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Testing the Purchasing Power Parity in China

Abstract

In this paper we examine whether purchasing power parity holds in the long run in China for the period 1970:1 to 2006:5 from an alternative method relative to the previous studies. We underlined the effects of large, but infrequent shocks due to changes of Chinese exchange policy (undertaken since the China's foreign exchange reform) on the real exchange rate, using outlier methodology. We also show that there is no tendency to the purchasing power parity in China to hold in the long run during this period.

Keywords : Purchasing power parity; real exchange rate; unit root tests; outliers; renminbi.
JEL Classification: C22, F31.

Résumé

Dans cet article nous cherchons à savoir si la parité du pouvoir d'achat est valide à long terme dans le cadre de l'économie chinoise sur la période 1970:1 à 2006:5 à partir d'une méthode alternative pa rapport aux études précédentes. Nous mettons en avant les effets d'importants mais peu fréquents chocs, dus à l'instabilité de la politique de change chinoise (depuis la réforme des devises étrangères mise en place par la China), sur le taux de change réel, en utilisant la méthodologie des points atypiques. Nous montrons également l'invalidité de la parité du pouvoir d'achat à long terme dans l'économie chinoise sur la période étudiée.

Mots Clés : Parité du pouvoir d'achat ; taux de change réel ; tests de racine unitaire ; points atypiques ; renminbi.

1 Introduction

In the past decades China has transformed itself successfully from a rigid centrally-planned economy to an increasingly open and market-oriented economy[1]. Therefore, China has achieved impressive economic growth and it has emerged as a significant force in the global economy. Due to China's continuing large trade surpluses and rapid accumulation of foreign exchange reserves much attention has been devoted to the Chinese currency, the renminbi[2] [RMB], and exchange rate regime. Given China's growing integration into the global economy and the fact that changes in its currency exchange rate will have a major external impact, the issue of RMB appreciation and the options for China's exchange rate regime have become of major concern to many countries. Although there is no consensus, the debate has continued to create a strong push for the RMB's further appreciation[3].

This paper focus on examining whether purchasing power parity [PPP] holds in the long run[4] in China. Simply defined, the PPP exchange rate is the exchange rate between two currencies which would equate the two relevant national price levels if expressed in a common currency at that rate, so that the purchasing power of a unit of either currency is identical[5]. The PPP can be viewed as a long-run equilibrium condition for the exchange rates: the real exchange rate should tend toward PPP in the very long run. The long-run PPP is also a central building block in the monetary models of exchange rate determination

[1]Branstetter and Lardy (2006) presented a summary of the major steps in the evolution of Chinese policy toward international trade and foreign direct investment and their consequences since the late 1970s.

[2]The Chinese currency is generally known as the renminbi (literally, 'people's money'), but the unit of measurement is the yuan.

[3]For a discussion on the appropriate level of the RMB, see Se-Eun and Mazier (2003), Roberts and Tiers (2003), Eichengreen (2004), Goldstein (2004), Zhang and Pan (2004), Frankel (2005), Laurenceson and Qin (2005), Coudert and Couharde (2005), Funke and Rahn (2005), and Dropsy (2005), Kaplan (2006), Shi (2006), *inter alia*.

[4]For a survey on PPP literature, see Froot and Rogoff (1995), Sarno and Taylor (2002), Taylor and Taylor (2004), and Taylor (2006).

[5]More precisely, this concept of PPP is often termed absolute PPP. Relative PPP is said to hold when the rate of depreciation of one currency relative to another matches the difference in aggregate price inflation between the two countries concerned.

(e.g., Dornbush, 1976). The real exchange rate may be interpreted as a measure of the deviation from PPP: when PPP holds, the real exchange rate is a constant so that movements in the real exchange rate represent deviations from PPP. Therefore, PPP is defined as reversion of the real exchange rate to a constant mean.

A number of recent work examined the PPP in China. For example, Xiaopu (2002), Wang (2005) and Shi (2006) used the standard unit root test developed by Dickey and Fuller (1979) on the real exchange rate over the period 1980-1999, 1980-2003 and 1991-2005, respectively, and concluded that the real exchange rate is non-stationary[6]. From panel data, Coudert and Couharde (2005) tested the PPP on the real exchange rate against the US dollar for the years 2002 and 2003. They did not reject the presence of a unit root. Funke and Rahn (2005) employed the unit root test with structural break proposed by Perron (1997) on the real exchange rate spanning the period 1985-2002. They showed that PPP does not hold even when taking into account a break that occurred in the last quarter of 1993. Therefore, these studies tend to reject the PPP.

However, the econometric techniques used previously have some drawbacks which can lead to fallacious rejection of the stationarity of the Chinese real exchange rate. Indeed, these methods did not take into account the presence of multiple structural breaks as well as the presence of outliers (infrequent large shocks). These kinds of events can be caused by the economic and political changes in China in the last decades, especially the changes of exchange policy (Huang and Wang, 2004).

Therefore, this paper further investigates the PPP in China by using efficient and robust approach to that kind of problem. We apply the efficient unit root tests developed by Elliott, Rotehenberg and Stock (1996) and Ng and Perron (2001) on the bilateral (to the US dollar) real exchange rate, corrected from the structural break and outliers, over the period 1970:1-2006:5.

The outline of the paper is as follows. In Section 2, the methodology for detecting outliers is described. The outliers detected in Chinese exchange rate, which can be associated to changes of exchange policy, are discussed in Section 3. Section

[6] Xiaopu (2002) and Shi (2006) obtained the same result by using the unit root test of Phillips and Perron (1988).

4 presents the unit root tests and interprets the results. Section 5 concludes.

2 Outlier Methodology

The search for outliers considers an unobserved components model in which there are two components: a regular component and an outlier component. This outlier component reflects extraordinary, infrequently occurring events or shocks that have important effects on macroeconomic time series. The model is given by

$$z_t = y_t + f(t) \tag{1}$$

where

$$y_t = \frac{\theta(L)}{\alpha(L)\phi(L)} a_t \qquad a_t \sim N(0, \sigma_a^2) \tag{2}$$

y_t is an ARIMA(p, d, q) process and $f(t)$ contains exogenous disturbances or outliers. Following Chen and Liu (1993), we will consider four types of outliers: additive outliers (AO), innovation outliers (IO), level shifts (LS), and temporary changes (TC). The models for different $f(t)$ are as follows

AO: $f(t) = \omega_{AO} I_t(\tau)$ LS: $f(t) = [1/(1-L)]\omega_{LS} I_t(\tau)$

IO: $f(t) = [\theta(L)/\alpha(L)\phi(L)]\omega_{IO} I_t(\tau)$ TC: $f(t) = [1/(1-\delta L)]\omega_{TC} I_t(\tau)$

where ω_i, $i =$ AO, IO, LS, TC, denote the magnitudes of the outlier, and $I_t(\tau)$ is an indicator function with the value of 1 at time $t = \tau$ and 0 otherwise, with τ the date of outlier occurring.

These outliers affect the observations differently: AO causes an immediate and one-shot effect on the observed series; LS produces an abrupt and permanent step change in the series (permanent shock); TC produces an initial effect, and this effect dies out gradually with time, where the parameter δ is designed to model the pace of the dynamic dampening effect ($0 < \delta < 1$); the effect of IO is more intricate than the effects of the other types of outliers[7]. IO will produce a

[7]Indeed, except for the case of IO, the effects of outliers on the observed series are independent of the model.

temporary effect for a stationary series whereas it will produce a permanent level shift for a non-stationary series (see Chen and Liu, 1993).
It is considered that AOs and IOs are outliers which are related to an exogenous and endogenous change in the series, respectively, and that TCs and LSs are more in the nature of structural changes. TCs represent ephemeral shifts in a series whereas LSs are more the reflection of permanent shocks. However, IOs will have a relatively persistent effect on the level of the series.

The methods are well-developed in the field of outlier detection based on intervention analysis as originally proposed by Box and Tiao (1975). An often used procedure is that of Tsay (1988). This method was also used by Balke and Fomby (1994), although with some modifications. Here we use the methods suggested by Chen and Liu (1993) and modified by Gómez and Maravall (1997) in the computer program TRAMO[8].

An ARIMA model is fitted to y_t in (2) and the residuals are obtained:

$$\hat{a}_t = \pi(B) z_t \tag{3}$$

where $\pi(B) = \alpha(B)\phi(B)/\theta(B) = 1 - \pi_1 B - \pi_2 B^2 - \dots$.

For the four types of outliers in (1), the equation in (3) becomes:

$$\begin{aligned}
\text{AO:} \quad & \hat{a}_t = a_t + \omega_{AO}\pi(B) I_t(\tau) \\
\text{IO:} \quad & \hat{a}_t = a_t + \omega_{IO} I_t(\tau) \\
\text{LS:} \quad & \hat{a}_t = a_t + \omega_{LS}[\pi(B)/(1-B)] I_t(\tau) \\
\text{TC:} \quad & \hat{a}_t = a_t + \omega_{TC}[\pi(B)/(1-\delta B)] I_t(\tau)
\end{aligned}$$

These expressions can be viewed as a regression model for $\hat{a}_t$, i.e.,

$$\hat{a}_t = \omega_i x_{i,t} + a_t \qquad i = \text{AO, IO, LS, TC},$$

with $x_{i,t} = 0$ for all i and $t < \tau$, $x_{i,t} = 1$ for all i and $t = \tau$, and for $t > \tau$ and $k \geq 1$, $x_{AO,t+k} = -\pi_k$ (AO), $x_{IO,t+k} = 0$ (IO), $x_{LS,t+k} = 1 - \sum_{j=1}^{k} \pi_j$ (LS) and $x_{TC,t+k} = \delta^k - \sum_{j=1}^{k-1} \delta^{k-j}\pi_j - \pi_k$ (TC).

[8]TRAMO: Time Series Regression with ARIMA Noise, Missing Observations, and Outliers. Franses and Haldrup (1994), Tolvi (2001) and Darné and Diebolt (2004) also used this method to detect and correct outliers in macroeconomic series whereas Balke and Fomby (1991, 1994) and Bradley and Jansen (1995) applied that of Tsay (1988).

The detection of the outliers is based on likelihood ratio statistics, given by:

$$
\begin{aligned}
&\text{AO:} \quad \hat{\tau}_{AO}(\tau) = [\hat{\omega}_{AO}(\tau)/\hat{\sigma}_a]/\big(\sum_{t=\tau}^{n} x^2_{AO,t}\big)^{1/2} \\
&\text{IO:} \quad \hat{\tau}_{IO}(\tau) = \hat{\omega}_{IO}(\tau)/\hat{\sigma}_a \\
&\text{LS:} \quad \hat{\tau}_{LS}(\tau) = [\hat{\omega}_{LS}(\tau)/\hat{\sigma}_a]/\big(\sum_{t=\tau}^{n} x^2_{LS,t}\big)^{1/2} \\
&\text{TC:} \quad \hat{\tau}_{TC}(\tau) = [\hat{\omega}_{TC}(\tau)/\hat{\sigma}_a]/\big(\sum_{t=\tau}^{n} x^2_{TC,t}\big)^{1/2} \\
&\text{with} \quad \hat{\omega}_i(\tau) = \sum_{t=\tau}^{n} \hat{a}_t x_{i,t} / \sum_{t=\tau}^{n} x^2_{i,t} \qquad \text{for } i = \text{AO, LS, TC,} \\
&\text{and} \quad \hat{\omega}_{IO}(\tau) = \hat{a}_\tau
\end{aligned}
$$

where $\hat{\omega}_i(\tau)$ (i = AO, IO, LS, TC) denotes the estimation of the outlier impact at time $t = \tau$, and $\hat{\sigma}_a$ is an estimate of the variance of the residual process (Chang et al., 1988).

Outliers are identified through running a sequential detection procedure, consisting of an outer and an inner iteration. In the outer iteration, assuming that there are no outliers, an ARMA(p, d, q) model is estimated, obtaining the residuals. The results from the outer iteration are then used in the inner iteration to identify outliers. The likelihood ratio test statistics for the four types of outliers are calculated for each observations. The largest absolute value of these test statistics ($\hat{\tau}_{max} = max|\hat{\tau}_i(\tau)|$) is compared to a pre-specified critical value, and if the test statistic is larger, an outlier is found at time $t = \tau$. In TRAMO the critical value is based on simulation experiments. When an outlier is detected, the effect of the outlier is removed from the data as follows: the observation z_t is adjusted at time $t = \tau$ to obtain the corrected y_t via (1) using the $\hat{\omega}_i$, i.e. $y_t = z_t - \hat{\omega}_i \nu_i I_t(\tau)$. This process is repeated until no more outliers can be found. Next, return to the outer iteration in which the ARIMA model is re-estimated, using the corrected data, and start the inner iteration again. This procedure is repeated until no outlier is found. Finally, a multiple regression is performed on the various outliers detected to identify spurious outliers[9].

[9]See Tolvi (2001) for detailed discussion on the outlier detection procedure.

3 The Chinese Exchange Rate Data

In this paper we study the Chinese monthly real bilateral exchange rates against the US dollar over the period 1970:1–2006:5. Formally, the real exchange rate q_t may be defined in logarithmic form as:

$$q_t = s_t - p_t + p_t^* \tag{4}$$

where s_t is the logarithms of the nominal exchange rate (domestic price of foreign currency), and p_t and p_t^* denote the logarithms of the domestic and foreign price levels, respectively. Figure 1 displays the Chinese real exchange rate.

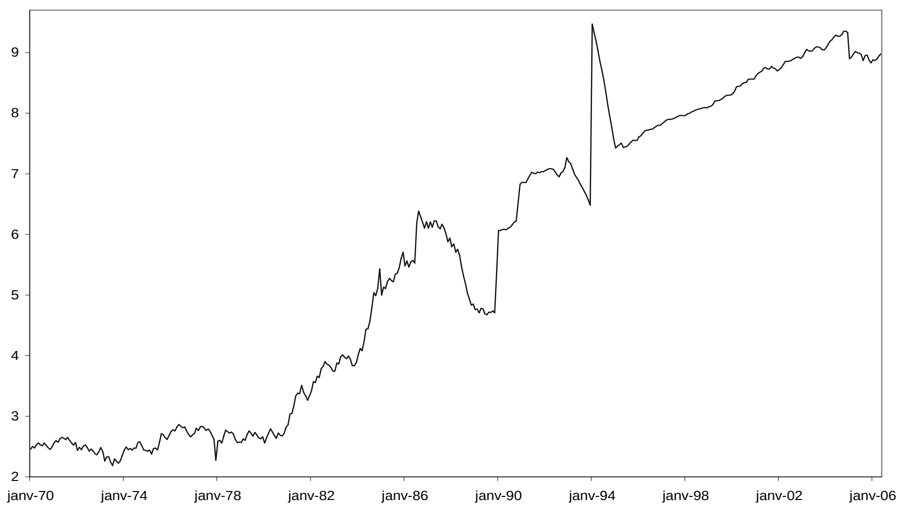

Figure 1: Chinese real bilateral exchange rate series.

Before to examine whether the PPP holds in the long run in China via the unit root tests we research the presence of outliers in the Chinese real bilateral exchange rate series. The results are presented in Table 1, and all detected outliers are given by series, with their type, timing, magnitude and t-statistics. As expected, outliers are detected, giving strong proof of infrequent large shocks. We show below that these shocks can be explained by the exchange policy led by China during this period, in particular several devaluations.

Table 1: Outlier Detection for Chinese Exchange Rate.

Date	Type	Magnitude	t-stat
1973.02	AO	-0.051	-4.10
1977.12	AO	-0.145	-11.81
1984.12	AO	0.074	5.80
1986.07	LS	0.118	6.33
1989.12	LS	0.141	7.55
1990.01	LS	0.105	5.71
1994.01	LS	0.392	21.21

In the 1950s and 1960s China pegged first to the US dollar and then to the British pound. In January 1970, a fixed official rate against the US dollar was established. Following the devaluation of the US dollar, the official rate was realigned in February 1973 (AO). With the breakdown of the Bretton Woods System, the single currency peg was replaced by a broad basket[10]. When China was a planned economy before 1979, the official exchange rate played no significant role in foreign trade, because with state monopoly in foreign trade, losses in exports resulting from an overvalued exchange rate were offset by profits from imports. However, the role of the exchange rate changed, after economic reform began in 1978. As foreign trade became decentralized, the overvalued official exchange rate hurt the export incentive (Xu, 2000)[11]. In August 1979, in order to improve incentives and promote export performance, the State Council introduced a foreign exchange retention system[12] and decided to adopt, in parallel

[10]We did not find explanation for the additive outlier in December 1977. This point could be due to error measure.

[11]See Lardy (1992, 2002) for more details.

[12]Under the foreign exchange retention system domestic economic units contributing to

to the official exchange rate, an “Internal Rate for Trade Settlement” [IRTS], operative from January 1981, i.e. a dual exchange rate system (Chou and Shih, 1998; Lin and Schramm, 2003). The IRTS was essentially for the internal settlement of trade transactions and was established at RMB 2.8 to the US dollar, and the official rate was for non-trade transactions and was established at RMB 1.5 to the US dollar.

However, the International Monetary Fund [IMF] had tried to persuade Chinese authorities to eliminate the dual-currency system and US authorities accused China of using the system to subsidize exports. In December 1984, China's central bank, the People's Bank of China [PBOC], announced the decision to abolish the IRTS by January 01, 1985. The dual exchange rate system was formally abandoned and the official exchange rate was devalued to the level of RMB 2.8 to the US dollar (AO).

In late 1984, the Chinese authorities adopted a number of administrative measures to control domestic demand and imports in response to rising inflation and a deteriorating balance of payments. A series of devaluations is applied that moved the official exchange rate from RMB 2.8 to the US dollar in August 1985 to RMB 3.7 in July 1986, especially in July 1986 (LS). The decision to devaluate was as much a political compromise as it was an effort to make the rate more in line with economic fundamentals (Lin and Schramm, 2003).

Because of the existing foreign exchange controls, foreign-funded enterprises were required to balance their own foreign exchange needs. To alleviate this constraint for foreign investors, there emerged regionally swap markets (Mehran *et al.*, 1996) called Foreign Exchanges Adjustment Centers or swap centers in which foreign-funded enterprises could swap foreign exchanges among themselves. Afterwards, local governments and state enterprises could enter swap markets to trade their retained foreign exchange quotas. At the end of 1986, with the rapid development of the foreign exchange swap market[13], a dual exchange rate system reemerged in China, i.e. the official exchange rate and the swap market rate. The swap market became an increasingly important tool to offset the distortionary effects

foreign exchange earnings were allocated a foreign exchange use quota in proportion to the foreign exchange earned (Zhang, 1999).

[13]See Lardy (1992) and Lin and Schramm (2003) for detailed discussion on the swap market.

of the overvalued official exchange rate and ensured the dynamism of the export sector.

In 1988, China adopted a number of policies (higher retentions ratios, the relaxation of price control and the expanded supply of foreign exchange) which greatly stimulated the development of the foreign exchange swap market. However, the market began experiencing the effects of a deteriorating economic environment (strong raising of inflation rate and trade deficit). Therefore, in mid-1989, the Chinese authorities adopted very strong measures to rein in the economy, tightening credits and raising interest rates. Two major devaluations (December 1989 and January 1990 (LS)) led to a considerable narrowing of the gap between the swap rate and the official rate. The swap rate had then become an important signal of macroeconomic performance.

Since April 1991, the Chinese government has officially adopted a managed floating rate regime[14] under which the official rate was allowed to adjust continuously in small steps. From 1991 to 1993, the official rate was devalued several times.

Due to the importance of the swap markets (80% of foreign exchange transactions were conducted at swap market rates at the beginning of 1992)[15] and the will of establishing a socialist market economy, China's exchange rate regime was reformed at the beginning of 1994. On January 01, 1994, official and swap market rates were unified into a single and market-oriented rate, which involved a strong devaluation of the official rate (LS in January 1994) at RMB 8.7 to the US dollar (within a band of plus or minus 0.25% of the previous day's reference rate)[16]. In

[14]Although the IMF has classified China as a managed floating exchange rate regime since 1987, China only officially admitted to such a regime in 1991 (Zhang, 2001).

[15]Lu and Zhang (2000) argued that the swap market proved to be a useful transition mechanism for China's foreign exchange liberalization.

[16]The unified exchange rate was fixed at the swap market rate that prevailed at the end of 1993. Indeed, when the system was phased out at the end of 1993, the official exchange rate stood at RMB 5.8 to the US dollar while the market swap rate was RMB 8.7 to the US dollar. The 1994 reform applied the market swap rate as the base rate, which meant that the Chinese currency was devalued around 50%. In fact, the devaluation was far less substantial as most foreign exchange settlements were already based on the market swap rate (Shen, 2001). The adoption of a uniform rate was coupled with a move to partial convertibility on current account. China officially achieved RMB convertibility under current accounts in December 1996.

order to determinate the China's exchange rate an interbank foreign exchange market, the China Foreign Exchange Trading Centre [CFETC], was instituted to replace the old swap market (Shen, 2001). After allowing a modest appreciation, the PBOC has actively sought to hold the exchange rate at around RMB 8.3 to the US dollar since 1995, a rate that was not changed until July 2005. Officially, China's exchange rate regime is managed float, but, in practice, the renminbi has been *de facto* pegged the US dollar since 1994 and allowed to vary only within a narrow range[17].

On July 21, 2005, the Chinese government announced its change in exchange rate system from the dollar peg system into a managed floating exchange rate system based on market supply and demand with reference to a currency basket[18], with a revaluation to RMB 8.11 to the US dollar. It was a calculated political move in response to mounting external pressures to revalue the Chinese RMB (Yi, 2006). However, as highlighted by Goldstein (2006), the revaluation of the renminbi that has occured since July 21 is clearly way to small to make a meaningful contribution toward appreciating significantly the real exchange rate and reducing either China's now huge external imbalance or large global payments imbalances more generally. Thus, it is not surprising that this exchange rate reform has no statistical effect on the real parity[19].

[17]The peg has worked as an important anchor to China's economic policies and has served the economy well. In the mid-1990, China managed to bring down its inflation rate significantly. China also escaped much of the turmoil during the Asian crisis in 1997-1998 and successfully maintained its peg (Koivu, 2005). IMF classified the renminbi as a conventional peg to the US dollar in 1999.

[18]The Chinese government has adopted a managed floating exchange rate system not only with reference to a currency basket but also in a range of plus or minus 0.3% (around the base rate).

[19]Ogawa and Sakane (2006) investigated the actual exchange rate policy conducted by the Chinese government since this reform and found that the Chinese government has a statistically significant but little change in exchange rate policy. However, it is not identified that the Chinese monetary authority is adopting the currency basket system because the change is too small in the economic sense. Furthermore, Zhang and Liang (2006) argued that the relative stable performance of the RMB/USD exchange rate since the July revaluation hints that the PBOC has not carried out a full basket peg yet and the US dollar still dominates the determination of the RMB exchange rate.

4 Unit Root Tests

Some studies showed that the outliers can seriously affect the unit root tests (Franses and Haldrup, 1994; Yin and Maddala, 1997; Murray and Nelson, 2000). Therefore, we applied two efficient unit root tests proposed by Elliott, Rothenberg and Stock (1996) [ERS] and Ng and Perron (2001) [NP] on outlier-adjusted and unadjusted exchange rate series[20].

ERS (1996) developed a unit root test based on a quasi-difference detrending of the series in order to increase power of Dickey-Fuller (1979) tests. They suggested the Dickey-Fuller generalized least squares (DF-GLS) test using the following regression

$$\Delta y_t^d = \beta_0 y_{t-1}^d + \sum_{j=1}^{k} \beta_j \Delta y_{t-j}^d + \varepsilon_t$$

where y_t^d is the locally detrended series y_t. The DF-GLS t-test is performed by testing the null hypothesis $\beta_0 = 0$ against the alternative $\beta_0 < 0$. The local detrending series is defined by

$$y_t^d = y_t - \hat{\psi}' z_t$$

where z_t equals to 1 for the constant mean case, and $(1, t)$ for the linear trend case, and $\hat{\psi}$ is the GLS estimator obtained by regressing $\bar{y}$ on $\bar{z}$ where

$$\begin{aligned} \bar{y} &= (y_1, (1 - \bar{\alpha}B)y_2, \ldots, (1 - \bar{\alpha}B)y_T)' \\ \bar{z} &= (z_1, (1 - \bar{\alpha}B)z_2, \ldots, (1 - \bar{\alpha}B)z_T)' \end{aligned}$$

and $\bar{\alpha} = 1 + \bar{c}/T$. ERS advise $\bar{c} = -7$ for the constant mean case and $\bar{c} = -13.5$ for the linear trend case.

Ng and Perron (2001) proposed modifications of the Phillips and Perron (1988) test, which is a non-parametric approach to correct residual autocorrelation by

[20] Darné and Diebolt (2004) studied the sensitivity of the unit root tests to the two-steps tests (correcting outliers and testing unit roots on outlier-adjusted data) from Monte Carlo experiments. They showed that this procedure does not affect the presence of unit roots in time series.

modifying the Dickey-Fuller test statistics, first, to correct the size distorsions (as suggested by Perron and Ng, 1996), second, to improve the power (as suggested by ERS, 1996). The NP test is based on the following regression

$$\Delta\tilde{y}_t = (\hat{\delta} - 1)\tilde{y}_{t-1} + \sum_{j=1}^{k} \hat{\phi}_j \Delta\tilde{y}_{t-j} + \hat{\varepsilon}_t$$

where $\tilde{y}_t$ is the locally detrended series y_t. Under the unit root null hypothesis, $\hat{\delta} = 1$; thus the NP test statistics, called M-GLS tests, are

$$\begin{aligned} MZ_t &= \left(T^{-1}\tilde{y}_T^2 - s^2\right)\left(4s^2T^{-2}\sum_{t=1}^{T}\tilde{y}_{t-1}^2\right)^{-1/2} \\ MZ_a &= \left(T^{-1}\tilde{y}_T^2 - s^2\right)\left(2T^{-2}\sum_{t=1}^{T}\tilde{y}_{t-1}^2\right)^{-1} \end{aligned}$$

where s is the autoregressive spectral density estimator of the long-term variance.

The results of unit root tests are displayed in Table 2. The tests are applied with a constant in the regression. The lag order k in the regression is selected by using both the standard information criteria and the modified information criteria [MIC] advocated by Ng and Perron (2001)[21]. The efficient unit root tests do not reject the unit root null hypothesis at the 5% level for the China's bilateral exchange rates from the both information criteria. Note that we obtain the same result from the outlier-adjusted and unadjusted series but with different values of the test statistics. This implies that the outliers disturb the unit root tests, and sometimes seriously (Yin and Maddala, 1997; Murray and Nelson, 2000).
We can conclude that the Chinese exchange rate data has no mean-reversion property, in which case all deviations from purchasing power parity are permanent. This implies that there is no tendency for purchasing power parity in China to hold in the long run.

[21]Ng and Perron (2001) showed that the standard information criteria (AIC and BIC) are not sufficiently flexible for unit root tests, mainly when there are negative moving-average errors, to select the appropriate number of lags k.

Table 2: Results of Efficient Unit Root Tests.

Series	Criteria	DF-GLS	MZ_a	MZ_t	k
outlier-unadjusted RER	BIC	0.90	0.89	0.90	0
	MIC	0.90	0.89	0.90	0
outlier-adjusted RER	BIC	-0.82	-2.13	-0.91	13
	MIC	-1.18	-6.13	-1.74	16
Critical value		-1.98	-8.10	-1.98	

* Significant at 5% level. k represents the lag order for efficient unit root tests, and is selected by using both the BIC and MIC.

5 Conclusion

This paper examined whether purchasing power parity holds in the long run in China for the period 1970:1 to 2006:5 from an alternative method relative to the previous studies. We underlined the effects of large, but infrequent shocks due to changes of Chinese exchange policy on the real exchange rate, using outlier methodology. These changes were undertaken since the China's foreign exchange reform in order to transform China from a rigid centrally-planned economy to an increasingly open and market-oriented economy. We also showed that there is no tendency to the purchasing power parity in China to hold in the long run during this period.

In accordance with our results the widespread finding concerning the large undervaluation of the renminbi must be taken with caution as long as PPP calculations are used. Indeed, PPP is not a good reference for assessing the level of equilibrium exchange rate for China, and can not be a reliable tool for economic policy.

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