalance, which had already remained throughout the past economic expansion phase. Although dramatic adjustments in the exchange rate were made through the Nixon shock and Smithsonian Agreement in 1971, loose monetary policy continued in 1972, and Japan finally faced serious inflation in 1973. High growth of the money supply through the BOP surplus and first Oil Crisis in late 1973 aggravated the situation.
After World War II, the Japanese economy had been primarily led by exports and overseas investments made by exporting industries. Therefore, there was serious opposition in both political and business circles to the appreciation of the yen, which might make the traditional growth pattern ineffective. The late 1960s and early 1970s were a period when international transactions started to be gradually liberalized. Under these circumstances, Japan faced a dilemma between external equilibrium (i.e. the BOP balance) and internal equilibrium (i.e. economic growth with full employment and no inflationary pressure). Due to the strong opposition mentioned above, what Japan pursued was to stimulative economic measures to improve the external imbalance, while trying to contain the pressure of appreciation on the yen as much as possible. In other words, what it pursued was a traditional “adjusted inflation,” which involved trying to achieve external equilibrium by raising domestic prices under a pegged exchange system, instead of moving to a floating exchange rate. Perhaps it should have floated its exchange rate earlier, and by doing so tried to achieve external equilibrium. This policy measure might have somewhat eased the ensuing inflationary pressure. We can summarize that this was an issue which economic theory later explained as a trilemma among ensuring free international capital transactions, maintaining the independence of monetary policy and keeping a pegged exchange regime.

6.4.2 The Mid and Late 1980s

Facing the sharp appreciation of the yen after the Plaza Accord, serious concern again emerged about the adverse impact of the appreciation on economic activities. To address this, Japan adopted a loose monetary policy from late 1985 to early 1987. From mid 1987 to 1989, although policymakers seemed to be aware that the loose monetary policy might be excessive and tried to tighten it, the loose policy continued until 1989. Consequently the “economic bubble” was created in the late 1980s and after the collapse of the bubble, Japan entered a prolonged recession (the “lost decade.”) Certainly, no single factor can explain the creation of the bubble. However, if
monetary policy had been tightened earlier, as the monetary authority perhaps originally intended, the size of the bubble would have been smaller and its aftermath might have been less serious than what actually happened.

Then, why did the monetary authority miss the chance to change its policy? After the Plaza Accord, the importance of policy coordination was emphasized among G7 countries, and the Japanese authority was also heavily influenced by the commitment to policy coordination when it formulated its economic policy. It seemed that Japanese authority felt strong pressure for Japan to expand domestic demand by keeping loose monetary policy and try to reduce its current surplus. On the other hand, like in the previous period when the yen appreciated, there was serious concern about the impact of its appreciation on the economy and it was recognized that one of the primary goals of monetary policy was to stabilize the exchange rate. Since the consumer price index (CPI) at the time was still stable, the concern about economic overheating and inflationary pressure was not necessarily shared by the public. The argument also prevailed at that time that since IT-related and R&D related business investments accounted for the increase in business investments, there was not need to worry too much about the possibility of overcapacity of production lines.

6.5 Lessons to Learn

6.5.1 Similarities and Differences between the PRC and Japan

These periods are somewhat similar to the recent economic situation surrounding the PRC. Looking at external factors, from the PRC’s point of view, the US, its most important trading partner, is involved in a war that is similar to the Viet Nam War, and that like it is consuming great financial resources. The US has also suffered from the collapse of the new economy bubble from 2001 until recently. This led to an increase of the twin deficits (trade deficit and fiscal deficit) in the US economy, putting a downward pressure on the value of the USD. Domestically, since the PRC joined the WTO in December 2001 and started to gradually liberalize capital account
transactions, it has increasingly registered trade surpluses and accumulated foreign reserves, while trying to make every efforts to ease the appreciation pressure on the renminbi, which is still primarily linked to the USD even after the PBOC’s announcement in July 2005.

There are major differences, however. First, the economies of the world are now much more interlinked through trade, FDI and huge flows of international money. Secondly, most major countries have in principle completed the liberalization of their current and capital account transactions under a floating exchange regime and removed various external barriers. Thirdly, unlike Japan during these periods, the PRC’s capital account balance continues to register large surpluses, reflecting the PRC’s traditional “one-way” regulation which encourages capital inflows by inviting foreign-invested enterprises, on one hand, and strictly regulates capital outflows on the other. Furthermore a significant amount of hot money (mostly deemed to be the recycling of capital flight in the past for speculative motives) is reported to be returning to the PRC, and it is reflected in the statistical errors and omissions in the PRC BOP account (Table 6.6), all of which further contribute to a significant accumulation of foreign reserves in a very short period of time. All these factors put higher appreciation pressure on the renminbi in comparison to the early 1970s and mid to late 1980s in Japan.

Table 6.6. Balance of Payments and Foreign Reserves of PRC

<table>
<thead>
<tr>
<th></th>
<th>2000</th>
<th>2001</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current balance</td>
<td>20.51</td>
<td>17.41</td>
<td>35.42</td>
<td>45.87</td>
<td>68.66</td>
</tr>
<tr>
<td>Trade</td>
<td>28.87</td>
<td>28.08</td>
<td>37.88</td>
<td>36.07</td>
<td>49.28</td>
</tr>
<tr>
<td>Capital balance</td>
<td>1.92</td>
<td>34.78</td>
<td>32.29</td>
<td>52.72</td>
<td>110.70</td>
</tr>
<tr>
<td>FDI</td>
<td>37.78</td>
<td>37.35</td>
<td>46.78</td>
<td>47.23</td>
<td>53.10</td>
</tr>
<tr>
<td>Errors &amp; omissions</td>
<td>▲11.9</td>
<td>▲4.9</td>
<td>7.8</td>
<td>18.4</td>
<td>27.04</td>
</tr>
<tr>
<td>Foreign reserves</td>
<td>165.57</td>
<td>212.17</td>
<td>286.41</td>
<td>403.25</td>
<td>609.90</td>
</tr>
</tbody>
</table>

Source: China Foreign Exchange Bureau, China Ministry of Commerce
On the other hand, the PRC is currently facing two serious issues that did not exist in Japan in the past, and which may explain why the PRC government is very careful about or is strongly resisting the appreciation of the renminbi. One is unemployment in rural areas and the mounting pressure to create employment opportunities in urban areas. This problem has become serious and in the eyes of the government, can only be resolved through rapid economic development. Naturally the PRC is very sensitive to anything that might affect employment opportunities in rural as well as urban areas.\textsuperscript{24} The other factor relates to resolving non-performing loans (NPLs) in the state-owned banks (SOBs) sector. In recent years, it seems that the PRC government and four asset management companies (AMC) have been trying to get foreign investors involved in the liquidation and disposal process of NPLs, but if the renminbi appreciates significantly, it will definitely discourage such actors to participate in the NPL problem, and the PRC does not wish to see this.\textsuperscript{25}

\textsuperscript{24} According to official data, the unemployment rate in urban areas is 4.2 per cent (about 8 million) at the end of 2004. However it is widely estimated that there are about 10 million laid-off employees (\textit{xiagang}) in the SOE sector and 150 million excessive workers in rural areas, of which 8-10 million come to urban areas to look for job opportunities every year. In addition, roughly 8-14 million new workers flow into the labor market every year.

\textsuperscript{25} At the early stage after the AMCs were set up in 1999, the PRC authorities already expressed interest or the necessity of inviting foreign investors to solve this problem. For instance, at the international forum on NPLs, which was held in Beijing in 2001, the governor of PBOC, while admitting the poor management environment of AMCs and also hinting that there were only limited financial measures available to cope with NPLs, stated that the mobilization of foreign funds would be indispensable to solve this problem. The State Development and Reform Commission (SDRC) issued a “Circular on Administration of Foreign Debts Relating to External Transfer of NPL by AMCs” in 2004, with the aim to streamline the procedure and improve the environment for foreign investors to invest in NPLs. It is reported that the Huarong AMC attempted to package a face value of 150 billion RMB for sale (the largest sale) targeting foreign investors in late 2004 (SCMP Oct. 20, 2004). It is also reported that Silver Grant International Industries Ltd., a Hong Kong, China listed company controlled by China Xinda AMC, which has dealt with the disposal of NPLs, unveiled a plan to sell more than USD200 million worth of new shares and convertible instruments to Citigroup Global Investment Management, and Silver and Citigroup signed an MOU to establish a joint venture to invest in NPL in the PRC (\textit{China Economic News}, Jan. 10, 2005). External sources are also expected to be used to strengthen banks’ capital adequacy ratio (e.g. an injection of 4.5 billion USD of foreign reserves as an additional capital fund to two of four SOBs).
Table 6.7. Background Comparison Between the PRC and Japan

<table>
<thead>
<tr>
<th>For the PRC</th>
<th>For Japan</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Similarity)</td>
<td></td>
</tr>
<tr>
<td>* US war on terror, Iraq</td>
<td>* US war in Vietnam</td>
</tr>
<tr>
<td>* PRC trade surplus with the US</td>
<td>* Japan trade surplus with the US</td>
</tr>
<tr>
<td>* US inflation pressure</td>
<td>* US inflation pressure</td>
</tr>
<tr>
<td>* US fiscal deficit</td>
<td>* US fiscal deficit</td>
</tr>
<tr>
<td>* High foreign reserves</td>
<td>* High foreign reserves</td>
</tr>
<tr>
<td>(Differences)</td>
<td></td>
</tr>
<tr>
<td>* PRC FDI surplus</td>
<td>* Japan FDI deficit</td>
</tr>
<tr>
<td>* Capital account liberalization already in place in major countries</td>
<td>* Major countries’ capital account liberalization not completed</td>
</tr>
<tr>
<td>* Some lessons to learn</td>
<td>* No lessons to learn</td>
</tr>
<tr>
<td>* PRC remains a developing country</td>
<td>* Japan was already an industrialized country</td>
</tr>
</tbody>
</table>

6.5.2 Impact on Macro Economy

Japan faced serious inflation both after the early 1970s and mid- to late 1980s. The important underlying factor to be noted here is that due to the strong opposition or concern about the possible adverse impacts of a sharp appreciation of the yen on economic activities, and in particular on export-oriented manufacturing industries, it may be that the monetary policy was excessively loose and that policy changes were not necessarily implemented for both periods in a timely way. However, in reality the macro economic situation was not so seriously affected as anticipated and it started to recover at an early stage. In other words, the impact of the currency appreciation on the economy tended to be overemphasized. Thanks to the appreciation of the yen, prices of raw materials declined and the terms of trade (export price index/import price index) improved significantly, in a way that benefited Japanese industries as well. It was also found that the international competitiveness of Japanese commodities was unexpectedly high in terms of quality management. Furthermore, as stated below, many Japanese companies started to adjust to the new
environment in a flexible way by, for example, shifting their production lines overseas. All these facts indicate the importance or difficulty of how to assess the behavioral change and international competitiveness of enterprises and how to predict the overall impact of currency fluctuations on macro economy.

In the context of the PRC, theory and empirical evidence have shown that the renminbi is indeed undervalued on average by about 17 per cent in recent years, and thus that the 2.1 per cent revaluation would not be sufficient to weaken the competitive power of the economy and reduce the trade surplus against the US. In the short run, because of the J-curve effect, the balance of trade may continue to expand. The revaluation has had a limited impact on overall inflation. Considering the chain effects and accumulated effects of the revaluation, the PRC economy should be able, from a macroeconomic perspective, endure a larger scope of revaluation. However, the PRC’s main problems are not at the aggregate level, where 9 per cent growth has continued, but in the structural or sectoral level. Different industries have different endurances to the shocks of revaluation. What the government is most concerned about is the agriculture sector and automobile sector, which may be easily affected by a revaluation, and the unemployment problems induced by revaluation. Currently, one of the major sources for absorbing excessive labor and mitigating the unemployment problem in the PRC is FDI. Assuming the current renminbi exchange rate and looking for cheap labor, many foreign companies have set up production lines and recruited a number of rural workers, particularly in special economic zones. If the renminbi is sharply appreciated, it will affect the PRC’s noncompetitive agriculture sector and state-owned enterprises (SOEs), and create more excessive labor, and FDI may decline somewhat due to the higher operating costs. This might make the unemployment problem more serious.

We note that overall, prices remain stable in the PRC. However, inflationary pressure, especially in real estate, may have increased in recent years. However, the inflation pressure is not due only to the undervaluation of the renminbi, for there are also some other factors. Two factors in particular, economic as well as political, can be cited.
Economically, in order to stabilize the renminbi’s exchange rate under the current surplus, the PRC has to absorb USD by issuing renminbi notes, and this tends to increase the money supply.\(^{26}\) Politically, unlike the old administration, the new PRC leadership tends to (or cannot but) accommodate all requests for development assistance from regional governments under the policy agenda of addressing regional disparities, and this is also putting inflationary pressure on the economy as a whole.\(^{27}\)

### 6.5.3 Independent Monetary Policy and Regulations on Capital Flows

Both the early 1970s and mid-late 1980s raised the traditional question of trilemma among three economic goals, i.e. ensuring free international capital transactions, maintaining the independence of monetary policy and keeping a pegged exchange rate regime. In the early 1970s, Japan tried to maintain a pegged exchange regime, while allowing adjusted inflation in order to achieve an external balance (in other words, a somewhat loose independent monetary policy). In the mid-late 1980s, under the framework of “international policy coordination” put forward in the Plaza Accord and Louvre Accord, readjusting or keeping exchange rates stable became a major goal of monetary policy. There may have been differing views about the goals of monetary policy, but this also would be the case when monetary policy lost its freedom and sacrificed domestic equilibrium. We should keep in mind that all goals cannot be achieved simultaneously, and need to think about relevant policy assignment.

In the context of the PRC, we need to note that the trilemma argument, which generally derives from small-sized economies, is not necessarily able to explain the phenomenon in the PRC. The trilemma argument states that a small country cannot carry out an independent monetary policy and fixed exchange rate policy while maintaining

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\(^{26}\) M2 in the PRC increased by 12.3 per cent, 17.6 per cent, 16.9 per cent, 19.6 per cent and 14.6 per cent respectively from 2000 to 2004 (PBOC statistics) compared to the average economic growth of 8-9 per cent. Although the growth rate of M2 declined in 2004, the velocity of money rose sharply, primarily due to the expansion of credit demand.

\(^{27}\) The National People’s Congress in 2005 launched another regional development initiative called “zhongbu boxing” (or Central Area Development Plan), in addition to the “xibu dakaifa” (or “go west policy”) and development plan for northeast area.
free capital flows. At the early stage of economic reform, the PRC was economically a small country. Monetary policy was regarded as an indication of sovereignty, and it had to be maintained. If we apply the trilemma argument to the PRC in the early stage of economic reform, under the situation when its capital account transactions were not fully liberalized, maintaining and pursuing a fixed exchange rate system and independent monetary policy could be justified, especially if it maintained a trade surplus. Today, the PRC cannot be regarded as a small country, for otherwise the US would not need to put pressure on the renminbi exchange rate. As a big economy, the PRC is capable of carrying out an independent monetary policy under a fixed exchange rate regime with regulated capital transactions. Thus, the fixed rate regime may not be a serious problem, although it may result in an external imbalance and may incur foreign pressure (the imbalance certainly may be caused not only by the exchange rate itself, but by other factors such as the American war on terror and the collapse of the US bubble economy). In fact, there are many measures that can be taken to deal with the problem. The current problems between the PRC and US can be resolved through external or domestic adjustments. Adjusting the renminbi exchange rate is only one of the options. For example, the US could cut its military expenditures, which account for more of 50 per cent of the whole world’s military spending. It could be resolved by easing export restrictions to the PRC. Nevertheless, as long as Japan’s experience is concerned, Japan could have mitigated inflationary pressure by taking a more timely monetary policy and leaving the external balance basically to the adjustment of the exchange rate. This is something which the PRC may learn from Japan’s experience.

Regarding the regulation of capital transactions, it should be noted that the PRC is still halfway along the path. In the course of liberalization, the PRC is moving to lift regulations on capital outflow (The “go-out” or “zou chuqu” policy). The “zou chuqu” policy is

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28 The zou chuqu policy encourages not only SOEs but also all kinds of enterprises to invest abroad. Under this policy, the State Administration of Foreign Exchange (SAFE) streamlined the approval procedures for companies investing abroad and only required the approval of local foreign trade authorities. The policy also includes various measures such as permitting
expected to mitigate appreciation pressure to some extent. However, at the same time, there will be increasing risks if the PRC further deregulates capital outflow while maintaining a rigid exchange rate regime (the issue of policy sequence). In the case of Japan, whether intentionally or unintentionally, as stated above, the movement toward a floating exchange regime took place in tandem with the deregulation of capital account transactions.

6.5.4 External Imbalances and Exchange Rate Adjustment

On the other hand, Japan’s experience also indicates that an external balance cannot be achieved only through exchange rate adjustment. Generally it is expected that currency appreciation raises export prices in terms of USD, which cuts down price competitiveness and decreases export volume. However, if we look at Japan’s experience in the mid 1980s, export prices in USD terms were only raised by 50 per cent vis-a-vis the appreciation of the yen, and the overall export volume was not significantly affected. The remaining 50 per cent was absorbed by the streamlining efforts of enterprises and the decline of the prices of imported raw materials (Japan’s White Paper on International Trade and Industry). In the end, looking at the I-S balance, the current imbalance reflects a domestic I-S imbalance among the countries concerned, and under a free international capital flow regime, the exchange rate itself is deeply affected by the capital flow and interest rates among countries, and the adjustment role of exchange rates to the current balance tends to be diminished (Japan’s Economic White Paper). We should note that in order to solve the problem of external imbalances, it is essential to focus on the structural I-S imbalance of each country.

In the context of the PRC, the current surplus is basically matched by huge excess savings in the household sector. Promoting household consumption is an important policy agenda not only from the perspective of addressing the external imbalance but also of

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PRC enterprises involved in international transactions to retain more foreign currency holdings, and allowing Chinese citizens emigrating overseas to transfer assets to their new places.
making economic growth sustainable. With regard to the direct impact of the appreciation of the renminbi on the PRC’s exports, it should be noted that exports by foreign-invested companies account for more than half of the PRC’s total exports and they may not be seriously affected. Companies importing raw materials and intermediate goods from other countries may offset the impact of the increase in export prices from the decline in import prices. Companies operating in coastal areas where labor costs are already high may mobilize more labor from inland areas. Japanese companies, which dispatch many Japanese expatriates, may convert those staff to cheaper local staff.

6.5.5 Impact on Different Interest Groups

Japan’s experience also teaches us that we should keep in mind the fact that different interest groups are affected by currency fluctuations in a different manner, and that some groups have a big voice and others do not. In the case of Japan, it was undoubtedly manufacturing industries such as steel and machinery that suffered from the appreciation of the yen, and those sectors traditionally had a large political voice. On the other hand, the non-manufacturing industries and consumers that would likely benefit did not have as much political influence, and their views were not necessarily reflected in policy-making. This indicates that it is both important and difficult to ensure fairness and balance among the interests of various groups.

In the PRC, who will benefit and who will lose from the appreciation of the renminbi? It is certain that SOEs and SOBs with no international competitiveness and other export industries, including agriculture, will suffer. Foreign-invested companies in general will also suffer. This may have an effect on FDI as a whole, but not a large one, because many foreign-invested companies are now looking at the huge potential of the PRC marked and are not only

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29 In the PRC, the high proportion of investment to GDP stands out. It has never been lower than 35 per cent since 1983 and recently it stood at more than 40 per cent. While the savings rate of households declined in 2003, it mostly went to investment channels (state bonds and funds) due to the negative interest rates on bank deposits and did not necessarily increase consumption.
looking for cheap labor. Who, then, will benefit? Consumers? What about the political influence of each group? The SOEs and SOBs may have a strong voice. However, as the market economy becomes more mature and people become rich, private enterprises and individual households are becoming increasingly influential.

6.6.6 The Long-Term Impact of Currency Appreciation

Japan’s experience shows that we need to pay attention not only to the immediate impact of the appreciation of the currency but also to its long-term effect on the economy, in particular on the nation’s industrial structure. In Japan, the sharp appreciation of the yen triggered an upgrading or conversion of the industrial structure both in the 1970s and 1980s and made Japan a more advanced or high-value added economy. In the 1970s, traditional leading industries such as textiles, steel, non-ferrous metals and chemicals were replaced by assembly-type industries such as automobiles, electric appliances and machinery. In the 1980s, many Japanese companies started to shift their production lines overseas, while trying to focus domestic production on more high-value added commodities.

In the context of the PRC, the appreciation of the renminbi or the movement to a more flexible exchange rate regime will clearly provide the country with a good opportunity for moving toward a more market-oriented economy. As estimated, the renminbi is now severely undervalued under a fixed exchange rate regime, which distorts resource allocation across countries. An appreciation of the renminbi would help to correct the distortion. However, regarding how much it should be revaluated, different estimates give differing views (we estimate that it is undervalued by 17 per cent in terms of the effective exchange rate). It is difficult for a planned economy to achieve a consensus or to find the answer to where the equilibrium level is. The only answer is to pursue marketization, adopt a more flexible exchange rate regime and let the market find the equilibrium level. However, the exchange rate is much more volatile and sometime more explosive than the price of goods, and this may lead to some economic and political chaos. For example, some people (i.e.,
McKinnon) thought that the ten lost years in Japan related to the sharp appreciation of the yen. Radical price reforms in 1988 in the PRC resulted directly in high inflation, and to a political storm in 1989 that forced the central communist party general secretary to step down. In view of the negative experience of Japan and the successful experiences of gradual reform in the PRC, we think that the PRC should resolutely remain on the road toward a more flexible exchange rate regime with a gradualist principle and let the foreign exchange market explore its equilibrium level in two or three years, to ensure that the economy does not experience a great shock and giving market participants more time to adjust their behavior and gradually adapt to a new exchange rate. From this viewpoint, the principle of controllability, gradualism and balance, which was announced by the PBOC, could be deemed to be a relevant one.
Chapter 7. Conclusion

Since 2001, the revaluation of the renminbi has been a hot topic and many papers have been published. But their conclusions are very different, because they are based on different models, data, and econometric techniques, as well as political considerations. Given the fact that so many differing views have been presented by so many economists, it is very difficult for the PRC monetary authorities to take any action. This encourages us to work on this interesting and challenging topic, in order to put forward something useful for policymakers and market participants. We also hope that this study will contribute to the economic literature. This paper includes seven chapters, and Chapter 4 and 5 constitute the core in this regard. We also look into Japan’s past experience in Chapter 6 to identify lessons that might be useful for policymakers in the PRC.

In Chapter 1, we investigate how the exchange rate regime of the renminbi evolves by classifying the exchange rate regime of Chinese currency into three historical development phases, i.e. from a single official rate regime to a dual track rate system and to a market-based managed floating system. Some characteristics of the exchange rate, and especially their relationships with the trade balance, are observed.

In Chapter 2, we investigate the debates on whether the exchange rate was undervalued and their backgrounds. We look at the diverse voices from foreign governments and international organizations, economists and PRC authorities. Under pressure from international society, the PRC government has reacted very cautiously. PRC Premier Wen Jiabao insisted that when revaluating the renminbi, the PRC should consider not only its impact on the PRC’s interest, but also on neighboring countries and the rest of the world. Exchange rate reform, he stated, should be carried out under the principle of gradualism, controllability, and balance. Zhou Xiaocuan, the governor of the PBOC, claimed that decisions on exchange rate policies should take account of various domestic factors and the balance of payments as a whole, instead of the trade
relation with any particular country. Even before the announcement of the 2 per cent appreciation in July 2005, PRC authorities had gradually tried to lift foreign exchange controls to ease the external pressure.

In Chapter 3, on existing theories of exchange rate determination, we briefly review various existing exchange rate theories, including absolute PPP, Relative PPP, CIP,UCIP, and B-S model, Fleming-Mundell model, F-M-Dornbusch model, Redux model, and PTM model. This review provided help for us in creating a new theoretical framework in Chapter 4.

To overcome some shortages of the existing models and to investigate what and how variables impacted exchange rate, in Chapter 4, “A General Equilibrium Model of the Exchange Rate,” we create a general equilibrium model with two countries (home and foreign) and three sectors (consumers, firms, and intermediate importers).

By solving the profit-maximizing problem, we can obtain the product supply function, investment demand function, export function, import function of each country, and obtain the three equilibrium conditions.

The model shows that the difference between small open countries and big countries is that small countries do not have the ability to carry out an independent monetary policy and control prices, and has to give up control and let the market decide, while a big country is able to carry out an independent monetary policy and to influence prices and usually is reluctant to give up this power. Given the fact that both the PRC and US maintain an independent policy, according to the model, a fixed exchange rate would be desirable. Otherwise, the economy may often be in a state of disequilibrium.

Another theoretical finding relates to the necessary conditions for the existence of a long-run steady-state exchange rate, which states that if the two countries have different long-run economic growth rates, there is no long-run steady-state exchange rate. Since there are different economic growth rates among the PRC, US, Japan and other developed countries, it is difficult to maintain a stable
renminbi exchange rate in the long run. Thus, it is impossible to resolve the issue of the renminbi through a one-time revaluation.

The third theoretical finding is that for the first time, we show theoretically that under general conditions, neither absolute nor relative PPP holds. Relative PPP may hold only in the long run if the two economies having identical economic growths. The condition for PPP to hold is that all elements concerned in the model between home and abroad must be equal.

Considering that the exchange rate may change explosively under external shocks, it is necessary to allow the exchange rate to float in a relatively narrow band around its equilibrium level.

Since the original model is a second order nonlinear difference equation system and clear expressions of the model’s solutions are not available, a restricted six-variable VAR (VEC) model is developed in Chapter 5, considering the PRC’s preferences regarding the trade surplus, foreign exchange reserve and inconvertibility of the renminbi.

One of the most important findings of our empirical study is the degree of undervaluation from 2000, which is estimated to be between 7 per cent and 25 per cent, and on average, 17 per cent.

The other finding of the empirical study is that moderate appreciation has a weak inflation effect in PRC and deflation effect in the US, and little negative effect on the trade surplus of the PRC.

Thus, policymakers should not only consider the direct effect of revaluation, but also the accumulated effect on the economy, when making nominal exchange rate revaluation policies. In terms of the NEER, we estimate that a 7-11 per cent revaluation would be acceptable, given that the PRC hopes to avoid an overvaluation and trade deficit.

Thus, it can be seen that the two per cent revaluation made on 21 July 2005 is in line with the direction of the estimates, although it is less than our estimates and market expectations, and may not be large enough to remove the pressure of the trade surplus. Considering that the PRC must try to avoid speculative attacks by controlling the fluctuation range, and that the undervaluation can be also corrected by inflation and the interest rate, as well as fiscal policy, we expect
that an annual appreciate rate of 3 per cent might be allowed in the coming three years. This would allow each market participant to adjust his or her behavior, and eventually act as a major tool to explore the equilibrium.

The PRC can draw some lessons from the experiences of Japan as outlined in Chapter 6. It is found that the macro economic situation was not as seriously affected as anticipated, and the impact of the currency appreciation on the economy seems to have been overemphasized. Actually, the international competitiveness of Japanese commodities and the adjustability of companies were unexpectedly high, and the trade surplus did not fall but still increased despite the appreciation yen. After the sharp appreciation of the yen, an upgrading or conversion of the industrial structure was triggered and a more advanced or high-value added economy was made in Japan.

The problems incurred by the appreciation were mainly at the structural level and in the financial sector. Following Japan’s experience, different interest groups are affected by currency fluctuations in a different manner. The problems that the PRC will face may be worse than those of Japan, however. Thus, the PRC government should pay greater attention to the impact of the exchange rate on different industries, and especially on property prices, and should adopt remedy measures.

The exchange rate is not the only way to adjust the external balance. The freedom of monetary policy is important. Japan, for instance, could have mitigated inflationary pressure by taking monetary measures in a more timely manner and by leaving the external balance basically to the adjustment of the exchange rate. This point perhaps is particularly important for the PRC.
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