Is there any economic integration among China and her Western partners?

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Abstract

In this paper, we test the real interest parity, uncovered interest parity, and purchasing power parity (PPP) for China against the US, European Union, the UK, and Japan. The real interest parity is an aggregate measure of economic integration, which can be decomposed into the integration of two major markets: the financial market and the goods market. The integration of each market can be further investigated by two independent parity tests. The uncovered interest parity is a measure of financial integration; whilst the PPP is a measure of integration of the goods markets. The main findings of this paper are that there is a long way to go for a full integration in either goods market or financial market between China and her major economic partners of the US, European Union, the UK, and Japan.

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1. Introduction

Since Deng Xiaoping adopted the open door policy in 1978, China has engaged extensively in international trade and has attracted persistent inflow of foreign capitals. China has become the third largest trading entity and the second largest recipient of foreign direct investment in the world by 2004. However, despite the extraordinary development of the Chinese economy, the market status of China has not been formally recognized by the major western governments. The large trade surplus generated by the firms located in China has also created some serious trade frictions and even political pressure for China to revalue her currency renminbi (Sun and Ma, 2005). The degree of integration of the Chinese economy with the world economy has not yet been completed and therefore is subject to formal investigation. Unfortunately, the research is limited on this area.

Tsang and Ma (2004) incorporated a Chinese macroeconometric model (Tsang and Ma, 1997) into the multi-country model of the MULTIMOD (Mark II), developed by the IMF (Masson, Symansky and Meredith, 1990). This integrated global model provided a general vehicle for the analysis of the spillover effects among the economies of China and the rest of the world. Based on some counterfactual simulations conducted on this integrated model, it was found that the Chinese economy is far from full integration with the rest of the world.

Nevertheless, this research did not decompose the integration of Chinese economy with individual regions and countries. Furthermore, it did not decompose the economic integration into goods market and financial market. Clearly, these two markets played distinguished roles in the process of overall economic integration. Therefore, this paper intends to fill in this gap by applying the unit root tests to the real interest parity (RIP), uncovered interest parity (UIP), and purchasing power parity (PPP) for China against the US, European Union, the UK, and Japan individually.

The real interest parity is an aggregate measure of overall economic integration, which can be decomposed into the integration of two major markets: the financial market and the goods market. The integration of each market can be further

investigated by two independent parity tests. The uncovered interest parity is a measure of financial integration; whilst the PPP is a measure of integration of the goods markets.

Each of the parity tests is implemented by testing the residuals from the parity conditions. If a residual is stationary, then it is an indication that the corresponding parity holds in the long-run. However, if the residual has a unit root and therefore is nonstationary, then it implies that the corresponding parity does not hold in either long-run or short-run.

Although few economists would hold the view that the PPP and UIP hold continuously in the short-run, it has been found among integrated, developed economies that the PPP and UIP hold in the long-run (Rogoff, 1996; Meredith and Ma, 2002). Similar results for the RIP can be found in Chortareas and Driver (2002).

The main findings of this paper for China's monthly data over the sample period of January 1997 to January 2005 are that there is always a unit root in the residuals derived from *any* parity condition. Therefore there is no evidence of any integration in either goods market or financial market between China and her major economic partners of the US, European Union, the UK, and Japan over the short-run and the long-run.

The remainder of the paper is organized as follows. Section 2 defines the parity conditions utilized in this paper. Section 3 tests all the parity conditions individually. Data sources are provided in Appendix. Finally, Section 4 concludes.

2. Definitions for parity conditions

The concept of real interest parity is based on *ex ante* expectations. The expected real interest parity (RIP) differential at time t between two countries is given as follows:

$$RIP \equiv r_{t,j}^{e,d} - r_{t,j}^{e,f} \qquad (1)$$

where $r_{t,j}^{e,d}$ and $r_{t,j}^{e,f}$ are the j-period expected real interest rates, for domestic and foreign country respectively. The superscripts 'd' and 'f' denote domestic and foreign

country respectively. The superscript ‘e’ indicates the expectation. In this paper, the domestic country is defined as China.

The real interest rates are defined as:

$$r_{t,j}^{e,d} \equiv i_{t,j}^{d} - \pi_{t,j}^{e,d} \text{ , and } r_{t,j}^{e,f} \equiv i_{t,j}^{f} - \pi_{t,j}^{e,f} \quad (2)$$

where $i_{t,j}^{d}$, and $i_{t,j}^{f}$ are the j-period nominal interest rates for domestic and foreign country, respectively. $\pi_{t,j}^{e,d}$ and $\pi_{t,j}^{e,d}$ are the j-period ahead, expected inflation rates in domestic and foreign country, respectively.

The expected real interest parity (RIP) differential of (1) can be decomposed into:

$$r_{t,j}^{e,d} - r_{t,j}^{e,f} \equiv (i_{t,j}^{d} - i_{t,j}^{f} - \Delta s_{t,j}^{e}) - (\pi_{t,j}^{e,d} - \pi_{t,j}^{e,f} - \Delta s_{t,j}^{e}) \quad (3)$$

where $\Delta s_{t,j}^{e}$ is expected depreciation of domestic currency in the next j-period, which is defined as follows:

$$\Delta s_{t,j}^{e} \equiv s_{t,j}^{e} - s_{t} \quad (4)$$

where $s_{t,j}^{e}$ is the expected nominal exchange rate in logarithm at time t+j. s_t is the nominal exchange rate in logarithm at time t.

The first bracket in (3), $(i_{t,j}^{d} - i_{t,j}^{f} - \Delta s_{t,j}^{e})$, is the expected uncovered interest parity (UIP) differential. The second bracket in (3), $[\pi_{t,j}^{e,d} - \pi_{t,j}^{e,f} - \Delta s_{t,j}^{e}]$, is the expected relative purchasing power parity (RPPP) differential.

Unfortunately, in practice data on expected parity differentials are unavailable. Hence *ex post* parity differentials together with rational expectations assumptions are being tested instead. Furthermore, j is set to equal to 1-month of maturity in this paper. As a consequence, annualized depreciation of Chinese currency is given as follows:

$$\Delta s_{t+1}^{a} \equiv (s_{t+1} - s_{t}) \times 12 \times 100 \quad (5)$$

where superscript ‘a’ indicates annualized percentage change.

Annualized domestic expected inflation rate at time t is given by:

$$\pi_{t+1}^{a,d} \equiv (p_{t+1}^{d} - p_{t}^{d}) \times 12 \times 100 \qquad (6)$$

where p_{t+1}^{d} and p_{t}^{d} are prices in logarithm at time t+1 and t respectively.

By substituting (5) and (6) into (3), we have a testable version of the real interest parity (RIP) differential:

$$r_{t,1}^{a,d} - r_{t,1}^{a,f} \equiv (i_{t,1}^{d} - i_{t,1}^{f} - \Delta s_{t+1}^{a}) - (\pi_{t+1}^{a,d} - \pi_{t+1}^{a,f} - \Delta s_{t+1}^{a}) \qquad (7)$$

If a parity differential is nonstationary after the test on its level term, then parity differential can be further tested on its first-difference to confirm it has only one unit root:

$$\Delta(r_{t,1}^{a,d} - r_{t,1}^{a,f}) \equiv \Delta(i_{t,1}^{d} - i_{t,1}^{f} - \Delta s_{t+1}^{a}) - \Delta(\pi_{t+1}^{a,d} - \pi_{t+1}^{a,f} - \Delta s_{t+1}^{a}) \qquad (8)$$

where Δ is the first-difference operator.

3. Empirical results

In this section, we first test the unit root in each time series of nominal interest rates, inflation rates, for China, the US, European Union, the UK, and Japan. We also test the first-differenced nominal exchange rates the Chinese currency renminbi (RMB) against the other four regional currencies. Then we apply the unit root tests to the real interest parity, uncovered interest parity, and relative purchasing power parity (PPP) for China against the US, European Union, the UK, and Japan individually.

Monthly (end-of-period) data on one-month inter-bank interest rates, nominal bilateral exchange rates and consumer price indices are gathered for China, the United States, the European Union, the United Kingdom, and Japan, from January1997 to January2005. Appendix provides detailed description on data sources.

Interest Rate, inflation rate and foreign exchange rate change are plotted in Figs. 1-3. The relative purchasing power parity (RPPP) differential, uncovered interest parity (UIP) differential, and real interest parity (RIP) are plotted in Figs. 4-6 in annualized percentages. Some preliminary phenomena can be observed. First, interest rates tend to decrease over time leaving inflation and the change of nominal exchange rate

remains constant but with large volatility. Second, we observe that RPPP differential fluctuate around zero with large volatility. The UIP and RIP differentials are decreasing first and then fluctuate around mean zero with large volatility.

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3.1. Augmented Dicky-Fuller (ADF) Tests for individual series

Consider a series at time t,

$$\Delta q_t = \alpha_0 + b q_{t-1} + \sum_{j=1}^{p} \delta_j \Delta q_{t-j} + \varepsilon_t \quad (1)$$

where Δq_t is the first-differenced time series. Δq_{t-j} is the j-th augmenting term. The number of augmenting terms is selected by first starting with a maximum of twelve lags and testing down. Lags were deleted if it is not significant using a standard t-test at the 5% significant level. Based on Q-statistics, lags are included, even when it was found to be insignificant, but their deletion would lead to serial autocorrelation at the 5% significant level. ε_t is the error term. Equation (1) is estimated by ordinary least square (OLS) regression and the unit root null hypothesis is rejected when the ADF-statistic is found to be significant at the 5% level for the null hypothesis H_0: b=0, against the alterative H_a: b<0.

Table 1 presents ADF unit root test results for each individual time series. Each ADF test is repeated with and without a linear time trend respectively. First, the ADF test indicates that all interest rates contain a unit root. Second, inflation rates of China and the EU both contain a unit root. However, the evidence is in favor of stationarity for inflation rates of the US, the UK, and Japan. Third, first-differenced nominal RMB exchange rates against the other four regional currencies are all stationary.

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Insert Table 1 About Here

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3.2. ADF Tests for parity differentials

Parity conditions are evaluated by the standard ADF unit root tests and evidences are in support of parity conditions if parity differentials are found to be stationary.

Table 2 presents ADF unit root test results of all the parity differentials of China against her four major economic partners [cf. equation (7)]. The ADF tests indicate that all the null hypotheses that parity differentials contain a unit root cannot be rejected at the 5% significant level.

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Insert Table 2 About Here

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Furthermore, Table 3 presents ADF statistic for parity differentials in first-difference [cf. equation (8)]. It indicates that all the differenced series are stationary at 5% significant level. This confirms that all the original parity differentials are indeed I(1) series.

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Insert Table 3 About Here

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The above results imply that real and financial integration are not yet well established between China and her four major economic partners of the US, EU, the UK and Japan.

Conclusion

In this paper, we tested the real interest parity, uncovered interest parity, and purchasing power parity (PPP) for China against the US, European Union, the UK, and Japan. We found all the three parity differentials had been failed for China against her four major economic partners over the sample period of January 1997 to January

2005. This conclusion is hardly surprising. The financial integration of China with the international financial markets is hampered by (a) the strict capital account and foreign exchange controls, and (b) underdeveloped domestic financial markets (Sun and Ma, 2003) and the banking sector. Although China joined the WTO at the end of 2001, there are still many trade barriers existing on Chinese boarders due to both protectionist measures imposed by the Chinese government and her major trading partners. Therefore, before these restrictions and problems will be lifted and solved, one would not expect a full integration of Chinese economy with the world economy.

Appendix. Data sources

The data are gathered from China Infobank, Datastream, and International Financial Statistics (IFS) published by the IMF. The monthly series retrieved from the China Infobank are the China 1-month interbank offer rate, Euro-RMB exchange rate, and Chinese CPI. The monthly series retrieved from the Datastream are (i) 1-month interbank interest rate of Europe, Japan, the UK, and the US, (ii) bilateral exchange rates of Japanese Yen-RMB, British pound-RMB, US dollar-RMB, and (iii) the EU CPI. The monthly series retrieved from the IFS are the CPI of Japan, the UK, and the US. The X-12 routine (with multiplicative factors on the levels) available in Eviews 5.0 was applied to seasonally adjust all the CPI series.

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Table 1. ADF unit root test results for individual time series (sample period: January1997 to January2005)

	No time trend				With time trend			
(1a) Nominal interest rates								
Country	Lag	Test Stat.	P-value	Conclusion	Lag	Test Stat.	P-value	Conclusion
China	3	-2.8719	(0.0525)	I(1)	3	-2.1641	(0.5035)	I(1)
US	3	-1.2943	(0.6296)	I(1)	3	-1.6257	(0.7754)	I(1)
EU	3	-1.4304	(0.5642)	I(1)	3	-2.114	(0.5311)	I(1)
UK	2	-1.341	(0.6077)	I(1)	2	-2.3857	(0.3845)	I(1)
Japan	12	-2.1525	(0.2252)	I(1)	12	-2.3366	(0.4097)	I(1)
(1b) Differenced nominal interest rates								
Country	Lag	Test Stat.	P-value	Conclusion	Lag	Test Stat.	P-value	Conclusion
China	3	-8.4549	(0.0000)	I(0)	3	-9.3609	(0.0000)	I(0)
US	1	-5.2616	(0.0000)	I(0)	1	-5.2373	(0.0002)	I(0)
EU	2	-3.5387	(0.0090)	I(0)	2	-3.527	(0.0423)	I(0)
UK	1	-4.1007	(0.0016)	I(0)	1	-4.0815	(0.0093)	I(0)
Japan	12	-3.4855	(0.0108)	I(0)	12	-3.9424	(0.0145)	I(0)
(2a) First-differenced log CPI*								
Country	Lag	Test Stat.	P-value	Conclusion	Lag	Test Stat.	P-value	Conclusion
China	11	-1.9789	(0.2955)	I(1)	11	-2.6208	(0.2724)	I(1)
US	12	-3.5291	(0.0095)	I(0)	12	-3.482	(0.0479)	I(0)
EU	10	-1.4214	(0.5682)	I(1)	10	-1.2507	(0.893)	I(1)
UK	0	-8.4053	(0.0000)	I(0)	0	-8.3604	(0.0000)	I(0)
Japan	4	-5.0519	(0.0001)	I(0)	4	-4.926	(0.0006)	I(0)
(2b) Second-differenced log CPI								
Country	Lag	Test Stat.	P-value	Conclusion	Lag	Test Stat.	P-value	Conclusion
China	9	-5.6949	(0.0000)	I(0)	9	-5.6543	(0.0000)	I(0)
EU	10	-4.5552	(0.0003)	I(0)	10	-4.5596	(0.0022)	I(0)
(3) Differenced log of RMB exchange rates								
Partner	Lag	Test Stat.	P-value	Conclusion	Lag	Test Stat.	P-value	Conclusion
US dollar	0	-18.277	(0.0000)	I(0)	0	-18.184	(0.0000)	I(0)
Euro	0	-14.411	(0.0000)	I(0)	0	-14.337	(0.0000)	I(0)
British pound	0	-15.697	(0.0000)	I(0)	0	-15.61	(0.0000)	I(0)
Jap. yen	4	-6.4011	(0.0000)	I(0)	4	-6.3577	(0.0000)	I(0)

Note: (1) Lag is the number of augmenting terms included. Conclusion is based on the 5% significant level.

(2) * If the 1st-differenced log CPI is already I(0), then there is no need to test the 2nd-differenced log CPI.

Table.2: ADF unit root test results for parity differentials of China against her 4 partners (sample period: January1997 to January2005)

	No time trend				With time trend			
(1) Relative purchasing power parity (RPPP)								
Partner	Lag	Test Stat.	P-value	Conclusion	Lag	Test Stat.	P-value	Conclusion
US	11	-1.7128	(0.4212)	I(1)	11	-2.2963	(0.4311)	I(1)
EU	8	-2.0911	(0.2488)	I(1)	8	-2.545	(0.3064)	I(1)
UK	8	-2.5517	(0.1071)	I(1)	8	-3.0661	(0.121)	I(1)
Japan	8	-2.6207	(0.0927)	I(1)	8	-2.6085	(0.2777)	I(1)
(2) Uncovered interest parity (UIP)								
Partner	Lag	Test Stat.	P-value	Conclusion	Lag	Test Stat.	P-value	Conclusion
US	4	-2.2627	(0.1863)	I(1)	4	-2.131	(0.5215)	I(1)
EU	7	-2.6757	(0.0823)	I(1)	7	-3.4239	(0.0547)	I(1)
UK	10	-2.0352	(0.2715)	I(1)	10	-3.0959	(0.1140)	I(1)
Japan	8	-2.4794	(0.1240)	I(1)	8	-2.5647	(0.2973)	I(1)
(3) Real interest parity (RIP)								
Partner	Lag	Test Stat.	P-value	Conclusion	Lag	Test Stat.	P-value	Conclusion
US	11	-2.3837	(0.1494)	I(1)	11	-1.8882	(0.6518)	I(1)
EU	4	-2.4092	(0.1421)	I(1)	4	-3.2283	(0.0855)	I(1)
UK	11	-2.7997	(0.0626)	I(1)	11	-2.3664	(0.3942)	I(1)
Japan	6	-2.1942	(0.6085)	I(1)	6	-1.9715	(0.6085)	I(1)

Note: See Table 1.

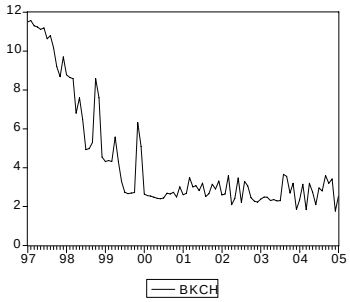
Table 3. ADF unit root test results for the parity differentials in 1st-difference of China against her 4 partners (sample period: January1997 to January2005)

(1) Differenced RPPP								
Partner	Lag	Test Stat.	P-value	Conclusion	Lag	Test Stat.	P-value	Conclusion
US	9	-5.59755	(0.0000)	I(0)	9	-5.44709	(0.0001)	I(0)
EU	8	-5.8476	(0.0000)	I(0)	8	-5.809	(0.0000)	I(0)
UK	8	-5.6703	(0.0000)	I(0)	8	-5.6658	(0.0000)	I(0)
Japan	8	-5.5517	(0.0000)	I(0)	8	-5.5119	(0.0001)	I(0)
(2) Differenced UIP								
Partner	Lag	Test Stat.	P-value	Conclusion	Lag	Test Stat.	P-value	Conclusion
US	4	-4.4805	(0.0004)	I(0)	4	-4.7969	(0.0010)	I(0)
EU	7	-6.7319	(0.0000)	I(0)	7	-6.6882	(0.0000)	I(0)
UK	10	-5.587	(0.0000)	I(0)	10	-5.5483	(0.0001)	I(0)
Japan	8	-5.4537	(0.0000)	I(0)	8	-5.4221	(0.0001)	I(0)
(3) Differenced RIP								
Partner	Lag	Test Stat.	P-value	Conclusion	Lag	Test Stat.	P-value	Conclusion
US	9	-4.82919	(0.0001)	I(0)	9	-5.06013	(0.0004)	I(0)
EU	4	-7.1681	(0.0000)	I(0)	4	-4.65007	(0.0017)	I(0)
UK	9	-4.36054	(0.0007)	I(0)	9	-8.7224	(0.0000)	I(0)
Japan	6	-6.3306	(0.0000)	I(0)	6	-6.6092	(0.0000)	I(0)

Note: See Table 1.

Figure 1. Nominal Interest Rates

China



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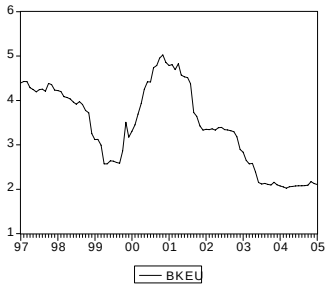

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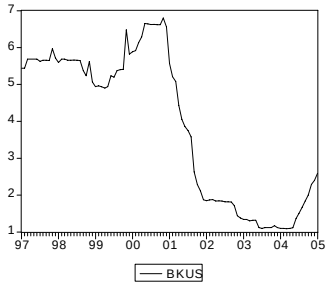

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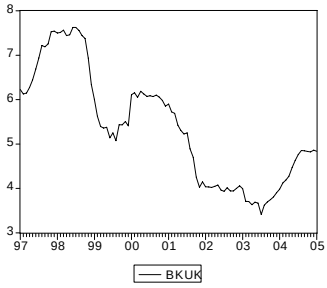

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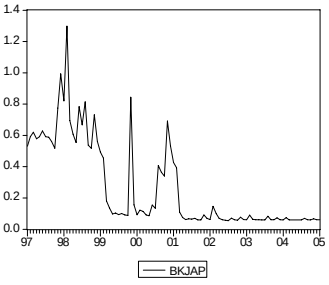
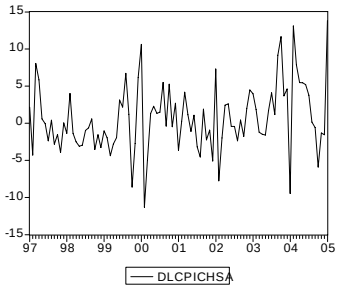


Figure 2. Inflation Rates

China



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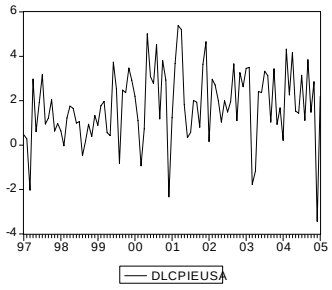

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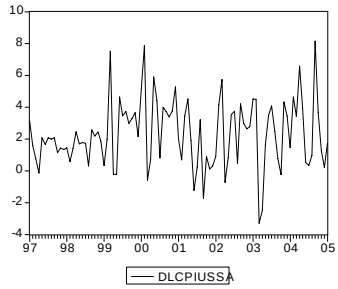

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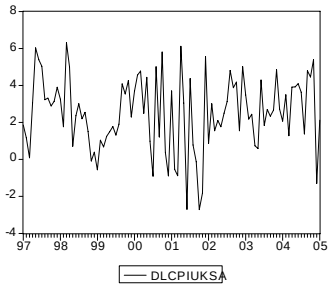

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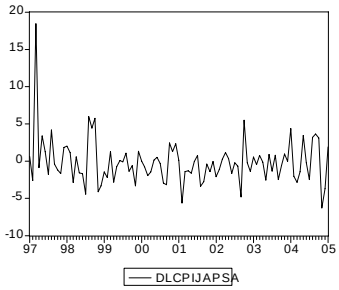
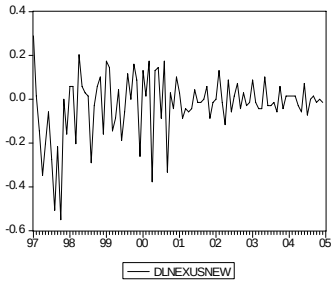
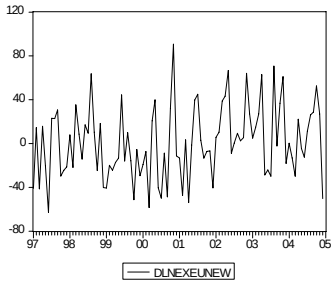


Figure 3. Renminbi Bilateral Exchange Rate Depreciation Rates

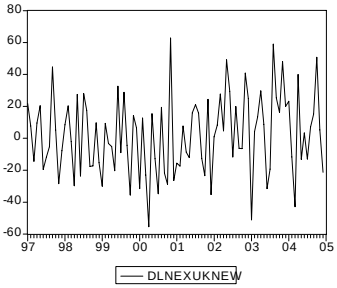
US Dollar



EURO



Pound Sterling



Japanese Yen

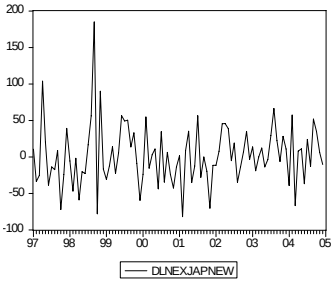
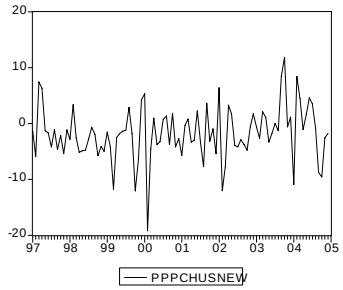


Figure.4. Relative Purchasing Power Differentials of China against her 4 partners

US



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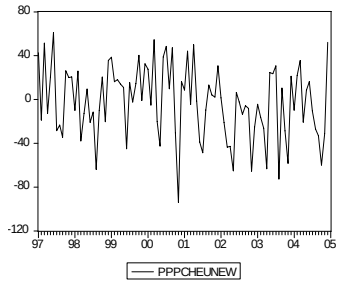
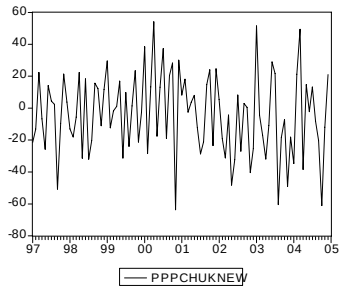


UK



Japan

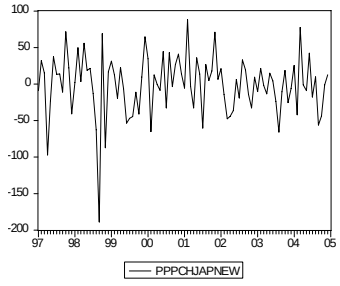
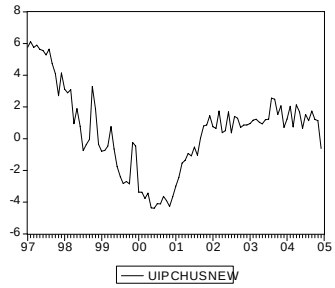


Figure.5. Uncovered Interest Rate Differentials of China against her 4 partners

US



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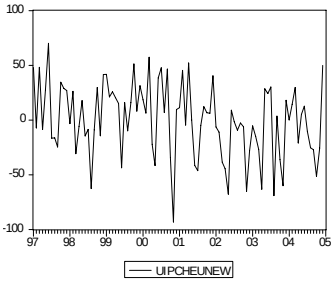

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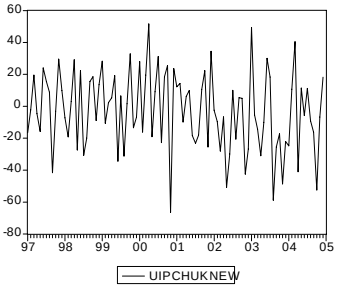


Japan

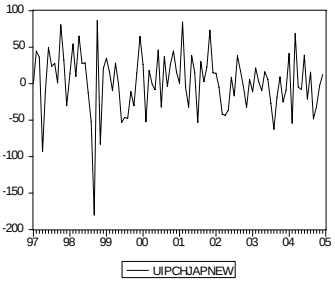
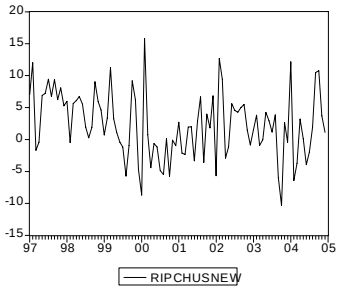


Figure 6. Real Interest Rate Differentials of China against her 4 partners

US



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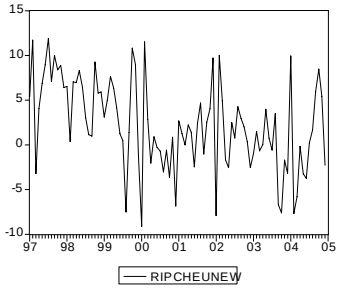
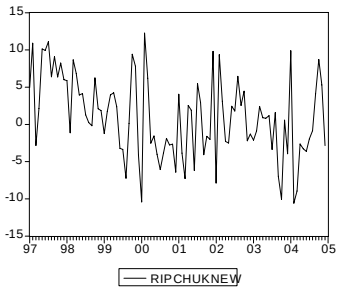


UK



Japan