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Foreign Exchange Rate Reform, the Balance of Trade and Economic Growth: An Empirical Analysis for China

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This paper aims at assessing China's foreign exchange reform and the impact of its currency devaluation on the balance of trade. Our empirical results suggest that China's economic reform has improved the sensitivity of the economic system and made it responsive to market signals to allow changes in the exchange rate to influence the trade balance in the long-run. However, the effect of the real effective exchange rate on the real trade balance appears to be moderate. The dual exchange rate system adopted in the mid-1980s, mitigated the impact of the exchange rate unification, facilitated the move towards an equilibrium level of exchange rate.

I. Introduction

In the past two decades China has transformed itself successfully from a rigid centrally-planned economy to an increasingly open and market-oriented economy, with GDP growing at an annual average rate of nearly 10%. The path and forms that China took to transform its economy were far from conventional. China's reform centred on improving incentives, hardening budget constraints and creating competition by regional decentralization of government and adopting a dual-track approach to market liberalization. This approach determines that China's reform has been partial, gradual and experimental in nature.

With the implementation of its "reform and opening up" decision made in 1978, China has successfully broken through the state monopoly of foreign trade and achieved significant progress in trade liberalization. Direct administrative controls of foreign trade have been substantially reduced, while trade has been conducted increasingly in accordance with its comparative advantage (Zhang (1997)). In line with its foreign trade system reform, China's foreign exchange reforms since 1978 have aimed to achieve a more realistic exchange rate for its currency through a dual-exchange rate system and successive devaluation of the Renminbi (RMB) as a means of promoting exports and the balance of trade in the 1980s and the early 1990s. The unification of China's two main currency rates at the beginning of 1994 and the deregulation on foreign invested enterprises in exchanging funds freely at selected banks without approval from

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the State Administration for Exchange Control (SAEC) early 1996 led eventually to the unconditional convertibility of RMB on current account transaction at the end of 1996. China's foreign exchange system has been, since the mid-1980s, classified as a more flexible management system.[1]

In this paper we first review the process of China's foreign exchange rate reform, and then assess empirically its impact on China's balance of trade and the economic development. We set the hypothesis and empirically test if China's economic reform started in 1979 has produced an economic system which was sufficiently responsive to market signals to allow changes in the exchange rate to influence the trade balance. We also shed light on the effects and implications of the foreign exchange rate unification at both micro- and macroeconomic level.

II. China's Foreign Exchange Policy and Reform

1. Exchange Rate System Prior to Unification in 1994

Since it became a national currency in 1949, the RMB has been fixed and inconvertible. With market isolation from the outside world, the role of the RMB was limited to an accounting tool and a means of planned resource allocation. It could neither respond flexibly to the change of price parities between China and the rest of the world, nor make prompt adjustment according to the changing supply and demand of foreign exchange. This is actually associated with the state monopoly of China's foreign trade regime under which all import and export contracts with foreign firms could only be signed by a dozen authorized import and export corporations. These foreign trade corporations (FTCs) in turn had to surrender all their foreign exchange earnings to and purchase foreign exchange from the Bank of China at the official exchange rate. Any profit or loss by FTCs was absorbed by the state budget as either profit delivery or subsidy. Conspicuously, traders under this regime had no incentives to make trade adjustments in response to prices changes and exchange rate policy. The changes in the official exchange rate would simply redistribute financial profits and losses among different import and export products and thus among various individual FTCs, and would not affect the overall balance of trade (Lardy (1992)).

Since 1978, China has attempted at least four times to reform and liberalize its foreign trade management system (Zhang (1997)). Major progress was made in the last two decades on breaking of the traditional "air-locked" system between domestic enterprises and the world markets by decentralizing trading rights and introducing the agency system in the early 1980s; increasing trading enterprises' initiative and autonomy and allowing them to assume independent responsibility through the contract responsibility system (CRS) since the late 1980s; liberalizing import control system by reducing substantially tariffs and import licences, preparing for its regaining of membership in

1. Since 1987 the exchange rate of RMB has been formally classified by IMF as a more flexible arrangement (other managed float).

GATT/WTO in the 1990s.

Driven by the foreign trade reform, China's foreign exchange reform went through two major stages: During the first stage (1979-1993) it focused on gradually bringing realism to China's foreign exchange policy through improving incentives and adopting a dual foreign exchange rate system. During the second stage (since 1994) China unified the foreign exchange market and made its current account convertible. The whole process of reform was gradual, smooth and remarkably successful. The Chinese experience of foreign exchange reform provides a good example for other interested economies to study.

In order to improve incentives and promote export performance, China introduced a foreign exchange retention system in 1979 and "Internal Rate for Trade Settlements (IRTS)" on January 1, 1981, in addition to the official exchange rate. Under the foreign exchange retention system domestic economic units contributing to foreign exchange earnings were allocated a foreign exchange use quota in proportion to the foreign exchange earned. This system has since then evolved with a complex set of regulations on allocating foreign exchange according to industry and location before a uniform retention rate for enterprises was set throughout the country by 1991.[2] During the early 1990s, experiments with cash retention were conducted in some areas such as in Hainan, Shanghai, and Shenzhen. As a result, the volume and share of retained foreign exchange earnings by local governments and enterprises increased dramatically. For instance, "(f)or the seven years 1980-6 total retentions were $46.6 billion... By the mid-1980s 42% of all foreign exchange was in the hands of the provinces and export producers, only 58% was controlled directly by the central government..." (Lardy (1992, p.57)).

The IRTS was calculated from the average cost of earning a unit of foreign exchange through exports and was set at RMB2.8 to the US dollar. This contrasts with the official rate of RMB1.5 to the dollar. It implied a *de facto* devaluation of the RMB by about 50% against the US dollar for FTCs. The IRTS was essentially for the internal settlement of trade transactions, while the official rate was for non-trade transactions. Since 1981, the official exchange rate was devalued frequently, sometimes on a large scale, but the internal rate had been kept relatively stable. The dual rate system was abandoned in 1984 when both rates were at par, namely RMB3.71 per dollar.

In 1986 China established the foreign exchange adjustment centres (FEACs), or swap centres as termed by the literature, where approved enterprises were permitted to buy and sell retention quotas at the market rate. Prior to the foreign exchange rate unification in 1994, there were 110 swap centres established in China's major cities. Under the parallel exchange market system, in-plan trade and above-plan trade were essentially conducted at two different exchange rates, i.e., the administered official exchange rate and the market-determined swap rate at the centres. From 1991 all citizens

2. The foreign exchange retention ratio varied among localities in the early 1980s, 50% in the coastal regions and 100% in the SEZs. On average about 25% of foreign exchange earned was allocated. In February 1991 the government changed its policy to allow exporters (other than foreign-funded enterprises) to receive retention quotas for 80% of their foreign exchange earnings, while 100% for mechanical and electronical products. These retention quotas were distributed to foreign trade corporation (60 percentage points), the supplying enterprises (10 percentage points), and the local government (10 percentage points).

were allowed to sell their foreign exchange at the swap centres, but their access to purchases of foreign exchange was still restricted.

The introduction of the dual exchange rate system was actually both a consequence of and a response to China's partial, gradual market-oriented reforms. First of all, the establishment of the swap centres provided an innovative mechanism, sort of internal convertibility of the domestic currency, for the reallocation of foreign exchange to meet the demands of a diverse group of importers (Lardy (1992)). Importers in this type were market-driven and could not get foreign exchange at the official rate. They would be willing to pay a market like price for foreign exchange at the swap centres to finance their imports.[3] Then, the dual exchange rate system exhibited enhanced incentives for exporters in line with the retention system, allowing more flexible pricing for above-plan exports. After freer trading was permitted in 1988, the premium on exchange rates in the swap centres rose to about 80%. This provided an additional incentive for exporters to sell goods on the international market and to convert their foreign exchange earnings into domestic currency at a more favourable swap rate than the official one. However, one may still have to observe that the overvalued official exchange rate bestowed on the users of imported goods and made the goods available at a lower price on the domestic market than would have been at an equilibrium rate. Finally, as the proportion of foreign exchange retained and traded by local authorities and enterprises increased, the role of the swap centres as a means of converting foreign exchange became significant. By 1992, an estimated 80-85% of all foreign exchange was traded and priced at the market rate at 110 swap centres.[4]

Although exchange rate at the swap centres had been determined principally by market demand and supply conditions through a bidding process, the rates on the same day might differ among the swap centres due to the flow control of foreign exchange between different centres. Moreover, the gap between the official rate and swap rate fluctuated over time, affected largely by market conditions and devaluation of the official exchange rate. In 1989, the premium fell sharply in the wake of a devaluation of the official exchange rate and a rapid increase of foreign exchange supply in the swap centres, and thereafter it narrowed to about 8 percent before it widened again to about 45% by early 1993 (see Figure 1).

With more flexible exchange arrangements since 1986, the official exchange rate was in effect pegged to the US dollar. In 1991, the exchange policy was altered to small-scale, more frequent adjustments in the official rate according to the prevailing conditions from the relatively large, one-step currency devaluations of the past, following two devaluations in 1989 (by 21%) and 1990 (by 9%). By April 1993, the real effective exchange rate of the official exchange rate had depreciated 33% more than in 1986 and 70% more than in 1980 (Bell *et al.* (1993)). This has been seen as an important drive towards a more realistic exchange rate and the eventual currency convertibility.

3. Foreign exchange purchased by importers through the swap centres accounted for about one fifth of China's total foreign exchange earnings by the end of the 1980s.

4. See World Bank (1994).

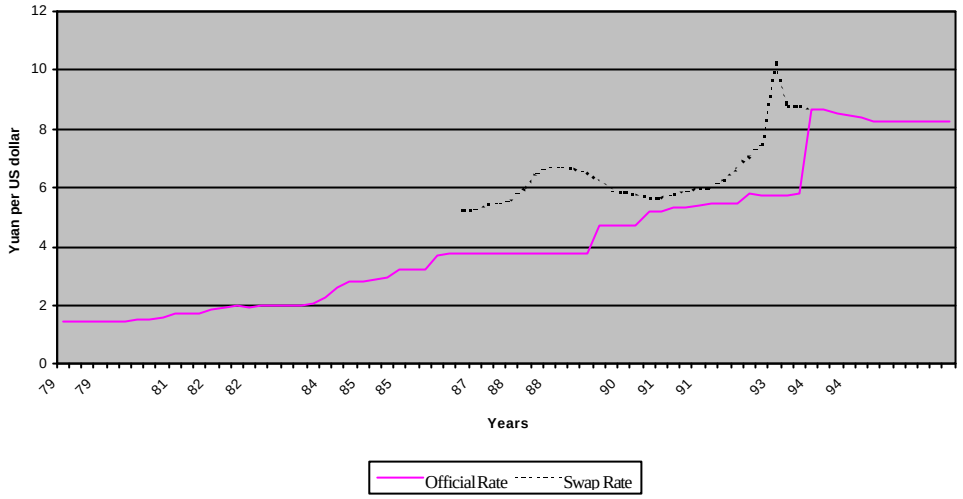

Figure 1a Nominal Exchange Rates of the RMB (1979:I-1996:IV)

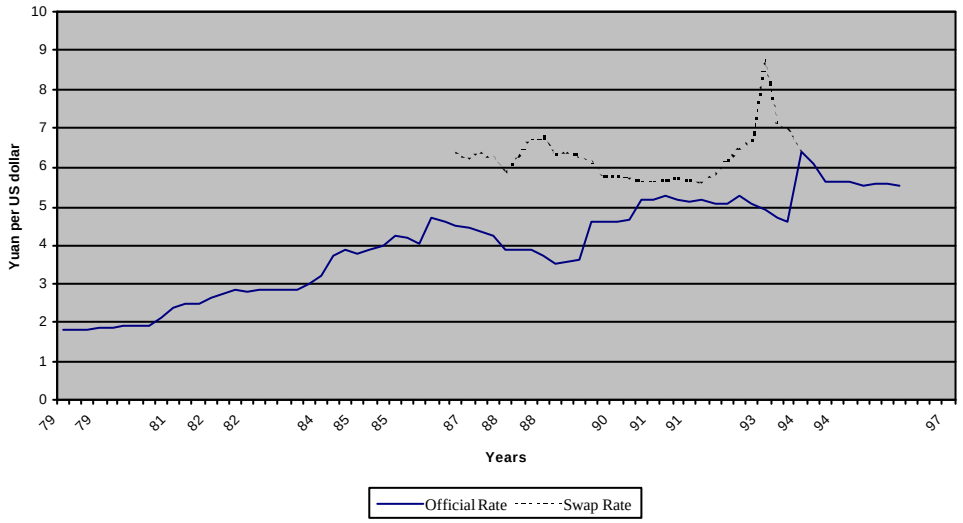

Figure 1b Real Exchange Rates of the RMB (1979:I-1996:IV)

However, one may have to note that the Chinese authority has been very cautious in devaluing the RMB over time, mainly due to the fear of macroeconomic instability and the inflationary effect of devaluation. This was more evident between the mid-1986 and late 1989 when China experienced rising domestic inflation. China's real effective exchange rate during this period had actually been appreciated.

It has become clear that the dual foreign exchange rate system played a quite important role in mitigating currency inconvertibility pressure and the inflationary effect of devaluation during the reform era. To certain extent it helped to break through the traditionally "air-locked" marketing system by reallocating certain amount (about one fifth at the end of the 1980s) of foreign exchange earnings at a market-like price to meet the demands of a diverse group of importers. However, the dual rate system was also a source of uneven competition. It created windfall profits or rents to those license holders when the quantities of imports and exports were rationed by a bureaucratically-allocated licensing system, and provided uneven chances of foreign exchange access and uneven benefits from decentralized exporting for local governments, exporters and producers. It also was unfair to foreign investors as their equity contribution in foreign exchange was calculated according to the official rate while subsequently they had to pay the higher swap rate when they needed foreign exchange.

2. The Unified Foreign Exchange System

Beginning on January 1, 1994, the dual exchange rates of the official and the swap were replaced by a unified, market-based exchange rate. Under the new exchange regime, the foreign exchange retention system was abolished and replaced by a system where all domestic enterprises must sell their foreign exchange revenues to designated foreign exchange banks on the spot except receipt on the capital account, and all approved purchases of foreign exchange must be settled at the prevailing market rate. A national inter-bank foreign exchange market was established to link all the designated banks and to replace the local and unlinked swap centres. It implies that, with the unified exchange rate system, the persistent differentials of the exchange rates among different swap centres have been eliminated and the efficiency of foreign exchange allocation has been enhanced. The new system has increased the effectiveness of the central bank's market intervention and moved the SAEC from direct control and authorization to indirect foreign exchange management. In particular, the People's Bank determines a benchmark rate that reflects the market conditions, and all designated foreign exchange banks can only buy and sell foreign exchange within a band of 0.25% above or below this benchmark rate. The SAEC, on the other hand, can focus on formulating its foreign exchange policy, regulating financial firms, approving and supervising the opening of foreign exchange accounts, and supervising the operations of the designated foreign exchange banks. With the new foreign exchange system, China has achieved conditional convertibility of the Chinese currency on current account transaction, yet an important drive towards full convertibility.

The unification of the dual exchange rates led to a substantial devaluation of the

currency from 5.8 to 8.7 *yuan* to the dollar, a rate quite close to that in the black market. This reform has thus far been more successful than expected. The inflationary impact of the unification was in fact much less significant than the devaluation rate would suggest, thanks to the dual exchange rate system which had channelled over 80% of the current account related foreign exchange transactions to the swap centres prior to the unification. Furthermore, since the unification the exchange value of the RMB has been remained stable, while appreciated against the US dollar in the last few years by about 5% in nominal terms and 22% in real terms by 1997. Finally, as a result of the new foreign exchange regulation, China's international reserves soared from US$20 billion at the end of 1993 to over US$50 billion by the end of 1994, and further to US$105 billion in 1996 and over US$140 billion by 1997. This has important implications for China's monetary policy, in particular, the central bank's ability to control the base money and the inflation target.

The new exchange rate system has a number of effects on the allocation efficiency of foreign exchange. First, the inter-bank foreign exchange market provides all firms with equal access to foreign exchange at the nationally unified rate, which helps to stop the speculative trading and rent-seeking behaviour. Then, firms in the inter-bank foreign exchange market are allowed to choose any designated bank with no geographical restriction. Finally, the inter-bank foreign exchange system covers all the current account transactions. One may have to note that the inter-bank foreign exchange market is essentially dominated by the two players, namely the People's Bank of China (the Central Bank) and the Bank of China, with both accounting for 70-80% of total foreign exchange purchases and sales, respectively (Lin (1996)).

To maintain continuity in policies towards FDI, China decided to let the swap market remain open only for foreign-funded enterprises (FFEs) and to allow them to keep their foreign exchange in designated accounts instead of selling it to a bank. Beginning on July 1, 1996 FFEs were allowed to enter the inter-bank foreign exchange market, and all remaining restrictions on currency convertibility for current account transactions were removed shortly. Since then, the volume of foreign exchange transactions conducted by FFEs in the swap centres declined drastically, comprising only about 10% of the total volume of their foreign exchange transactions. Therefore, the Chinese government announced the termination of foreign exchange swap business and the concurrent closing of foreign exchange swap centres from December 1, 1998 to facilitate the unification and standardization of China's inter-bank foreign exchange market, reduce the procedures for foreign exchange transactions by FFEs, and expedite the circulation of capital. This is apparently an important step in improving China's investment environment.

Thus, China has achieved its intermediate term objective of unconditional convertibility on current account transactions three years ahead of the year 2000 by which China had committed in its negotiation for accession to the WTO, and met the requirements of Article VIII of the Agreement of International Monetary Fund (IMF) by the end of 1996.[5] The ultimate goal of the reform is to reach full convertibility of the currency for capital account transactions. Until then, cross-border capital flows

will still be subject to controls of the government.

III. The Theoretical Framework and Methodology

It is commonly believed that the effect of the real exchange rate on a country's trade balance follows a J-curve effect: a currency depreciation worsens a country's trade balance in the short run but improves it in the long run. The rationale behind the J-curve is that import prices respond quickly to exchange rate changes, while import and export volumes adjust slowly to movements in relative prices. Thus, the initial effect of a depreciation on the trade balance is "perverse" if import value increases by more than the increase in export value. In the long run, however, the trade balance will improve when import and export volumes adjust to the higher (lower) import (export) prices. The empirical results of some recent studies do not provide a clear-cut answer regarding the validity of the J-curve hypothesis. Rosensweig and Koch (1988), Mead (1988), and Mahdavi and Sohrabian (1993) find evidence of a "delayed J-curve pattern" consisting of a number of overlapping standard J-curve. Some others even find no statistically reliable evidence of a stable J-curve (Rose and Yellen (1989)). The central points of these studies seem to suggest a slow and partial pass-through of changes in the exchange rate into import prices and even a relatively quicker and larger pass-through into export prices.

More recently, an alternative explanation, the so-called "modern theory" of trade-balance determination (Greenwood (1984), Razin (1984), McKinnon and Ohno (1986)) began to receive attention. This theory gives a greater weight to intertemporal shocks[6] and exogenous supply shocks in explaining trade imbalances. The empirical consequences of this modern theory are twofold: first, because exogenous factors affect the movements of both the real exchange rate and the trade balance, the change in one variable can only partially explain the change in the other variable; second, the relationship between the two variables may be bidirectional (Hill (1990)). However, empirical studies of the nexus between real exchange rate and the trade balance have usually assumed a unidirectional causal relationship in the opposite direction (Himarios (1989)).

There are a few studies on the relation between the changes of the exchange rate and export performance in the Chinese economy. Wang (1993) finds that there is a positive relationship between real exchange rate and exports. Using quarterly data from 1980:I to 1989:IV, Brada *et al*. (1993) find that in the short run the J-curve does not exist and the devaluation of the RMB serves to improve the balance of trade (at a 10% significant level) in both the long-term and short-term specifications. However, these studies did not include the recent drastic change of the foreign exchange system,

5. The effective date of acceptance of Article VIII of the IMF's Articles of Agreement was on December 1, 1996.
6. The intertemporal shocks are defined as disturbances such as a change in the world interest rate or a shift in intertemporal preferences which have no direct effect on the real exchange rate, but directly impact the trade balance by shifting the time distributions of domestic consumption and production. See Hill (1990).

nor the interrelationship between exchange rate and domestic inflation. As we have seen from the previous discussion, the latter has actually been the major concern of the government when devaluing its currency.

This paper centres on issue related to the relation between the exchange rate and the trade balance by taking account of the effect of exchange rates unification and the nexus between devaluation and inflation. The model of the trade balance that we employ can be derived from the underlying foreign and domestic supply and demand for imports and exportables under a rather broad range of assumption (Mann (1986), Rose and Yellen (1989), Brada *et al*. (1993)), which is defined as following:

$$BOT = BOT(EXCH, YD, YW) \tag{1}$$

where *BOT* is the real trade balance in local currency; *EXCH* is the real exchange rate; and *YD* (*YW*) is real income measured in domestic (foreign) output. As *YD* represents the real income measured in domestic output, an increase in *YD* may cause an increase in demand for imports and/or the supply of exportables.

To investigate whether there exists a stable linear steady-state relationship between the interested variables, unit-root and cointegration tests are applied to each variable in (1). Unit-root tests show if a time-series variable is stationary. Cointegration analysis determines the long-run (cointegrating) relationship between the variables in (1) when all the variables are found non-stationary (i.e., have unit roots). In order to test for unit roots in the sample data, we employ the Augmented-Dickey-Fuller (ADF) tests on both levels and differences of all the variables in (1). If all variables studied are I(1), we then use the Johansen maximum likelihood (ML) method (Johansen (1988), Johansen and Juselius (1990)) to test whether these variables are cointegrated. The Johansen approach allows testing in a multivariate framework and avoids some of the drawbacks of the Engle-Granger (1987) cointegration method. In contrast to the Engle-Granger procedure, the Johansen approach considers the error structure of the data processes, allows for interactions in the determination of the relevant economic variables and is independent of the choice of the endogenous variables. Most importantly, the Johansen approach allows explicit hypotheses tests of parameter estimates and rank restrictions using likelihood ratio tests (Johansen and Juselius (1992), Strauss (1996)).

According to Johansen's procedure, a p-dimensional vector autoregression (VAR) of order k (VAR(k)) can be specified as follows:

$$Z_t = \alpha_0 + \prod_1 Z_{t-1} + \ldots + \prod_k Z_{t-k} + \omega_t, \qquad t = 1 \ldots T. \tag{2}$$

Then, VAR model (2) can be rewritten in a vector error-correction model (VECM) in order to specify the short-run dynamics of cointegrated variables:

$$\Delta Z_t = \alpha_0 + \prod Z_{t-k} + \sum_{j=1}^{k-1} \theta_j \Delta Z_{t-j} - \omega_t, \tag{3}$$

where Δ represents the first difference operator, Z_t is a $n \times 1$ vector of variables, $\prod$ and θ are n by n matrices of unknown parameters, and ω_t is a Gaussian error term. All long-run information about the relationship between variables is contained in the impact matrix $\prod$. When the matrix $\prod$ has full column rank, it implies that all variables in Z_t are stationary. When the matrix $\prod$ has zero rank, the system is a traditional first-differenced VAR involving no long-run elements. However, when the rank of $\prod$ is intermediate or $0 <$ rank($\prod$) $= r < n$, there exist r cointegrating vectors that make the linear combinations of Z_t become stationary or cointegrated. In this case, $\prod$ can be decomposed into two n by r matrices, Φ and Ω, such that the reduced rank $r < n$ of $\prod$ is hypothesized as $H(r): \prod = \Phi\Omega'$. The vectors of Ω represent the r linear cointegrating relationships such that $\Omega' Z_t$ is stationary. The matrix Φ represents the error-correction parameters. The ML estimation procedure provides a likelihood ratio (LR) test called trace test (λ_{trace}) that evaluates the null hypothesis of, at most, r cointegrating vectors versus the general null of n cointegrating vectors. Another test derived by Johansen (1988) is the maximum eigenvalue test (λ_{max}) which is a more powerful LR test. This test is to evaluate the null hypothesis of r cointegrating vectors against the alternative of $(r+1)$ cointegrating vectors. Rejection of this hypothesis suggests the existence of the maximum r cointegrating vectors. Asymptotic critical values are shown in Osterwald-Lenum (1992) and can be adjusted by a scaling factor, $T/(T-nk)$ to eliminate finite sample bias of Johansen's tests (Cheung and Lai (1993)).

IV. Data and Empirical Results

1. Data

The methodology described in the last section is employed to test the hypothesis that there exists a stationary long run relationship between trade balance, exchange rate and output in the transition economy of China. We employ monthly data spanning the period 1986:01 through 1997:01. The sample period is chosen for three reasons. First, it was not until the mid-1980s that the focus of China's reforms shifted to the urban sector, marked the beginning of the comprehensive reform era. The comprehensive reforms were interrupted by the austerity programme and the Tiananmen Square event in the late 1980s, but resumed and accelerated dramatically after Deng Xiaoping's tour to the southern China in 1992. Then, China's price reform was formally launched in the mid-1980s through a "dual-track" approach, allowing firms to make limited responses to market signals in their production plans and trade the above-plan quotas at the market prices. By the mid-1990s, prices of most products in China were completely liberalized. Finally, with the deepening of its foreign trade and exchange rate reforms, China has successfully broken through the traditionally "air-locked" marketing system. As a result, the economic agents can possibly adjust their behavior in response to market signals. Foreign trade

was conducted increasingly by its comparative advantage instead of using administrative measures in the past. Therefore, it is widely expected that China's trade balance should become more responsive to the exchange rate changes during this period.

The major sources of data are IMF: International Financial Statistics, the Statistical Yearbook of China, the Monthly Statistics of China, and Hong Kong Monthly Digest of Statistics. *BOT*, the real trade balance, is obtained by deflating the nominal trade balance by the consumer price index (CPI). *EXCH* is the real effective exchange rate which is calculated as a trade weighted average of the bilateral exchange rates between China and its major trading partners. *YD*, the real domestic income, is proxied by the value-added of industrial production at a constant price, which is available on a monthly basis. *YW* is the foreign real income which is proxied by the industrial production (IP) index at a constant price. However, the monthly IP index is only available for Japan and the United States among China's major trading partners in our sample. For comparison purpose, we conduct two sets of empirical study by including and excluding this variable. All the real variables use the CPI as the price deflator because of its monthly availability and wide coverage. A full description of measurements and definitions of the variables involved in the analysis is contained in the Appendix.

2. Tests for Unit Roots and Cointegration

Table 1 presents stationary tests for the variables in Equation (1) using ADF tests with a constant and a time trend. The autoregressive lag lengths are chosen to whiten the residuals as the Box-Ljung *Q*-statistic suggests. The test statistics show that for the levels of all the series, the null hypothesis that a unit root exists cannot be rejected. The unit root tests of the first difference of the variables reject the null hypothesis. These findings suggest that each series contains one unit root and thus I(1). These results have important implications to the understanding of those controversial issues regarding RMB devaluation and its impact on China's trade balance, as studies based on the conventional method without taking unit root into account will generate divergent, even opposite conclusion as those taking some transformation (e.g., first-differencing) before stationarity is achieved.[7]

Table 1 Augmented Dickey Fuller Tests for the Presence of Unit Root

Variables	Level		1st Difference	
	lag length	Coefficient (Test Statistic)	lag length	Coefficient (Test Statistic)
BOT	6	-0.452 (-2.880)	5	-3.196 (-6.979)*
EXCH	4	-0.031 (-1.104)	3	-0.938 (-5.033)*
YD	5	-0.034 (-0.283)	4	-3.939 (-10.38)*
YW	4	-0.059 (-1.087)	3	-2.253 (-9.331)*

Note: *(**,***) indicates the null hypothesis of non-stationarity is rejected at a 1% (5%, 10%) level of significance. The relevant critical values are -4.03(-3.45, -3.15) (Fuller (1976)).

7. For instance, Rose and Yellen (1989) find little or no evidence of the existence of a J-curve in the U.S. trade balance, while the use of data in levels would have led to an opposite result.

Since all variables are I(1) in Equation (1), the cointegration of the real trade balance with the real output and exchange rate is a necessary condition for the existence of a long-run relationship such as (1). Table 2 reports the results of the Johansen maximum-likelihood-ratio test for cointegration. The results show that the hypothesis of no cointegrating vector ($r = 0$) can be rejected at the 5% significance level in the tests of both including and excluding foreign real income variable. Applying the Johansen test to the sub-period spanning from 1992:01 through 1997:01 leads us to conclude that there exist two cointegrating vectors (one for excluding foreign income) at the 5% significant level. This finding confirms the existence of an underlying stationary steady-state relationship between the balance of trade and the variables of interest.

The maximum likelihood estimate of the cointegrating vector (normalized) gives the following long-run relationship between the real trade balance and the variables of interest for the whole sample period (standard errors are reported in parentheses below the coefficient estimates):[8]

$$BOT = \underset{(0.192)}{0.0874EXCH} - \underset{(0.092)}{0.4469YD} + \underset{(0.135)}{0.3785YW} - \underset{(18.2)}{43.17} \qquad (4)$$

If foreign income variable is excluded, we have

$$BOT = \underset{(0.028)}{0.0869EXCH} - \underset{(0.1388)}{0.3583YD} - \underset{(0.85)}{6.928} \qquad (5)$$

The estimated parameters in both Equations (4) and (5) are significant and have the right signs as expected. Numerically, domestic income and foreign income have the most important long-run effects on the real trade balance. The real effective exchange rate is shown to have a long-run effect, but is not particularly sizable. As indicated by the equations, a 10% devaluation of the real effective exchange rate tends to improve the real trade balance by about 0.9%, other things being equal. Nevertheless, our empirical results seem to suggest that China's economic reform during the past two decades has improved the sensitivity of the economic system and made it responsive to market signals to allow changes in the exchange rate to influence the trade balance, though the effect was still not sizable. The (normalized) estimates of the long-run relation for the sample period 1992:01-1997:01 are (1, -0.581, 1.301, -8.179, 660.31) for the specification including foreign income and (1, -0.231, 0.058, 44.42) for the one without foreign income. Both are significant at the 5% significant level and show the right signs. In comparison with the results from the whole sample period, the long-run effect of the exchange rate on the trade balance has become of considerable importance in the 1990s. This finding is in line with our earlier discussion on China's reform in the 1990s. It is also observed that with the inclusion of foreign income variable in the model, the

8. With a different setting, Zhang (1998) finds strong evidence suggesting changes in the trade balance Granger-cause changes in the exchange rate, but weakly for the reverse causal relationship.

exchange rate tends to have a much larger effect on the trade balance, which is consistent with theory.

Table 2 Cointegration Test Using the Johansen Procedure

Variables	Lag Length[a]	H_o: r	λ_{trace}	λ_{max}	$\lambda_{trace}(0.95)$[b]	$\lambda_{max}(0.95)$[b]
1986:01-97:01						
I. *BOT EXCH YD YW*	10	0	51.14**	27.12**	47.21	27.07
		1	24.02	15.12	29.68	20.97
		2	8.90	6.54	15.41	14.07
		3	2.36	2.36	3.76	3.76
II. *BOT EXCH YD*	10	0	37.05**	23.65**	29.68	20.97
		1	13.40	11.83	15.41	14.07
		2	1.57	1.57	3.76	3.76
1992:01-97:01						
I. *BOT EXCH YD YW*	3	0	64.75*	28.60**	53.12	28.14
		1	36.15**	22.30**	34.91	22.00
		2	13.85	9.89	19.96	15.67
		3	3.96	3.96	9.24	9.24
II. *BOT EXCH YD*	3	0	41.91*	22.81**	34.91	22.00
		1	19.10	14.72	19.96	15.67
		2	4.38	4.38	9.24	9.24

Note: [a] The lag length is chosen based on AIC criteria.
[b] The critical values are taken from Osterwald-Lenum (1992).
*(**) indicates statistical significance at 1% (5%) level.

3. The Exchange Rate and the Trade Balance in the Short Run

Once the long-run relationship between the trade balance and the interested variables has been determined, we turn to the short-run dynamics of this relationship. To test how quickly the balance of trade will respond to a change in the exchange rate, we estimated a short-run version of Equations (4) and (5) by taking account of the J-curve effect and the error-correction process.[9] The J-curve effect was modeled by including nine lagged values of the exchange rate in the specification to reflect the adjustment path of the Chinese economy following a devaluation. Since Equations (4) and (5) imply an equilibrium relationship among trade balance, exchange rate and income, any deviations from equilibrium in one period, captured by the error term, will bring forth corrections in the opposite direction in the next period to adjust toward the stable equilibrium position. In particular, when the error is positive, the trade balance is too high relative to the

9. See Krugman and Baldwin (1987), Rose and Yellen (1989), and Brada *et al.* (1993).

equilibrium path and economic agents will make an adjustment in the opposite direction, and vice versa. To capture the effect of exchange rate unification in 1994 on the trade balance, we also included a dummy variable in our estimation.

The results are reported in Table 3. As shown in Table 3, the detrimental effect of a real devaluation on the trade balance in most cases is felt in the following month after devaluation though the effect is not significant, and the real effective exchange rate normally takes six months to yield a significant effect on the real trade balance. The *F*-test of the joint hypothesis that all the exchange rate coefficients are zero is rejected at the 5% significant level. The sum of the exchange rate coefficients is statistically significant for all estimations with a positive sign except for the one excluding foreign income variable in 92:01-97:01. For the latter, the detrimental effect of a real devaluation on the trade balance begins in the month in which the devaluation takes place and becomes statistically significant in three months. Our results do not suggest that the dynamics of the adjustment path in the Chinese economy follow the traditional J-curve effect, as the estimated coefficients do not smoothly progress from negative to positive values and back to zero again. Rather, some "incorrectly" signed coefficients appear cyclically during the lagged period. This finding is consistent with Rose and Yellen (1989) and Brada *et al.* (1993). It implies that, after the two-decade reform, the economic system was still rather weak in the short-run to respond to the market signals so as to use the exchange rate policy to manage its external balance.

The error-correction term is statistically significant but has different sign with the estimations including or excluding foreign income. This finding is reinforced by the factor that the Chinese government often used measures such as direct administrative control in lieu of foreign exchange rate policy to adjust its external imbalance. It is interesting to note that domestic income have a significant negative impact on the trade balance when the sum of the exchange rate coefficients is positive and foreign income is included, which is consistent with the finding of Brada *et al.* (1993), but it turns to a positive value when the foreign income is excluded from the estimation and the sum of the exchange rate coefficients is negative (for the sample period 92:01-97:01). Again, this is clearly another case of direct administrative control over the external balance when exchange rate policy could not improve the trade balance and when foreign demand for domestic products is neglected.

The effect of the exchange rate unification on the trade balance is positive and significant at the 1% level for estimation excluding foreign income variable. This has aroused our interest of assessing other consequences of the new exchange rate regime in addition to what we have discussed earlier. The unification of the dual rate system has brought successfully the exchange rate of the RMB closer to the equilibrium level without leading to drastic increases in the budget deficit and the domestic money supply and to a burst in inflation. In 1994, China's money supply grew by 33% and inflation rate was 22 % in contrast with an inflation rate of 15% in 1993. To confirm the inflationary effect of devaluation, we conducted a simple exercise by estimating a model for inflation rate with a nominal exchange rate, a monetary variable, domestic output growth, a dummy variable for the regime change and a lagged term of inflation as explanatory variables,

Table 3 Parameter Estimates for Short-Term Balance of Trade

Variable	Model I		Model II	
	Coefficient	*t*-statistic	Coefficient	*t*-statistic
1986:01-1997:01				
Constant	-0.4842	-0.6224	3.5246	4.9033*
DM*EXCHR	0.0109	0.7710	0.0516	4.8201*
△YD	-0.1449	-2.4996*	0.1095	2.1332**
△YW	0.5626	1.5614***		
Error Correction	-0.1490	-2.1418**	0.3998	9.3390*
△EXCHR				
Lag 0	0.1647	1.9579**	0.0731	1.1342
1	-0.0552	-0.6540	-0.0400	-0.6207
2	-0.0086	-0.0998	0.0105	0.1617
3	0.0224	0.2610	0.0060	0.0911
4	-0.0281	-0.3278	-0.0542	-0.8304
5	0.1258	1.4702	0.0696	0.6011
6	-0.4357	-5.0671*	-0.2977	-4.4494*
7	0.4591	5.0344*	0.3885	4.1363*
8	-0.1899	-2.0755**	-0.1686	-2.5870*
9	0.0396	0.4562	0.0436	0.6764
Sum	0.0940	7.6990*	0.0311	6.3586*
R^2	0.4400		0.6700	
D.W.	2.2287		1.6870	
F	4.390*		2.23**	
1992:01-1997:01				
Constant	-1.2567	-0.7727	14.0157	11.3188*
DM*EXCHR	0.0015	0.0696	0.1251	10.9062*
△YD	-0.2407	-1.5616***	0.3693	4.2703*
△YW	3.7940	2.3879**		
Error Correction	-0.1105	-0.8940	0.7690	14.5928*
△EXCHR				
Lag 0	0.1535	1.2366	-0.0167	-0.2972
1	-0.1235	-0.9240	-0.0637	-1.0677
2	-0.0105	-0.0798	-0.1342	-2.3130**
3	-0.0488	-0.3795	-0.1015	-1.7850***
4	0.0506	0.4042	-0.1545	-2.1764*
5	0.2830	1.4132	0.0954	1.6492***
6	-0.5840	-4.4807*	-0.2264	-3.8960*
7	0.5902	4.2856*	0.0362	0.5317
8	-0.2889	-2.0015**	-0.1654	-2.9881*
9	0.0099	0.0773	0.1075	1.9220***
Sum	0.0315	7.0319*	-0.6233	8.420*
R^2	0.5822		0.9130	
D.W.	1.9718		1.5270	
F	4.570*		5.960*	

Notes: To test the null hypothesis of all the exchange rate coefficients are zero, we apply the *F* test given by: $F = [(RSS_R - RSS_{UR})/m]/[RSS_{UR}/(n-k)]$ which follows the *F* distribution with m and (n-k)df. *(**,***) indicates significant at 1% (5%, 10%) level.

and found interestingly (available on request) that with a 10% depreciation the domestic price level will induce a 1.9% price increase prior to the reform and by 1.2% post the reform. This to some extent explains the 7% increase in inflation rate following the 50% depreciation on January 1, 1994, thanks to the dual exchange rate system which had mitigated over time the effect of the exchange rate unification.

It remains an interesting question on to what extent the difference between the swap rate and the official exchange rate can be explained by the economic variables. Or, what are the major determinants of the premium on exchange rates in the swap centres? To answer this question, we tried to establish a simple model for premium (*PRM*) determination with the explanatory variables of economic growth (ΔYD) proxied by the growth rate of the industrial production, net exports (*NX*), and change of international reserves ($\Delta RESERV$). The estimation results are as follows:

$$PRM_t = \underset{(-1.63)}{-0.378}\ \Delta RESERV_t + \underset{(1.97)}{0.428}\ \Delta YD - \underset{(-0.62)}{1.358}\ NX + \underset{(4.59)}{0.663}\ PRM_{t-1} \qquad (6)$$

$$R^2 = 0.623 \quad D.W. = 1.839 \quad S.E. = 12.8 \quad F = 17.63$$

where *PRM* is defined as the difference between the swap and official rates, and the *t*-statistics are reported in the parentheses below the estimated coefficients. It is interesting to note that the premium on the exchange rates in the swap centres is by and large determined by economic variables such as the economic growth, net exports, international reserves and the lagged value of the premium. The inclusion of the lagged premium in the model is appropriate when the spread between the official rate and the swap rate is characterized by a partial adjustment mechanism or when the premium adjusts only slowly to net export, reserves and output changes. The domestic output growth affects significantly the exchange rate development and is a major contributor to the widening of the spread between the official rate and the swap rate. This finding is consistent with our earlier discussion. When China experienced a rapid economic growth, the domestic demand for both imported goods and exportables would increase, so did for foreign exchange. With the dual exchange rate system, it was possible for those firms that could not obtain foreign exchange at the official rate to purchase the needed foreign exchange at a higher swap rate. This would push up demand for foreign currency, and increase the premium on exchange rates in the swap centres.

However, any increase in the supply of foreign exchange will tend to ease the gap between the dual exchange rates. Our results show that net exports and the reserves level are the pulling factors from widening the premium, though the coefficient of net exports is not significant. Increases in the reserves level tend to reduce the premium, while taking dollars out of the system will increase the premium given the rigidity of the official rate. This to certain extent allows us to conclude that, with the accumulation of the international reserves, the unification of the dual exchange rates became much easier as the difference between the two exchange rates would have been substantially reduced.

V. Conclusions

This paper assesses China's foreign exchange reform and examines the long-run (cointegrating) relationship between the real trade balance, exchange rate and domestic (foreign) income using the Johansen maximum-likelihood procedure. We find empirical evidence that in China there is a long-run relationship among these variables. But the effect of the real effective exchange rate on the real trade balance appears to be moderate. These results suggest that China's economic reform has improved the sensitivity of the economic system and made it responsive to market signals to allow changes in the exchange rate to influence the trade balance in the long-run. Our short-run version of model estimation does not conclude the existence of a J-curve effect, though the sum of the exchange rate coefficients is significant and positive in most of our estimations.

The unification of the dual foreign exchange rate system in 1994 has improved the efficiency of China's foreign exchange management and contributed to the establishing of the preconditions for full current account convertibility.[10] With the new system the central bank's ability to stabilize the exchange rate and the current account has been strengthened, but China's monetary policy has become more sensitive to its external conditions. Our empirical results suggest that the dual exchange rate system adopted in the mid-1980s has mitigated the impact of the unification, facilitated the move towards an equilibrium level of exchange rate. However, before a balance between government revenues and expenditures, described by McKinnon (1982) as the necessary condition for the full liberalization of foreign exchange, is achieved, it is rational for China to continue to rely on exchange controls and to restrict international capital flows (Lardy (1992)).

10. See Greene and Isard (1991) for detailed discussion over the preconditions for convertibility.

Appendix

Description of the Variables

BOT: real trade balance defined as the nominal trade balance deflatored by the China's consumer price index. Sources: the *Statistical Yearbook of China* and the *Monthly Statistics of China*.

EXCH: real exchange rate defined as the nominal rate of RMB multiplied by the relative price ratio of the world price level over that of China. The consumer price indexes are used. The index of the world price level is taken to be the trade-weighted consumer price index of the four countries. The nominal exchange value of the RMB is measured by the trade-weighted exchange rate index of the RMB against the four countries (Hong Kong, Japan, Singapore, and the United States) as they are the largest trading partners of China, taking a share of more than 60% (72% in 1996) in China's total foreign trade. Their average shares in China's foreign trade from 1986 to 1996 were used as weights in calculating the index. Sources: the *Monthly Statistics of China*, *Hong Kong Monthly Digest of Statistics*, *Statistical Yearbook of China*, and *IMF: International Financial Statistics* and *Hong Kong Monthly Digest of Statistics*.

YD: the real domestic income, proxied by the value-added of industrial production at a constant price, which is available on a monthly basis. Source: *Monthly Statistics of China.*

YW: foreign real income, proxied by the weighted industrial production (IP) index of China's major trading partners at a constant price. However, the monthly IP index is only available for Japan and the United States among China's major trading partners in our sample. Source: *IMF: International Financial Statistics*.

PRM: exchange rate premium is defined as the difference between the swap and official rates. Source: *Monthly Statistics of China*.

RESERV: the international reserves data were from *Monthly Statistics of China*.

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