Unification of China's Foreign Exchange Rates*

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Abstract

This paper studies China's foreign exchange system before and after the 1994 unification of the official and swap exchange rates. We analysed the behaviour of the official and overall swap rates and the swap rates of twelve local foreign exchange adjustment centres across the country. Deficiencies as well as achievements before 1994 led to the reform, which significantly improved the efficiency of resource allocation and the monetary control, and is a very important step in the reform sequencing. Success in terms of convertibility, however, remains to be seen. Problems existing under the new system, including restrictions imposed on buyers of foreign exchange and the lack of co-ordinated macro-economic policies, pose potential threats to this fragile emerging market.

Keywords: China, Exchange rate, Swap market, Unification

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The Unification of China's Foreign Exchange Rates

1. Introduction

On January 1, 1994, China took a major step towards currency convertibility by unifying its official and swap market exchange rates. The system of trading foreign exchange through the foreign exchange adjustment centers (FEAC, or swap centers) was replaced by a national interbank foreign exchange market. Obviously, the new system was introduced to overcome the drawbacks of the old system; however, there has been lack of empirical evidence on the efficiency and performance of the swap markets. Questions have also been raised about the implications of the unification for China. For example, in what ways does the unified system improve the efficiency of foreign exchange allocation? Is the People's Bank of China (PBoC) capable of stabilizing the value of the Renminbi (RMB)? Are the impacts of the unification, such as that on currency convertibility, more symbolic than real? In this paper, we study the behavior of the swap rates and the official rate during the pre-unification period, and assess the significance of the unification by comparing the mechanisms of the swap market and the unified market centered around the banks.

Although the old system had many problems, it paved the way for the new unified market. An evaluation of experiences accumulated will help to understand the working mechanism and implications of the new system. Consistent with its gradualist approach to economic reform, the Chinese authorities have been using the foreign exchange swap markets as a testing ground where foreign exchange allocation is guided by market supply and demand since its inception in 1986. The unification essentially expands the coverage of an already sizeable swap market (accounted for 80 per cent of China's current account transactions) to all foreign exchange transactions. Although trading of foreign exchange is now conducted through commercial banks, the previous FEACs are still participants of the interbank trading system.

The swap market was not a totally free market. Heavy administrative intervention, especially restrictions on buyers in the market, twisted the fundamental demand and supply forces. In spite of this, movements of the price in this market still reflected changes in the market conditions. The relationships developed over time between the swap rate and its macro-economic determinants, like money supply, inflation, import and export, and the interest rate provided an economic basis for the unified market rate, and offered valuable experiences towards its management and the control of the macro-economy.

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The paper is structured as follows. In Section 2 we describe and compare the salient features of the institutional mechanisms of the dual and unified exchange rate systems. Section 3 analyzes the behavior of the swap market exchange rates in 12 major FEACs across the country. We study the degree of integration, volatility, and causality relationship of FEACs in various regions. Section 4 examines the macroeconomic linkages between the general level of the swap market rate, the official rate, and other macroeconomic variables. Section 5 assesses the implications of our findings for the unification and its significance. Finally, Section 6 concludes the paper.

2. The Swap Market and the Unified Foreign Exchange Market

2.1 The Dual Exchange Rate System

China's currency, the RMB, has been inconvertible since it became a national currency in 1949. Until the start of the economic reform in the late 1970s, China's foreign trade and foreign exchange allocation were under the direct planning of the central government. Foreign trade plans were carried out by a dozen of foreign trade corporations (FTCs), whose losses and profits were subsidized by and submitted to the central government. The FTCs must surrender all their foreign exchange earnings to and purchase foreign exchange from the central government at the official exchange rate. During this period, the RMB exchange rate served little economic function; it was only a price for budget allocation under the trade plans.

Its development since 1978 has been driven by the country's foreign trade reform. In order to increase the role of market forces and to reduce the burden of state subsidies on foreign trade losses, China started to decentralize its foreign trade and foreign exchange systems in 1979. Subsidies for the FTCs were reduced gradually. A foreign exchange retention system was introduced. Under this system, FTCs were given the right to buy back a certain amount (specified by the retention quota) of the foreign exchange earnings that they surrendered to the central government at the official exchange rate. The retention system led to the establishment of the FEACs[1] in 1986 where enterprises short of foreign exchange could "adjust" their needs by purchasing foreign exchange or retained quotas from the enterprises who had surplus foreign exchange quotas. China thus had a dual exchange rate system. The administered official exchange rate governs transactions under the foreign trade plan and most capital account transactions, and the more flexible "swap" market exchange rate was determined in the FEACs for foreign exchange transactions outside the foreign trade plan.

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[1] See Appendix 1 for a summary of the main features of the FEACs.

The FEACs were purely local organizations established locally, and operating independently from each other. They were subject to the regulations of the local branches of the State Foreign Exchange Administration Bureau (SFEAB), who is subordinated to the People's Bank of China (PBoC, the central bank). The PBoC generally did not buy and sell foreign exchange directly in the FEACs except when the gap between swap and official rates widened sharply, such as in the summer of 1993. However, the SFEAB exerted its control over the swap market rates by imposing restrictions on the access to FEACs. Generally speaking, there were few restrictions on the sales of foreign exchange. In contrast, significant restrictions existed on the purchasing side. Purchases of foreign exchange were subject to the approval of the SFEAB, which checked the conformity of foreign exchange uses with the priorities set by the government. Presentation of valid documents, such as an import license, was also required.

Besides the fact that the FEACs were purely local organizations, several features of their institutional structure also worsened market segmentation. First, the local governments frequently intervened to prevent foreign exchange in their jurisdiction from flowing to other regions, as foreign exchange was an underpriced and scarce resource. This problem was especially serious during periods of tight foreign exchange supply. Evidence of this type of administrative control has been well documented for the Anhui and Liaoning Province (Wang 1992, Tang 1993).

To make the situation worse, systematic information flows among FEACs were nonexistent. Swap centers were not linked together by any communication network. In most cases, prevailing prices in other FEACs were not available to buyers. According to Zhiping Liu (1991), "among the many swap centers, only a few of them will periodically inform each other of their prices. The centers only report their trading prices and volume to the Exchange Rate Division of the SFEAB." The SFEAB, however, was an administrative authority and did not publish the information in a timely manner.

Another source of segmentation arose from the administrative structure of the swap centers. The prefectural swap centers were subordinated to the provincial centers. Transactions between prefectural centers from different provinces had to be conducted through their respective provincial centers. This type of administrative procedure discouraged inter-regional transactions and impeded the efficiency of foreign exchange allocation. Besides, under the foreign exchange retention system, most of the quotas were accrued to the FTCs instead of to the enterprises producing the export goods. Since the retained quotas would not expire, some FTCs had a tendency to hoard the quotas for speculative purposes. Such speculative behavior increased the volatility of exchange rate movements in the swap markets.

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Despite the efforts of local governments to discourage foreign exchange outflows from their jurisdictions, some channels for linkage did exist. First of all, the central government encouraged the centers to build and strengthen connections with one another. A national foreign exchange swap center was established in Beijing to facilitate transactions between government units and between FEACs from different jurisdiction. However, the real driving forces behind the linkages came from the reform of the foreign trade system. With the liberalization of the foreign trade sector, an increasing number of FTCs were made to be responsible for their own domestic currency profits and losses. This provided economic incentives for enterprises and local governments to compete for foreign exchange from FEACs across the country. For example, when the supply could not satisfy demand in Wuxi city in 1990, the Wuxi Swap Center was able to obtained two million dollars from nearby cities (Huang 1990). In another instance, the XinJiang Swap Center adjusted almost one million dollars from other provinces when there was an acute shortage of foreign exchange in the XinJiang Province in 1993 (Financial Times 1994).

Finally, cross-region investment, joint ventures among foreign trade corporations and foreign investment enterprises also provided a channel for linkage among FEACs. Despite the effort to decentralize the trade sector, the huge trade enterprises with cross-regional connections were still dominant players in the FEACs. In regions with large-scale foreign investment, foreign investment enterprises were also very important. For example, of the 43 dealers in the Shanghai FEAC in 1990, 35 were state and collective businesses and nine were foreign investment enterprises (the Shanghai Swap Center 1991). In the Dalian FEAC, 50% of the supply of foreign exchange was from foreign investment enterprises (Financial Times 1993).

Since foreign exchange bought from the swap centers must be utilized according to the purposes specified in the purchasing application, direct arbitrage by enterprises to buy low in one center and sell high in another center was prohibited. Nevertheless, since there was no restrictions on the sale of foreign exchange, a cross-region enterprise could sell foreign exchange at swap centers that offered higher price and use the proceed to cover the loss from buying foreign exchange at a lower rate for import in other regions. The second way to arbitrage was through the movement of goods. If the differential between the exchange rates of two FEACs became wide enough, a cross-region enterprise could import from the region where the swap market exchange rate was lower and ship the imports to the destination where cost of foreign exchange was higher.

2.2 The Unified Foreign Exchange System

On January 1, 1994, China unified its official and swap market exchange rates. The official exchange rate was depreciated from RMB 5.8 to US$1 at end of 1993 to RMB 8.7 to US$1 which was

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the swap rate in Shanghai at that time. The system of FEACs was replaced by a national interbank foreign exchange market. The market is a network of designated foreign exchange banks (DFEB) in 26 major cities, with its headquarters in Shanghai.[2] The retention system was abolished and Chinese enterprises are required to sell all their foreign exchange earnings to and purchase foreign exchange from the DFEBs at the exchange rate quoted by the banks. The exchange rate now is determined in the following way. At the beginning of each trading day, the PBoC publishes the middle rate of the previous trading day. The DFEBs quote their own rates within a range of this rate set by the PBoC. To ensure competitive operation of the market, the foreign exchange balances of the DFEBs must fall within a certain percentage of their foreign exchange assets. Any surplus or shortfall must be eliminated by trading with other DFEBs or the PBoC (Asiamoney, 1994).

The new system has certainly improved the efficiency of foreign exchange allocation since foreign exchange is traded at the unified rate. The elimination of the retention system has made hoarding of foreign exchange by FTCs for speculative purposes no longer possible. On the other hand, the central government's control over foreign exchange resources is strengthened. Chinese enterprises no longer have the proprietary right to their foreign exchange earnings. Meanwhile, despite the "abolishment" of the priority list, purchases of foreign exchange from the DFEBs are still subject to approval and presentation of valid documents. The new system has essentially reduced the availability of foreign exchange outside the control of the central government.

3. Empirical Evidence on the Behavior of Regional Swap Market Rates

In this section, we study the behavior of the swap market exchange rates in 12 most actively traded FEACs in China before the unification. They include the National Center (NC), Beijing (BJ), Tienjin (TJ) and Dalian (DL) in the north, Shanghai (SH), Nanjing (NJ) and Hangzhou (HZ) in the east, Guangzhou (GZ), Shenzhen (SZ) and Xiamen (XM) in the south, and Xian (XI) and Chengdu (CD) in the west. An evaluation of the state of operation in the pre-unification period can put the foreign exchange reform in perspective. As mentioned in the introduction, a certain degree of linkage among the FEACs ensured a smooth transition to the new system.

For comparison purpose below, we select Beijing, Shanghai, Shenzhen, and Chengdu as the *reference center* of their respective regions since they are the relatively better developed centers in their

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[2] See Appendix 2 for details of the reform process.

own regions. Our sample period is from the beginning of 1992 to the end of 1993.[3] We compare the regional standard deviations of the four regions. The results are presented in Table 1.

3.1 Within-Region Integration

First we compare the degree of integration of the four regions. If the swap centers of a region are more integrated than those of the other region, we should expect the standard deviation of the swap rates in the former region to be smaller than that of the latter. In panel I, we compare the mean standard deviation of the four regions over the full sample period. The mean standard deviation of the eastern region is the smallest, while the deviation of the southern region is the greatest. These results confirm the observation that the market in the eastern region around Shanghai is relatively better established. The southern region, however, is less integrated. In panel II, we measure the degree of integration from a cross-sectional perspective. We compare the four regional standard deviations cross-sectionally for each of the 61 observations in our sample. Then we record for each region the number of times its standard deviation is the maximum or the minimum. By almost half of the times (28 out of 61) the standard deviation of the eastern region is the minimum of the four regions, and by one-sixth of the times (10 out of 61) its deviation is the maximum. On the other hand, the southern region is the least integrated of the four regions. It has the highest frequent of maximum and lowest frequency of minimum. The results in Table 1 indicates that significant regional difference exists in terms of degree of integration, indicating that the swap markets might be geographically segmented. We turn to this issue in the next subsection.

3.2 Regional Segmentation

After the regional comparison, we shift our attention to the relationship between individual centers and the four regional reference centers. Such relationship can shed some light on the degree of geographical segmentation in China's foreign exchange swap market. We perform analysis on the mean absolute deviation (MAD) of swap rates of individual centers from those of the four reference centers. The existence of regional segmentation would imply an inverse relationship between MAD and geographical distance. In Table 2 we report the mean absolute deviation of each center's swap rate from the swap rates of the four reference centers and the average rate of the 12 centers. We also compute the *mean* MAD for each region.

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[3] The Chinese government did not report high-frequency swap market exchange rate data until early 1992, and it did not do so on a regular basis at the beginning. Consequently, the frequency of our data set is irregular. There are a total of 61 (mostly weekly) observations from 1992 to 1993, with only seven observations for the first four months of 1992. The summary statistics reported in this section are based on these 61 observations. After eliminating observations with irregular frequency, we have 39 bi-weekly observations from June 1, 1992 to November 15, 1993 to conduct the casualty tests in Section 3.3.

First, let us focus on the <u>mean</u> MADs of the 16 region-reference center pairs (the bold type, italicized figures) in Table 2. Each column of mean MAD indicates the mean MAD of each of the four regions <u>from a given reference center</u>. On the other hand, each row of mean MAD shows the mean MAD of each of the four reference centers <u>from a given region</u>. For the eastern region, there is an inverse relationship between the mean MAD and geographical distance at the regional level. The second row of mean MAD indicates that of the four reference centers, the eastern reference center's rate is the closest to that of the eastern region, followed by the northern, western, and southern reference centers. Moreover, from the second column of mean MAD, of the four regions, the eastern region's rates are closest to that of the eastern reference center's rate, followed by the northern, western, and southern regions.

The patterns of the mean MAD of the northern (first row and column) and (fourth row and column) western regions also support similar inverse relationships, although not as clear as the eastern region. For example, the mean MAD of the northern region is the minimum of column one and the second minimum of row 1. The inverse relationship, however, does not exist for the southern region. The third column of mean MAD actually shows a "direct" relationship between mean MAD and distance.

From the perspective of individual centers, there is evidence of an inverse relationship between MAD and distance (from reference centers) for five centers: the National Center, Beijing, Shanghai, Nanjing, and Hanzhou. In column 5 of the table, we calculate MAD from the average swap rate of the 12 FEACs. Of the four FEACs with the smallest MAD, two are in the north (National Center and Tienjin) and two are in the east (Shanghai and Hanzhou).

In Tables 3 and 4, we examine exchange rate differentials from a cross sectional perspective. In each time period, we measure the deviations and absolute deviations of each swap center's rate from the rates of the four reference centers as well as from the average rate. For each center, we record the reference centers which deviate the most and the least from its swap rate (Table 3). We also record whether the center's swap rate is above, equal, or below the reference centers' rates (Table 4). The results in Table 3 reveal a direct (inverse) relationship between the frequency of maximum (minimum) and the distance for eastern region. These relationships also hold, to a less extent, for the northern region. In Table 4, one can see that the eastern and western regions' swap rates are higher than the average in general. On the other hand, the southern region's rates are the lowest of the four regions.

The results in this section show evidence of market segmentation in China's swap market. The contrasts between the eastern and southern regions are especially sharp. The results also lend support to the belief that eastern region is the center of the swap markets across the country[4].

3.3 Causality Relationship

In this subsection we examine the causality relationship between each of the 12 FEACs and the three reference centers, namely Beijing, Shanghai, and Shenzhen. We first test for the order of integration of the swap market exchange rates. A time series, X_t, is said to be integrated of order d if it is a stationary series after differencing d times. To find out the order of integration of the data used in the causality test, we employ the ADF unit root test suggested by Dickey-Fuller (Dickey and Fuller 1979, 1981). Results are summarized in Table 5. Since the null hypothesis of a unit root in the series cannot be rejected in the level but is rejected in the first difference, all the series are integrated of order one. Accordingly, we conduct our causality tests in the first order difference of the series. In Table 6, we test for Granger-causality for each pair of individual center-reference center in VAR framework, with the adequacy of the lag length checked for serial correlation by using the Lagrange multiplier chi-square statistics.

Several aspects of these results are worth noting. First, contrary to intuition, there are quite a few cases where the more active reference centers' exchange rates are Granger-caused by the smaller, less active individual centers' rates. Usually one would expect the direction of causality to be the other way around. The counter-intuitive results here probably reflects the reality that foreign exchange supplies in smaller FEACs were usually tighter than those in larger, more well-developed ones. As a result, a change in the swap rate of a smaller center could lead to a change in the swap rate of a reference center when the former tries to purchase foreign exchange from the latter. Considering the distance between them and the segmented market structure of the swap markets, the fact that Beijing had causality relationship with Guangzhou, Xiamen, Xian, and Chengdu indicates that the swap markets have achieved a significant degree of linkage. Second, the eastern-region centers were again the most integrated group, either among themselves or with centers of other regions. Shanghai's swap rate Granger-caused those of Beijing, Tienjin, Nanjing, Hangzhou, and was Granger-caused by those of Nanjing, Hangzhou, and Xiamen. As for Nanjing and Hangzhou, they had causality relationship with all

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[4] In fact, we have regressed the absolute swap rate differentials on a constant and a time trend for all pairwise FEACs. Most of the time trend coefficients are positive, although very close to zero and statistically insignificant. This indicates that despite the causality relationships detected in section 3.3, significant administrative barriers reamined to inhibit the development of the foreign exchange swap markets in China.

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the three reference centers. Finally, Shenzhen in the south only had causality relationship with FEACs in its own region and with Nanjing in the east.

4. A Macro-Perspective of the Exchange Rates Behavior Before the Reform

The overtime movement of the official rate and the swap rate during the period 1987 to 1993 is plotted in Figure 1. The swap rate is a weighted average of the major swap centers. The official rate was pegged to the US dollar, with a few major changes. In the third quarter of 1986, it was depreciated from the earliest RMB3.20 per US dollar to RMB3.72 per dollar[5]. In the third quarter of 1989, this rate was depreciated to 4.72. Then in the forth quarter of 1990, it was further depreciated to about 5.2. From 1991 to 1993, a managed floating system was adopted, and the currency was gradually but steadily depreciated to 5.8.

In contrast, the swap market rate exhibited much greater fluctuations. Its movements can be divided into a few stages. It first depreciated from about 5.20 in the first quarter of 1987 to about 6.6 in the third quarter of 1989. It then appreciated to 5.7 in the forth quarter of 1990. From 1991 to the third quarter of 1993, it depreciated, first slowly, then accelerating, to a historically low level of over 10. It came down to about 8.7 after heavy government intervention.

Overall, the gap between the official rate and the swap rate widened in the period 1987 to mid-1989. The gap then narrowed until the two rates came very close. From 1991 to 1993, the gap expanded sharply again. In both cases the gap widened because the official rate was kept steady while the swap rate had depreciations.

Obviously, the official rate and the swap rate behaved in different manners. Their movements were driven by different forces, but they were also related through certain mechanism. The development of the relationships between the official and swap rates and the economic variables provided a foundation for the market rate introduced by the unification, and needs to be examined closely.

4.2 Behavior of the Official Rate

To find out the relationships between the official rate and other major macro-economic variables, we performed pairwise Granger-causality tests. The results are summarized in Table 7. We found: (1) The official rate was significantly Granger-caused by inflation and the swap rate (at the 5 per cent and 10 per cent significance levels, respectively). There was no reverse causality from the official rate to the inflation and the swap rate. (2) Exports were Granger-caused by the

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[5] The exchange rate is quoted as RMB/US$ in this section.

official rate (at the 10 per cent level). This indicates that the depreciation of the official rate provided incentives to exports.

The causality findings conform to historical experience. The depreciation of the official rate was forced by increasing pressures from inflation and from the inflating costs of export goods. Inherited from the centralized planning system, the principle of the central bank in setting the official rate was to refer to the average cost of export goods; i.e., the domestic purchasing price of the goods plus a 13 per cent foreign trade commission. Given the exchange rate set in such a way, the exporting companies, on average, could cover their costs. The problem with such a system was the general losses from export of goods, the costs of which were higher than the average of the exporting firms. Such "policy losses" were subsidized by the government. To restrict the scale of subsidies and the frequency and scale of currency depreciation, higher foreign exchange retention ratios would be allowed, especially for the industries and products with higher costs. For example, after 1988, the industries of machineries and electrical products were allowed to retain 100 per cent of their foreign exchange earnings, in a bid to reduce heavy government subsidies to this industry. Nevertheless, the inflation and inflating export costs would still lead to more substantial losses and fiscal subsidies, and eventually forced the authorities to depreciate the official rate.

A closer look at experiences from two sub-periods supports our above discussion. From 1987 to the third quarter of 1989, the official rate was fixed at 3.72 per dollar. During this period, the official retail sales price increased by about 50 per cent, causing a substantial real exchange rate appreciation, and an increase in the cost of export goods. The foreign exchange retention rate was raised in early 1988 from only 25 per cent to about 70-80 per cent (100 per cent in some cases) for selected industries. The retained quotas were traded in the swap market at a higher rate. This helped cover the rising cost of the export firms. Despite this remedy, the losses and fiscal subsidies were building up. Losses of foreign trade corporations financed by central government budget was over RMB28 billion in 1987, RMB27 billion in 1988, and RMB34 billion in 1989 (World Bank, 1994). The over-valued official rate was forced to depreciate by 27 per cent to adjust the value of the currency to a reasonable level.

The other episode was the 1991-1993 period. The official exchange rate was steadily depreciated under the managed-floating arrangement in response to the accelerating inflation. The depreciation rate (12 per cent), however, was far smaller than the inflation rate (23 per cent). A further rise in the foreign exchange retention rate (to about 80 per cent on average) helped to postpone more drastic depreciation, as exporting firms could cover their losses by selling the

quotas at higher prices. When the official and swap rates were unified on January 1, 1994, the official rate was depreciated to the swap rate level by 50 per cent to count for the built-up inflationary effect.

4.3 Behavior of the Swap Rate

We performed Granger-causality tests between the swap rate and the same set of macro-economic variables used to test the official rate. The results are also summarized in Table 7. The causality tests reveal that the swap rate was significantly Granger-caused by the money supply (at the 5 per cent level) and the interest rate and imports (at the 10 per cent level). The money supply and imports were also caused by the swap rate (at the 10 and 5 per cent levels, respectively). A closer look at the results reveals that while the effects on the swap rate from the money supply and imports were positive, the effects from the swap rate on the money supply and imports were negative (the signs were not shown in the table). These results indicate that (1) while more imports exert pressure on the swap rate to depreciate, a depreciated swap rate discouraged imports; (2) the increase in the money supply forced the swap rate to depreciate, and the depreciation induced the central bank to intervene by tightening up the money supply; and (3) the interest rate had significant causal effects on the swap rate, as it was controlled by the central bank and was usually adjusted along with changes in the money supply.

Historical experience suggests that the swap rate was dominated by the relative supply and demand conditions of the foreign currency and the domestic currency during this period. While the domestic currency was affected by the money supply and the interest rate, the supply and demand of foreign exchange were affected by export and import activities. Since the central bank loosened its control over the swap market in 1987, the swap rate depreciated from about RMB5.6 per dollar in late 1987 to 6.65 in late 1988. This was a result of high money supply growth (increased by 20 per cent), high inflation (18.5 per cent), and strong imports (increased by 28 per cent in comparison to a 20 per cent increase for exports). From late 1988 to late 1989, the swap rate appreciated to 5.9. The immediate cause was the extremely tight money supply enforced in 1989 (with its growth slowed down to only 6 per cent). As a result, many enterprises were forced to sell their foreign exchange in the swap markets, and less enterprises had the RMB fund to buy foreign exchange. Imports increased by only 7 per cent while exports increased by 11 per cent. Steady money supply, improved current account and relatively lower inflation in the period 1990 to 1992 helped to keep the swap rate steady. The swap rate started another phase of depreciation in 1992, reaching an all time low level of 10.1 in August 1993. This was pushed by the strong money

supply (increased by 38 per cent in 1992 and 25 per cent in 1993), high inflation (13 per cent in 1993) and inflation expectation, and strong import demand (increased by 26 per cent in 1992 and 29 per cent in 1993).

5. Significance and Prospect of the Unification

5.1 Significance

The unification and the new market rate are well-founded on the market environment developed during the swap market era, and are pushed by the deficiency of this environment. Empirical results in Sections 3 and 4 revealed such deficiencies and the urgent need for reform of the swap market system. The swap market before unification was characterized by a significant degree of regional segmentation, especially between the eastern region and the southern region. The rigid, segmented administrative structure did not appear to inhibit the development of the swap markets. The statistically significant causality relationships existing between the swap rates of the major FEACs and other centers' suggest that a more effective foreign exchange allocation mechanism is called for. On the other hand, the relationships established between the swap rates and the fundamental macroeconomic variables also call for a better market environment, and urge the authorities to coordinate their monetary and fiscal policies.

The unification has brought a few significant improvements to China's finance and trade system. As we discussed in Section 2, one of the most important changes is the improvement in resource flow. In contrast to the segmented local swap markets which accept only local participants and sell foreign exchange only for local uses, the new interbank market has unified all the local markets into a single national market. This market facilitates nationwide resource flows, and has eliminated regional differences in the exchange rate. No more arbitrage opportunity exists. Buyers and sellers across the country face the same market conditions.

There have also been substantial improvements in the market microstructure. Before the reform, except for following a few guidelines issued by the SFEAB, the FEACs were local organizations operating independently. They lacked a uniformed and well-established institutional structure, standard trading and settlement practices, an efficient information system, and a competent regulatory framework. In contrast, the reform has introduced a nationally unified market which is based on the major banks, centralized regulations, an electronic trading and information system, and standard trading and settlement practices. All these improved the microstructure of the market, and have helped raise the efficiency of the market.

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Broader coverage of the market rate is achieved as a direct consequence of the unification of the official rate and the swap rate. Before the reform, 80 per cent of foreign trade was covered by the swap rates. The unification has extended the coverage of the market rate to all international payments and capital flows. This provides a strong encouragement to China's international trade, as export earnings are no longer taxed by the official rate. It also encourages foreign direct investment in China (which was also converted at the official rate before the reform). Following the unification, China's foreign exchange reserves were almost doubled from US$21.2 billion at the beginning of 1994 to over US$50 billion at the end of the year. During this period, the current account surplus was about 5 billion dollars (the current account suffered a 12 billion dollar loss in 1993). Capital inflow contributed most of the increase in reserves. The removal of the uncertainty of devaluation of the official rate and the relatively higher interest rates in China attracted capital inflows. For example, in December 1994, while the interest rate of one-year time deposits was about 6 to 7 per cent in the US and Hong Kong, this rate was almost 11 per cent in China. The inflation-indexed interest rate for three year time deposits reached 22 per cent.

Mechanism for monetary control and foreign exchange market intervention has also been greatly improved. First, the level of money supply no longer adjusts passively to foreign exchange buying and selling. Under the foreign exchange retention system, what was retained by enterprises were foreign exchange quotas. According to the foreign exchange regulation, foreign exchange had to be sold to the central bank upon reception, and be bought from the central bank for importing and other international payment purposes. The country's foreign exchange earnings and uses thus directly affected the monetary base and the money supply. In contrast, under the new system, foreign exchange should be sold to and bought from the commercial banks, hence is delinked from the monetary base. Theoretically speaking, there should be no more direct linkage between foreign exchange earnings and uses and the money supply[6]. This reverses the passive role of the central bank.

Secondly, the new system empowers and calls on the central bank to intervene. As we showed above, under the old system, the official rate was not directly affected by the money supply. Although there was a relationship between the general level of the swap rate and money

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[6] However, because the foreign exchange balances of these banks could not exceed a certain limit (see Subsection 2.2), lots of foreign exchange still ended up in the hands of the central bank. In 1994, expansion in China's monetary base and money supply was mainly caused by the central bank's foreign exchange purchase.

supply, the various local rates, the lack of a common market, and the existence of a relatively fixed official rate made this relationship less conspicuous. Besides, since the power for and duty of monetary control were largely concentrated in the hands of the headoffice of the central bank, the local authorities did not have much incentives, nor the instruments, to intervene in the segmented local swap markets. Due to the lack of coordinated macro monetary policies, administrative measures (typically buyer restrictions and moral persuasion) tended to be used by local authorities in their intervention in the local swap markets. After the unification, the interbank market enables the central bank to intervene by buying and selling foreign exchange in this market.

The unification has significant implications for raising the efficiency of China's banking and foreign trade industry. To the commercial banks that had been separating their domestic fund operations from foreign exchange operations, the new interbank foreign exchange market enables them to combine such operations together, thus improving their asset-liability management and the efficiency of loanable funds. To the foreign trade industry, the foreign exchange retention system, the foreign exchange planning, and the overvalued official exchange rate together formed the biggest obstacle to further reforms. Their abandoning will significantly raise the competitiveness, freedom, and incentives of the exporting enterprises.

Looking from a wider perspective, the unification is a milestone in China's market-oriented economic reform sequencing[7]. Because the foreign exchange system is integrated with the financial system and the foreign trade system, its reform will lend support to and require further financial and foreign trade reforms. The stable currency environment the unification has brought about is also beneficial to the reforms and to the economic growth.

5.2 Prospect

The unification is a step in the right direction in making the Renminbi fully current account convertible. As we mentioned above, the new system has strengthened the authorities' ability to exercise macroeconomic control, has provided a more efficient trading mechanism for foreign exchange, has increased the economic incentives for foreign trade, and has restored the foreign exchange reserves. The eventual elimination of all existing administrative regulations to achieve full current account convertibility depends on many conditions and considerations, including the state of the fiscal budget, the

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[7] For further discussions of reform sequencing see, for example, McKinnon (1991, 1973), and Krueger (1986).

maturity of the interbank financial market, the success of enterprise reform, and the establishment of laws to clarify property rights, etc[8].

Nevertheless, in spite of the achievements of the unification, we hold the view that it is still too early to declare the reform a success, as substantial (instead of superficial) changes remain to be seen.

First of all, the reform has not yet made any substantial improvement on the convertibility of the currency, which is the ultimate target of the reform. The new market rate is essentially only a unified swap rate with an expanded coverage and a better market environment. Restrictions prevailing before the reform, including those on imports and on capital outflows, have been retained so far. Buyers of foreign exchange still need to hold a "valid certificate," which is controlled by the authorities according to state priorities. Limited capital account uses were permitted under the old system, and such limitations have been kept so far (see Appendix 1).

The biggest obstacle to the improvement of convertibility is the reliance of the authorities on restrictions of foreign exchange purchases and uses to manage the market exchange rate. Earlier we found that import activities had significant effects on the swap exchange rate. Administrative control over imports was the main instrument the local authorities used to regulate the swap rates. The new market exchange rate, similarly, can be conveniently adjusted by controlling imports via restricting buyers and uses of foreign exchange. Nevertheless, limiting imports and capital outflows means limiting the convertibility of the currency. If import control becomes an instrument for exchange rate control, then the degree of currency convertibility will vary according to market conditions.

Higher convertibility means a reduction in restrictions on buyers in the market. If a steady currency is targeted, the phase-out of these restrictions as a major market intervention instrument needs the support of credible and coordinated monetary and fiscal policies and experienced interbank market intervention. Unfortunately, such policy coordination is still new to the authorities. The swap rates and the swap markets were regarded as secondary and supplementary to the relatively fixed official rate before 1994, and thus were not given timely consideration by the central monetary authorities in deciding their monetary and fiscal policies. It will become more obvious in the unified market than in the segmented swap market that the exchange rate is

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[8] For further discussions on this topic see, for example, Calvo and Frenkel (1991) and Polak (1991).

determined by the relative supply and demand of the foreign currency and the domestic currency. Tight supply of the domestic currency and weak demand for imports will push the rate to appreciate, while loose supply of the domestic currency and strong demand for imports will put pressure on the currency to depreciate. Since the currency is still overvalued at the present (evidenced by the restrictions on imports), the support of a relatively tight policy is needed. In this sense, the market rate put a new constraint on the central bank's monetary operations.

To conclude, success of the unification ultimately depends on to what extent the restrictions on market access can be removed, and to what extent the monetary and fiscal policies can be coordinated with the move towards higher convertibility. A combination of loose money supply and more restrictive control over the buyers in the market is dangerous, as it will turn the market rate back to another unrealistically over-valued official rate, similar to the one existed before the reform. Should this happen, the new market would be even worse than the swap markets, as the enterprises, at least, had a dual rate system and retained quotas as a buffer before the reform.

6. Summary

In this article we studied China's foreign exchange system. We analyzed problems associated with the behavior of the official rate and the swap rates across the country and the achievements realized that led to the significant 1994 reform, and evaluated the significance of the unification.

China started with a single exchange rate entering the 1980s. It then adopted a dual exchange rate system featuring the foreign exchange retention system and the swap markets in the mid-1980s. The retention system and the swap markets were introduced to compensate for the costs of the exporting firms, to give them incentives, and to allow enterprises limited access to foreign exchange for importing purposes. As time and reforms went on, this system generated enormous chaos, deficiencies, and problems that destroyed itself. It also established market connections and accumulated experiences. All of these led to the 1994 reform.

On the micro-level, the operation of the swap market was characterized by deficiency and market segmentation. The eastern and northern regions apeared to have reached a certain degree of maturity before unification. The unified system has provided an interbank market to facilitate the flows of foreign exchange resources. It has also extended the coverage of market exchange rate to all foreign exchange transactions. The elimination of the retention system has reduced the availablity of foreign

exchanges outside the control of the central government. This helps to consolidate all foreign exchange transactions into a single market, instead of spreading out the transactions in the official, swap, and black foreign exchange market as before the reform.

On the macro-level, we see that the official rate and the swap rate followed different rules in their movements, and no pattern was found in the width of the gap between them. The step-by-step depreciation of the official rate was forced by inflation and the inflated costs of exported goods, and provided incentives to export. The fluctuation of the swap rate, in contrast, closely followed the movements in money supply, the interest rate, and the imports, and also caused changes in imports and money supply. The swap rate led the official rate in the depreciation process. The gap varied over time, reflecting the degree of over-valuation of the official rate. Losses of the exporting companies suffered under the over-valued official rate was compensated by heavy fiscal subsidies and by the retained foreign exchange quotas which could be sold at the more depreciated swap rates.

The 1994 unification of the different swap rates and the official rate showed the determination of the authorities to end the chaos of the system, the poor efficiency of resource allocation, and the poor macro-economic control. The reform is an important step in the economic reform sequencing, and has significant implications for China's market oriented financial and foreign trade reforms. Nevertheless, although the institutional structure for a market has been established, it remains to be seen whether the reform is a real success. If the so-called market rate is managed (by controlling buyers in the market) at a much over-valued level and the domestic monetary and fiscal policies fail to be coordinated, then this rate will easily become another pre-reform official rate. Should this happen, it would contradict the ultimate target of the reform (full convertibility), and would be a situation even worse than the swap market era in many respects. In that case, a new black market would possibly develop again.

Appendix 1. Main Features of China's Foreign Exchange Swap Market

Participants	All state, collective, foreign-investment, and private enterprises and businesses in the region may participate. Self-employed business people and households may sell their foreign exchange in this market, but they are not allowed to buy foreign exchange. The central bank is represented in the market. It buys and sells foreign exchange to stabilize demand and supply around certain price range.
Organization	A membership system is adopted. Only members may bid and ask in the market. Non-members cannot trade directly in the centers, and must trade through their brokers. There are two types of memberships: (1) Brokers. They are banks and non-bank financial institutions that hold a Foreign Exchange Businesses Permit issued by the SFEAB. They can only trade as agents for their clients. (2) Dealers. These are non-financial institutions that participate in foreign exchange operations. They can only trade for themselves. Application for memberships must be submitted in writing to the local branch of the SFEAB. Upon approval, each member possesses one seat in the center, and may send up to two representatives, who must be holders of a certificate issued also by the SFEAB.
Qualified sources of foreign exchange	Retained foreign exchange quotas and foreign exchange by foreign exchange earning enterprises engaged in trade and non-trade activities; foreign exchange income of the foreign investment enterprises; and foreign exchange owned by self-employed business people and individuals.
Qualified uses of foreign exchange	Top priorities: the import of agricultural input goods, necessary goods for living, input goods for key projects, foreign exchange earning production, high-tech equipment, repayment of principal and interest of foreign debts, and profit repatriation. Secondary priorities: input goods for industrial production, goods for research, education, health care, culture, business needs of foreign investment enterprises, repayment of foreign currency loans made by domestic financial institutions, etc. Typically, import of luxury consumption goods and funding for foreign exchange investment of domestic enterprises in and outside the country are not entertained.
Currencies traded	US dollar, Great British pound, German mark, French franc, Japanese yen, and Hong Kong dollar. Foreign exchange quotas are denoted in the US dollar.
Pricing	The price is determined principally by demand and supply conditions through a bidding process. The price for quotas is determined as the difference between the US dollar (cash) swap rate and the current official price.
Trading process	Both the buyers and sellers must get approval in advance from the local branch of the SFEAB, and holding a certificate certifying a specific sales or purchase. The buyers and sellers can then either apply for trading directly or ask a broker to make a trading application to the swap center, upon presenting the SFEAB certificate. The swap center will pool all the qualified applications together and have trading sessions. The member's name, trading quantity and price will be published. When the bid price is lower than the ask price, the bidding will go on, and the bidder and asker will adjust their original prices. When the bid price is higher than the ask price, the highest bid wins.
Delivery and settlement	A sum of guarantee money must be paid up before the trading. The broker is responsible for non-member's delivery and settlement. The swap center takes care of dealers' delivery and settlement. So the non-members and the dealers should deposit enough RMB or foreign exchange guarantee money into special accounts held with the broker and the center, respectively. Settlement of transactions must be completed before noon of the next business day.

Appendix 2. Main Features of the Unification of Exchange Rates in 1994

Main contents of the reform package	(1) Unifying the exchange rates, and implementing a market-based, managed-floating exchange rate. The official rate was depreciated from RMB 5.8 to US$1 at end of 1993 to RMB 8.7 to US$1 (which was the swap rate at that time) on January 1, 1994. The official rate has been determined principally by the foreign exchange market ever since then. (2) Replacing the foreign exchange retention system with a system where foreign exchange should be sold to and bought from the commercial banks (under the retention system, foreign exchange was sold to and bought from the central bank). Compulsory plans governing the foreign exchange income and uses were abolished. The demand for and supply of foreign exchange were matched through the foreign exchange market instead of through the plans. (3) Establishing a nationally unified inter-bank foreign exchange market to replace the local and segmented swap centers, and introducing a computerized trading and information system. This market helps adjust the foreign exchange positions of the banks, and providing clearing services.
The first stage: January 1 to March 31, 1994	Before a well-established foreign exchange market which is centered on banks was established, the major swap centers across the country were retained for transitory purposes. In the period January 1, 1994 to March 31, 1994, the exchange rate was determined as follows. The swap centers remained functioning; but they had to refer to the rate of the swap market in Shanghai in determining their own rates. The regional centers should be active in trading with other regions. This regulation largely unified the earlier different rates across the country, leaving only minor variations. The official RMB to US dollar rate was published by the People's Bank everyday, the calculation of which was based on the weighted average price of 18 swap centers throughout the country in the earlier business day. All foreign exchange transactions were settled according to this price.
The second stage: April 1 to July 31, 1994	(1) The market is centered around banks instead of around the swap centers. Foreign exchange should be sold to the designated banks and be bought from them (providing they hold valid certificates). The banks form an inter-bank foreign exchange market in adjusting their positions. The central bank intervenes in the inter-bank market by buying and selling to affect the exchange rate. The swap centers will phase out gradually. (2) The official exchange rate is determined daily based on the weighted average inter-bank rate. The designated foreign exchange banks buy and sell foreign exchange within a floating range of the official rate. The inter-bank market guarantees that rates of different banks will not differ by a big margin. (3) Computerized national trading system was established to connect different regions and banks, and to speed up clearing and settlement. (4) National-unified regulations on the foreign exchange market were put into operation.
The third stage: post July 1994	Foreign investment enterprises were adopted into the foreign exchange market centered on banks. In the first and second stages, they remained buying and selling foreign exchange through the swap markets and were allowed to continue to keep their foreign exchange in designated accounts (instead of selling it to a bank). This was meant to guarantee the access of foreign investment enterprises to foreign exchange and to consolidate their confidence before the new system was well-developed.

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Appendix 3: Data Sources

Except specified otherwise, data used in this paper are taken from (1) Financial Times, various issues; (2) China Finance, various issues; (3) International Financial Statistics, various issues; (4) China Statistical Yearbook, various issues; (5) China Financial Outlook, People's Bank of China (1994); (6) China: Foreign Trade Reform and China: Internal Market Development and Regulation, World Bank (1994).

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Table 1. Regional mean standard deviation

I. <u>Time series comparison</u>		
	<u>Mean standard</u>	
	<u>deviation</u>	
North	0.110	
East	0.076	
South	0.135	
West	0.093	

II. <u>Cross sectional comparison</u>		
	<u>frequency</u>	<u>frequency</u>
	<u>of Maximum</u>	<u>of Minimum</u>
North	17	13
East	10	28
South	20	4
West	14	16

Table 2. Mean absolute deviations (MAD)

	reference centers: Individual centers:	Beijing (North)	Shanghai (East)	Shenzhen (South)	Chengdu (West)	Overall average
Northern Region	National Centre	0.094	0.120	0.153	0.121	0.074
	Beijing		0.120	0.167	0.157	0.104
	Tianjin	0.134	0.092	0.142	0.118	0.069
	Dalian	0.152	0.159	0.138	0.146	0.105
	mean MAD	*0.127*	*0.123*	*0.150*	*0.136*	*0.088*
Eastern Region	Shanghai	0.120		0.161	0.148	0.085
	Nanjing	0.156	0.103	0.195	0.151	0.113
	Hanzhou	0.118	0.072	0.146	0.129	0.073
	mean MAD	*0.131*	*0.088*	*0.167*	*0.143*	*0.090*
Southern Region	Guanzhou	0.138	0.134	0.153	0.114	0.100
	Shenzhen	0.167	0.161		0.156	0.109
	Xiamen	0.204	0.226	0.186	0.191	0.171
	mean MAD	*0.170*	*0.174*	*0.170*	*0.154*	*0.127*
Western Region	Xian	0.168	0.129	0.186	0.132	0.111
	Chengdu	0.157	0.148	0.156		0.097
	mean MAD	*0.163*	*0.139*	*0.171*	*0.132*	*0.104*

Note: The mean MAD of each region - reference center pair is the arithmetic average of the MAD of each swap center in the region from the reference center.

Table 3. Frequency of maximum and minimum absolute deviations

	ref center / ind center	Frequency that maximum absolute deviation is from:				Frequency that minimum absolute deviation is from:			
		BJ (NORTH)	SH (EAST)	SE (SOUTH)	CD (WEST)	BJ (NORTH)	SH (EAST)	SE (SOUTH)	CD (WEST)
North	NC	10	12	18	21	31	11	8	11
	BJ		16	23	22		29	17	15
	TJ	13	9	24	15	18	19	8	16
	DL	15	17	17	12	18	15	15	13
East	SH	16		22	23	29		16	16
	NJ	14	8	26	13	16	22	11	12
	HZ	15	9	21	16	15	26	19	11
South	GZ	14	13	20	14	17	16	13	15
	SZ	20	19		19	20	15		23
	XM	8	19	16	17	24	8	11	17
West	XI	14	11	19	16	11	17	10	22
	CD	16	20	25		21	19	21	

tes: (1). NC = National Center, BJ = Beijing, TJ = Tienjin, DL = Dalian, SH = Shanghai, NJ = Nanjing, HZ = Hanzhou, GZ = Guanzhou, SZ = Shenzhen, XM = Xiamen, XI = Xian, CD = Chengdu.

(2). The figures for each individual center are the frequency of maximum (the first 4) & minimum (the last 4) absolute deviation over the sample period that can be traced to each of the 4 regional reference centers

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Table 4. Frequency of signs of deviations

ref center / ind center	AVERAGE			Beijing (NORTH)			Shanghai (EAST)			Shenzhen (SOUTH)			Chengdu (WEST)		
	>	=	<	>	=	<	>	=	<	>	=	<	>	=	<
North NC	23	0	38	26	0	32	17	1	43	34	3	24	24	2	35
BJ	22	1	38				14	6	41	34	4	23	18	4	39
TJ	40	0	21	40	9	12	26	7	28	46	0	15	31	6	24
DL	23	1	37	28	7	26	16	7	38	30	0	31	21	4	36
East SH	42	0	19	41	6	14				49	0	12	30	4	27
NJ	47	0	14	47	4	10	39	2	20	45	3	13	28	4	29
HZ	45	0	16	41	6	14	34	8	19	46	1	14	30	5	26
South GZ	22	0	39	28	2	31	10	5	46	29	3	29	16	2	43
SZ	21	0	40	23	4	34	12	0	49				26	2	33
XM	13	0	48	18	2	41	10	1	50	27	0	34	16	1	44
West XI	43	0	18	42	1	18	34	1	26	44	0	17	42	2	17
CD	35	0	26	39	4	18	27	4	30	33	2	26			

Note: (1). For each individual center-reference center pair, the three numbers reported are, in order, the frequency that X - Y is greater than (>), equal to (=), or less than (<) zero over the sample period (61 observations), where X is the individual center swap rate and Yt is the reference center swap rate.

(2). see note(1) of table 3

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Table 5 Unit root tests

Variable	DF	ADF (lag)	Variable	DF	ADF (lag)
NC	-2.0075	-1.5689 (2)	ΔNC	-6.7701**	-6.5824**(1)
BJ	-1.9605	-1.5847 (2)	ΔBJ	-6.6889**	-6.6406**(1)
TJ	-2.1196	-1.9965 (1)	ΔTJ	-6.8299**	-6.2004**(1)
DL	-1.6439	-1.4800 (2)	ΔDL	-5.4384**	-5.9279**(1)
SH	-1.9342	-1.6487 (2)	ΔSH	-5.7266**	-6.1405**(1)
NJ	-1.8056	-1.8799 (1)	ΔNJ	-4.6632**	-4.7733**(1)
HZ	-1.8829	-1.6732 (2)	ΔHZ	-6.3434**	-6.5681**(1)
GZ	-1.8777	-1.4997 (2)	ΔGZ	-6.3593**	-6.3028**(1)
SZ	-1.8214	-1.4695 (2)	ΔSZ	-6.5984**	-6.3239**(1)
XM	-1.9353	-1.5151 (1)	ΔXI	-8.9118**	-6.6510**(1)
XI	-1.9140	-1.6226 (2)	ΔXI	-5.9254**	-5.8951**(1)
CD	-1.7119	-1.4262 (2)	ΔCD	-5.9380**	-6.8444** (1)

Notes:

(1). Numbers reported are the value of the calculated t-ratio of 'b' in the Dickey Fuller (DF) & Augmented Dickey Fuller (ADF) tests.

DF test: $\Delta X_t = a + bX_{t-1} + e_t$

ADF test: $\Delta X_t = a + bX_{t-1} + \sum_{i=1}^{m} C_i (X_{t-i} - X_{t-i-1}) + e_t$

(2).
Critical values are taken from Mackinnon (1990)

** denotes statistical significance at the 5% level

For DF test,   5% critical value = -2.94

For ADF test, 5% critical value = -2.9422 when m=1

　　　　　　5% critical value = -2.9446 when m=2

(3).   See note (1) of Table 3.

Table 6. Granger - causality tests

ref \ ind	NC	BJ	TJ	DL	SH	NJ	HZ	GZ	SZ	XM	XI	CD
BJ	3.08* / 0.008	(self)	1.237 / 0.38	6.035** / 1.32	7.05** / 0.248	39.25** / 6.44**	7.452** / 0.812	2.89* / 0.0077	0.439 / 0.149	8.83** / 0.424	5.674** / 0.32	5.534** / 0.8
SH	1.411 / 1.804	0.248 / 7.05**	0.65 / 3.79**	0.626 / 1.537	(self)	23.90** / 5.36**	4.06* / 3.126*	1.1 / 0.827	0.971 / 0.919	4.53** / 2.77	0.092 / 0.625	0.712 / 0.048
SZ	0.094 / 0.715	0.15 / 0.439	0.576 / 0.059	1.474 / 0.071	0.919 / 0.971	6.85** / 0.908	3.56* / 2.149	2.91* / 3.06*	(self)	2.73* / 0.973	0.472 / 0.622	1.04 / 0.114

Notes: The two figures reported in each cell are the F statistics of the Granger causality tests between the corresponding individual center (the column variable) and reference center(the row variable). The upper right(lower left) figure is the F statistic of the null hypothesis that the individual (reference center) center does not Granger cause the reference (individual) center. * denotes significance at 10%. ** denotes significance at 5%

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Table 7. Granger- causality test results: 1987.1 - 1993.4

	Offical rate	Swap rate	Interest rate	Inflation	Imports	Exports	Money	Int'l reserve
Offical rate		3.47* (1.05)	1.75 (1.09)	7.56** (1.72)	1.41 (0.61)	0.46 (3.57*)	0.94 (2.39)	1.09 (1.30)
Swap rate	1.05 (3.47*)		4.67* (1.62)	1.64 (10.48**)	3.93* (3.36*)	1.59 (0.21)	6.51** (6.56**)	1.67 (1.78)

Note: The two figures reported in each cell are the F statistics of the Granger causality tests. The upper right(lower left) figure is the F statistic

of the null hypothesis that the variable in the row (in the column) is caused by the variable in the column (in the row).

* denotes significance at 10%. ** denotes significance at 5%. Data used are seasonally adjusted and log-transformed.

Figure 1. The official and swap exchange rates