Real Exchange Rates and Real Interest Rate Parity: The Case of China[1]

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Abstract

This paper empirically examines the likelihood of any long-run relationship between real exchange rate and real interest rate (RERI) differentials in China using vector autoregressive model (VAR) and hybrid cointegration methodology. The preliminary results based on some limited monthly data are indicative of a rather weak long run relationship. However, the empirical investigation also highlights the fact that since the foreign exchange reform in 1994, the deviations from the parity conditions is correlative with foreign exchange reserve and a ratio of M0 to M2.

I Introduction

China is currently the world's largest transition and developing economy. Since the economic reforms of the late 1970s, China has enjoyed a remarkable growth in the order

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of 9.5% per annum on average. By the end of 2002, China's GDP reached 1.24 trillion US dollars with a GDP growth rate standing at 8 percent over the previous year. The total value of trade in 2002 reached 620.8 billion US dollars, with the foreign capital actually utilized estimated at 52.7 billion US dollars, making China ahead of the US as the largest recipient of direct overseas investment in the world (See National Bureau of Statistics People's Republic of China, 2003). China is now the 6th largest economy and 5th largest trading nation in the world. These achievements have been primarily related to the nature of reform and opening to the outside world that Chinese Government has insist on for a long time. China's entry into the WTO in 2001 played a definite role in bringing China into a new stage in her opening-up program.

II An Overview of the Market Reforms in China

For almost three decades after 1949, the Chinese economy remained largely closed to the outside world because the government pursued an essentially autarkic strategy based on a belief in "self reliance". However, having learnt from the past experience, China is led to believe that isolation leads to backwardness. In this section we will briefly examine the paths of price reform, interest reform and foreign exchange reform as being integral parts of China's transition to a market economy.

(1) Pricing Reform

Before the reform, most commodities on the Chinese market were priced by the state. In 1978, price reform started from gradually eliminating of centralized pricing and assigned purchases of agricultural products and relaxing controls on the prices of most agricultural

products. Along with the expansion in the scale of the commodity market and the change of the relations between commodity supply and demand, the state carried out price reform on a gradual basis. By now, the reform has been through three stages.

The first stage, (1979-1984) must be considered as the focal point of the reform, as the central authorities transferred the administrative power of some prices to the working of markets. The strict controls on prices by government, therefore, began to become flexible. The second stage, (1985-1992), efforts were made to allow demand and supply in markets play much greater roles in the mechanism of determining prices. The third stage corresponds to 1992 when the Government officially recognized that the idea of establishing a socialist market economy was not after all incompatible with the Party's proclaimed idea. This meant that the reform on price management system was further accelerated as prices of a large number of products were left o be determined by market forces. (Li, 2000).

In consideration of these reforms, there are currently three forms of price determination: state fixing prices, state guiding prices, and market regulatory prices. Between 1978 and 2001, the share of the state fixing/guiding prices in the total retail sales of goods has reduced from 97% to only 4%(Li,2003).

(2) Interest Rates Reform

For a long time, the Central Bank of China (BPOC) set the interest rates for commercial bank lending and deposits, following the policy of reducing the enterprises cost with the low interest rate（Sun and Ma,2004）. Under this system, commercial banks could not

adjust interest rate in accordance with their customers demand, making commercial banking inefficient and ineffective.

An attempt at liberalizing interest rates during 1986-88, enabling banks to set lending and deposit rates freely within specified margins above the administered rates, was brought to a temporary halt in the midst of the inflationary developments of 1988-89. Since the early 1990s, banks and non-bank financial institutions have again been granted the freedom to vary lending rates within pre-specified margins, with the width of the margin depending on the type of institution. (Mehran and Quintyn, 1996).

After the establishment of a nationwide unified inter-bank lending and borrowing market, in June 1996, PBOC lifted controls on the ceiling for interest rates on inter-bank loans, subjecting them to negotiations between the lender and borrower. Over the period 1998-1999, the range for floating interest rates was expanded twice, and the interest rate ceiling was raised from 10 percent to 30 percent. In September 2000, foreign currency interest rates were also subjected to reforms. Firstly, the process of making decisions on fixing interest rates on small foreign currency deposits was transferred to China Banking Association. Secondly, the controls on large fixed deposits and foreign currency loans were also lifted, and hence implemented uniformly by all commercial banks.

(3) Foreign exchange rate reforms

Over the 1950-1980, China adopted fixed exchange rate with Yuan/$ rate equaled RMB 1.5 to the dollar. An internal settlement rate of RMB 2.8 to the dollar was introduced in 1981 to remedy the substantial overvaluation. Since then, the official exchange rate

began its steady and gradual process of devaluation. After abolishing the Internal Settlement Rate which was adopted for foreign trade transaction from 1981 to 1985, the foreign exchange swap market was established to develop out of the foreign exchange retention system[2]. Because the swap rates are determined by demand and supply in foreign exchange swap market, they are different from the official rates. China's foreign exchange rate system was classified as more flexible other than managed floating arrangement by IMF in 1987.

In 1991, the foreign exchange authorities began to allow cash retention instead of quota retention, and adjusted official rates to swap market rates. In 1994, China embarked on a major market–oriented exchange reform. The official and swap market rates were unified at RMB 8.7 per dollar. Foreign exchange retention system was abolished. Instead, enterprises were required to buy and sell foreign exchange through designated foreign exchange banks. The authorities claim that the exchange rate is a managed, floating exchange rate, but it would rather be considered as a managed fixed exchange rate. The 30 day's absolute percentage changes of the interbank rates are only slightly greater than 0.03%[3], and the appreciation of exchange rate in Yuan/$ has not been greater than 5.1% over the period 1994-2002.(Guo, 2003). Facing the impact of the Asian financial crisis since 1997, the Chinese government has declared that it will maintain the exchange rate of the RMB, stating that the RMB will not be devaluated, and the size of floating bands has been reduced. In April 1999, IMF classified China's exchange rate regime as

[2] Under the foreign exchange retention system, enterprises could receive the retention quotas according to a portion of their foreign exchange earned from export to purchase back foreign exchange at the official exchange rate for import goods and services approved by the state. The holder of the retention quotas could sell them in the foreign exchange swap market.

[3] Authors thanks Lin Guijun and Shu Jinghong for they kindly gave the calculated result.

a conventional pegged arrangement.

In December 1996, China accepted the obligations of Article VIII of the Fund's Articles, and hence attained the current account convertibility. This was a major breakthrough in reforming the country's foreign exchange control system.

Although it may appear that China still maintained very strict capital control, in fact the RMB is already partially convertible under the capital account, with convertibility possible for 43 items under the IMF classification. Recent investigations show that about 45% of transactions under the capital account are now convertible. These include direct investment, purchase of Chinese stocks (B-shares) by foreigners, overseas investment by Chinese banks and other financial institutions, and transactions of state treasury bonds. Over 41% of all such transactions are subject to restrictions, and only 13.9% are under strict control (Guo, 2003).

However, in the wake of the Asian financial crisis, Chinese officials have backed away from a strict schedule for capital account liberalization, and moved towards a more gradual approach in opening up its capital markets.

On the whole, China's foreign exchange reform is characterized by trade liberalization and the absorption of inflows of foreign direct investment. This reflects the fact that the government's emphasis is primarily based on strengthening the real sector and export capability of the economy (Lin, 2002).

III Literature Review and Methodological Issues:

The relationship between real effective exchange rate (REER) and real interest rate differential (RIRD) has been a matter of investigation amongst many economists. This is because, in a given open economy with perfect capital mobility and limited government intervention, such relationship offers potential contributions in business and policymaking processes. Moreover, the prominent theoretical significance of such relationship has been addressed to by, amongst many, Keynes (1932), Frankel (1979), and, more recently, Engle (2000). Based on the theoretical underpinning offered in the Mundell-Fleming (M-F) model, an increase in RIRD is expected to strongly correlate with an appreciation in REER. Research and investigation based on the M-F model has, in most cases, failed to support the theory and hence outperformed by a random walk model (see, amongst many, Meese and Rogoff, 1983; Wolff, 1987; and Meese, 1990).

However, the more practical extension of this theory offered by Mundell-Fleming-Dornbusch (M-F-D), prescribes that the determination of REER can be made more effectively, if some real fundamental macro indicators are also included in this relationship. Using either a single multiple regression (for example, Frankel, 1979; Edwards, 1988; and, Edison and Pauls, 1991) or more complex equations systems (amongst many, Wolff, 1987; Hinkle and Montiel, 1999; Wu and Chen, , and Jin, 2003), no unanimous verdict in support of the theory has yet been offered. In fact, research in this area has now been channelled through a search for a third suitable macro variable to be incorporated into the M-F model. An off-spring of such search has led to the use of

the time-varying parameter technique, using the Kalman-Filter models (for more up to date approach see, Wu and Chen, 2001).

In this paper, we do not intend to apply the M-F-D model to Chinese economy. Rather, we wish to use the conventional M-F model based on a simple relationship between REER and RIRD, and hence examine by how far has the Chinese economy opened up since its major currency reforms of 1994. In so doing, if we show that the two variables are stationary of the same order, then we may argue that there may exist a stable long run relationship between them. However, if such a long run relationship failed to exist, we are then interested to measure the extent of deviation.

Recall the interest parity:

$$1 + i_t = (1 + i_t^*)\,[1 + (E^e_{t+1} - E_t)/E_t] \qquad (1)$$

where i_t and i_t^* are the current real domestic and foreign interest rates respectively; E^e_{t+1} and E_t are the real expected and the spot exchange rates, respectively. Using the limit theory, expression (1) can be approximated as:

$$i_t = i_t^* + [(E^e_{t+1} - E_t)/E_t] \qquad (2)$$

The M-F parity then is expressed as:

$$i_t - i_t^* = [(\Delta E^e_t/E_t] \qquad (3)$$

The left hand-side of expression (3) is RIRD; and the right hand-side is an expression of real effective devaluation rate, REER. Assuming $E^e_{t+1} = E_{t+1,}$ expression (3) can then be shown as a semi-log-difference, in the following form:

$$RIRD_t = dLog\,(REER_t) \qquad (4)$$

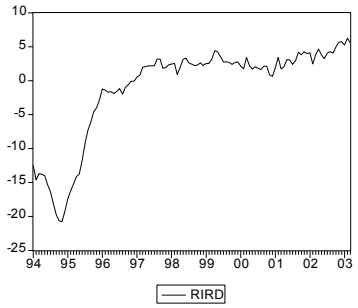
The currency appreciation means that E falls below its previous period, and hence pushing the right-hand side of expression (4) up and that RIRD will increase. As pointed out earlier, the parity holds if we show that both sides of expression (4) are stationary at level, that is I~ (0), and $RIRD_t$ = a dLog ($REER_t$) ,where a is expected to be not significantly different from1. Moreover, if the results indicate that both variables exhibit first differenced stationarity, we can then argue that there may exist a long run linear relationship between REER and RIRD in a cointegration setting.

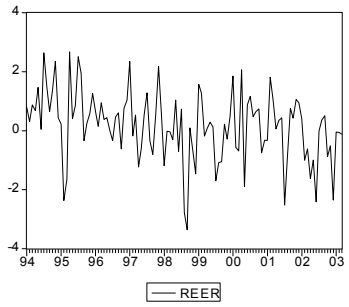
IV Data and Findings

The RIRD is the real prime lending rate in China minus the real prime lending rate in the United States. China's real prime lending rate is equal to the nominal prime lending rate minus inflation rate in China. The U.S. real prime lending rate is equal to the nominal prime lending rate minus 12-month changes in the CPI in the United States. The China's prime lending rate is obtained from IMF (International Financial Statistic). China's CPI is obtained from National Bureau of Statistics of China. United States' prime rate changed by banks and United States' CPI have been collected from Federal Reserve and Bureau of Labour Statistics respectively. The REER is the trade-weighted real effective exchange rate for the Chinese RMB vis-à-vis major trading partners composed by the IMF.

Charts 1 and 2 show the historical pictures of RIRD and REER over the entire period of the study. As for RIRD, up to 1993/4 there have been significant deviations in the rates, but post reforms of 1994 indicate much slower volatility in RIRD. By the same token, REER

has been oscillating severely prior to 1994/5, but demonstrates much slower devaluation/appreciation of currency over the period 1995-2003.





As the starting point, the data have been subjected to test for stationarity using the unit root test. If the test shows that both variables possess integration of order zero (no unit root), then it can be said that the variables exhibit that parity holds in the long run. The findings of such test using both Dickey-Fuller (1979) and Phillips-Perron (PP) (Phillips and Perron, 1998) approaches tend to yield identical results, and for this reason, we have only reported the results of ADF test, as shown in Table 1. As for RIRD, for the entire period, as well as the two sub periods, 1985-1993 and 1994-2003, no level stationarity is exhibited. However, RIRD is shown to be stationary of order one, I(1) in all cases. However, the table also shows that dLogREER is level stationary for the entire period, as well as the two sub-periods.

TABLE 1: Results of Stationary Test

VARIABLES	**LEVEL**			**First Diff**		
	1985-2003	**1985-1993**	**1994-2003**	**1985-2003**	**1985-1994**	**1995-2003**
RIRD	-3.36*	-2.92	-3.73**	-4.86***	-4.65***	-7.21***
dlog(REER)	-11.6***	-10.16***	-9.65***			

* Significant at the 10% level
** Significant at the 5% level
*** Significant at the 1% level

These results indicate that parity defined as $RIRD_t$ - dLog ($REER_t$) is stationary of order one and hence cointegartion appears not to be appropriate. This is further verified when the results of the pair-wise Granger causality indicate that there is a two-way relationship between the two variables. This is shown in Table 2, where the estimates of F-statistic are shown to be statistically significant at the 1% level in both cases.

TABLE 2: Results of Granger Causality: 1985-2003

Null Hypothesis	Obs	F-Statistic	Prob.
RIRD does not Granger cause dlog (REER)	189	4.723	0.0103
dlog(REER) does not Granger cause RIRD	189	4.899	0.0101

Considering the results of stationarity and given the evidence in Table 2, we are led to resort to a vector autoregressive model (VAR), a dynamic time series simultaneous system of equations. In the context of parity, an augmented bi-variate VAR may be drawn as:

$$Z_t = a_0 + a_1 t + \Sigma b_i Z_{t-i} + u_t \qquad (5)$$

where Z is an (2 x 1) vector of jointly determined dependent variables, RIRD and dlog(REER), *t* is the time trend, and *u* is a vector of disturbances satisfying the classical assumptions.

Although the VAR technique is a reduced form procedure, it however offers several advantages over competing methods. As has been noted by Raynold et al (1991), the VAR technique imposes no *a priori* constraints or assumptions on variables, and allows

the data to determine the model. Moreover, the moving average part of expression (5) embodies the so-called *historical decompositions* (HDs) and *variance decompositions* (VDs) of the estimated VAR model, which will enable one to work out the size and the life length of impulses produced by variables as a result of a shock to the system.

The estimated optimal VAR reduced form is shown in Table 3. As can be seen, the estimated parameter of dlog(REER) is significantly different from zero and unity, indicating the extent of deviation from parity. Moreover, the estimated coefficient of RIRD(-1) is shown to be significant in determination of current level of RIRD. Finally, the Chow test, using likelihood ratio, indicates that a structural break, taken place in the 1993, must have been statistically significant.

TABLE 3: Estimated VAR Reduced Form

VARIABLE	**Coefficient**	**Std. Err**	**t-Statistic**	**Prob.**
Constant	0.324	0.0871	3.852	0.001
RIRD(-1)	1.366	0.0632	21.61	0.000
dlogREER(-1)	-0.123	0.0224	5.125	0.001
t	0.034	0.0013	26.23	0.000
F-Stat = 2157 (0.000)	SE Reg = 0.164		Mean Dep Var = -2.89	
Chow LR = 70.05 (0.000)				

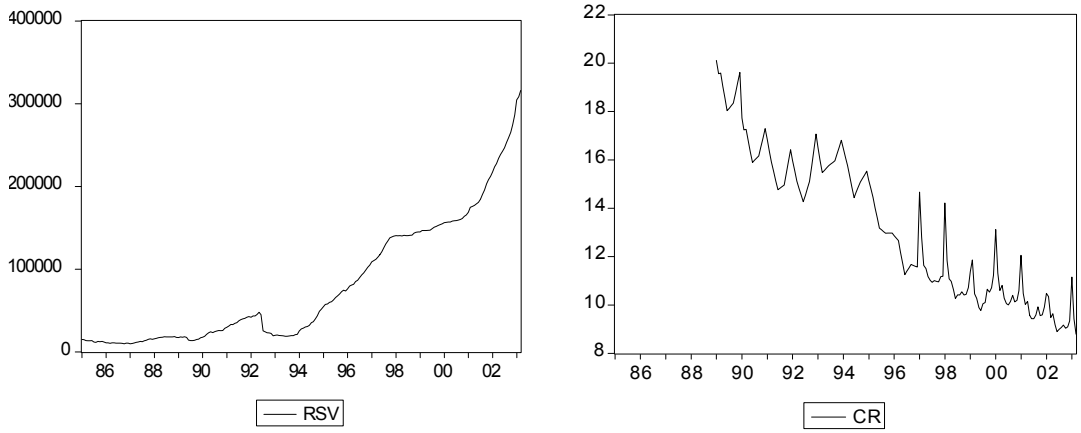
The associated impulse pictures are shown in Graph 3. These pictures also suggest that one Standard Error change in dlogREER will have a long lasting negative effect on RIRD.

For the sake of modeling, two main points here need to be mentioned. First, considering that there has been a significant structural break in the early 1990s, any stable modeling

needs to be based on the post reform period, enabling the derivation of more consistent forecasts. Second, in the light of the findings so far examined, it may be argued that parity can be modeled against some relevant macro indicators. Most researchers (amongst many, Wu et al, 2001; Zhang, 2001; and Jin, 2003) have considered foreign reserves as the most appropriate factor in determining parity. In the case of China, as an emerging developing economy, it has been noticed that money supply seems to play a crucial role in RIRD and hence indirectly affecting the parity. A good indicator of money supply in this case may be a ratio of M0 to M2. This is because as nations adopt more radical financial reforms/liberalisation, banking system will be able to absorb more money and hence offer more credits. Under this analysis, the ratio of cash holding would be expected to fall, as the efficient financial institutions will be able to release more credits to customers.

To this end, for our parity model, in addition to foreign reserves, we have considered a variable representing the share of M0 from total money stock, shown as CR here. In graphs 4 and 5, log(Reserve) and CR are depicted, respectively. A quick glance on Graph 4 shows that the real value of reserves, in $US, has increased significantly since the early 1990s reforms. Moreover, as predicted, the M0 share, in Graph 5, demonstrates a significant decline over time as financial reforms have been implemented.

Graph 4 Graph 5



The application of DF unit root test for the post-reform period suggests that both log(reserve) and CR are I(1), indicating that modeling parity would be feasible, since the parity shown as RIRD - dlog(REER) has also exhibited I(1). In the light of this information, the Johanssen cointegration test has been made, the results of which are shown in Table 4. These findings suggest that there exist at least one linear cointegrating equation between these three variables at the 1% level of significance.

TABLE 4 : Summary Results of Unrestricted Cointegration Rank Test

Sample: 1994:01 – 2003:03
Variables: Parity, log(Reserve), CR

Hypothesised No. of CEs	Trace Statistic	Critical Values	
		5%	1%
None*	38.26	15.6	20.1

At most 1**	24.81	3.78	6.65

*(**) denotes rejection of the hypothesis at the 5%(1%) level.
VERDICT: Trace test indicates 2 cointegrating equations at both 5% and 1% levels

In order to develop a long run model of parity determination, therefore, the linear model should include a series of long run vector error correction residual, representing the historic relationship between the three variables, as follows:

$$RIRD_t - dlog(REER)_t = c_0 + c_1 \log(Reserve)_t + c_2 CR_t + c_3 Resid_t(-1) + u_t \qquad (6)$$

The results of the estimated equation (6) are shown in Table 5. As the findings suggest, over the period 1994:01-2003:03, the contributions of both reserves and CR in determination of parity have been statistically significant. According to these findings, a 1% increase in reserves would lead to 7% deviation from parity. Moreover, as shown in Table 5, a 1% increase in CR would lead to appreciation of currency by as much as 1.1%.

TABLE 5: Estimated Expression (6), 1994-2003

VARIABLE	**Coefficient**	**Std. Err**	**t-Statistic**	**Prob.**
Constant	-0.7832	0.4325	1.8121	0.052

Log(Reserve)	7.0182	1.1872	5.9147	0.001
CR	-1.0865	0.3423	3.1743	0.010
Resid(-1)	0.4532	0.0234	19.362	0.000

F-statistic = 139.00 (0.000) SE Reg = 0.0234

V Conclusions

The complex nature of interactions between real exchange rate and real interest differential has led to different strands of research in developing/emerging economies. In the case of China, this paper has made an attempt to test for the existence of parity before and after the 1993/4 financial/market reforms. We found that the two variables, RIRD and REER, exhibit different degrees of integration, and that the application of cointegration has become irrelevant. That is, we can not draw any long run linear relationship between these variables. An estimated VAR model, therefore, showed that parity does not hold over the period of the study.

To discover if there is any way we could model parity, a linear model was drawn based on foreign reserves and cash holding ratio. Over the post reform period, we showed that both cash holding and reserves do determine parity. It is however anticipated that as the time goes by and financial sector becomes more efficient, the cash holding ratio becomes stable at a typical OECD level, hence helping parity to hold. Moreover, real foreign reserves can reach its ceiling and further changes become insignificant and hence helping the parity to hold.

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