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# IS CHINA INTEGRATED WITH HER MAJOR TRADING PARTNERS: EVIDENCE ON FINANCIAL AND REAL INTEGRATION

**Mehmet Huseyin Bilgin[1], Chi Keung Marco Lau[2], Manuela Tvaronavičienė[3]**

*[1] Kadir Has University, 34083 Cibali-Fatih, Istanbul, Turkey (corresponding author)*
*[2] The Hong Kong Polytechnic University, Hung Hom, Kowloon, Hong Kong*
*[3] Vilnius Gediminas Technical University, Saulėtekio al. 11, LT-10223 Vilnius, Lithuania*
*E-mail: [1]mhbilgin@khas.edu.tr; [2]tcmarkov.lau@polyu.edu.hk; [3]manuela@vgtu.lt*

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**Abstract.** Applying the new panel unit root test developed in this paper, we can overcome the pitfalls of old-fashioned panel unit root tests making it possible for researchers testing individual series for a unit root while taking contemporaneous cross-sectional dependence and structural break into account. The proposed test was used to investigate the status of financial and real integration of China, Japan, UK, the European Union, and the United States based on the empirical validity of real interest parity, uncovered interest parity, and relative purchasing power parity. We found strong evidence in favor of those parity conditions and hence concluded that financial and real integration between China and the other four countries was well established using the new developed panel unit root test while the traditional tests (either univariate or panel) fail to do so.

**Keywords:** financial and real integration, uncovered interest parity, real interest parity, purchasing power parity, foreign trade, China.

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## 1. Introduction

Recently a vast amount of studies have focused on the effect of trade flow issues after China entered the World Trade Organization (WTO), for example Wang (2003) and Ma (2001), Wei *et al.* (2000), Noland *et al.* (1998), and Fernald *et al.* (1999), among others. Despite claims about significance of institutional conditions (Tvaronavičienė *et al.* 2009), there is a lack of

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thoroughgoing quantitative analyses focusing on the empirical issues of real and financial links between separate countries. Financial links, e.g. between China and her major trading partners were elaborated by e.g. Cheung, He and Ng (1994), Glick and Hutchison (1990), Chinn and Frankel (1994), De Brouwer (1999), Kumhof (2001), and Cheung *et al.* (2003, 2006). Lane and Schmukler (2007) concentrated on the international financial integration of China and India. In his senior thesis, Lei (2006) analyzed the real and financial integration between China and Taiwan basing his research on the empirical validity of real interest parity, uncovered interest parity and relative purchasing power parity. Moreover, Chan *et al.* (2007) investigated the real and financial integration among East Asian economies. They incorporated the ASEAN-5, South Korea and mainland China with the US and Japan taken as base countries. The authors have chosen a SURADF panel approach, which complies with one of perceptions expressed by other authors (e.g. Kahraman and Kaya 2010). Additionally, Cheung *et al.* (2006) assessed and compared the linkages between China and the other Chinese economies of Hong Kong and Taiwan against the linkages with Japan and the US. They characterized the time series behavior of three criteria of integration, namely real interest parity, uncovered interest parity, and relative purchasing power parity.

In this paper, we examine the empirical validity of real interest parity, uncovered interest parity, and purchasing power parity. These three parity conditions define the key links between markets. As Cheung *et al.* (2003, 2006) mentioned those parity conditions are traditionally used to quantify the degree of integration in capital, financial, and goods markets. However, the unit root tests applied in their studies are not appropriate in the sense that they ignore the issues of contemporaneous cross-sectional dependence and structural break in the arbitrage process, and therefore resulted in misleading conclusions.

It is important to study the real and financial integration of China with her major trading partners of developed countries for several reasons. Firstly, the international competitiveness of a country has become increasingly crucial for survival in a globalized world; the current paper assesses the competitiveness of the Chinese economy from the perspective of the degree of integration in the commodity and financial markets, and hence sheds light on its international competitiveness. Secondly, it is of current interest for researchers to know if China can pull the world, especially the developed countries out of recession in occurrence of economic shocks, for example like the current financial crisis. Many observers hope China can be the engine of the world economy, however, despite the fact that China's phenomenal growth continues a strong link between China and developed economies is a necessary condition for China to become the engine of the world economy.

Furthermore, the financial aspect is also one of the strong motivations of this study. We attempt to analyze how financial reforms and the liberalization of capital accounts of China affect the financial integration of China with her major trading partners. As Lane and Schmukler (2007) mentioned, China's international balance sheet is highly skewed. In fact, in 2008, China became the third largest FDI recipient country (after the United States and France) in the world. Moreover, China has become an important source of outward investment. There are also large amounts of capital flows and portfolio investments in China and from China to her major trading partners. These all make analyzing the financial integration of China with her major trading partners important.

The rest of this paper is organized as follows. Section 2 lays out a conceptual framework for analyzing the components of financial and real integration. Section 3 presents empirical evidence for the validity of those three parity conditions. Some concluding remarks are offered in Section 4.

## 2. A Conceptual framework for analyzing integration

Following the idea of Cheung *et al.* (2006) the evidence of real market integration exists when relative purchasing power parity holds while there is evidence for financial integration where uncovered interest parity holds. Moreover, if both real and financial parity exists simultaneously the real interest parity has to hold. The concept of real interest parity is based on ex ante real interest rate. Hence, theoretically we expected Real Interest Parity (RIP) differential between two countries:

$$r_{t,j}^{e,d} - r_{t,j}^{e,f} \equiv (i_{t,j}^{d} - i_{t,j}^{f} - \Delta s_{t,j}^{e}) - [\pi_{t,j}^{e,d} - \pi_{t,j}^{e,f} - \Delta s_{t,j}^{e}], \quad (1)$$

where $r_{t,j}^{e,d}$, $i_{t,j}^{d}$, and $\pi_{t,j}^{e,d}$ are the $j$ period expected real interest rate, expected nominal interest rate, and expected inflation in domestic country respectively. The $d$ and $f$ denotes domestic and foreign countries respectively where $e$ and $j$ indicate expectation and $j$ period maturity, $j$ equal to $t + 1$ in our case. Expected depreciation is defined as:

$$\Delta s_{t,t+1}^{e} \equiv s_{t,t+1}^{e} - s_t \cdot 12 \cdot 100, \quad (2)$$

where $s_{t,j}^{e}$ is the expected nominal foreign exchange rate in logarithm between two countries at time $t + 1$ while $s_t$ is the nominal foreign exchange rate in logarithm at time $t$. Annualized domestic expected inflation rate at time $t$ is given by:

$$\pi_{t,j}^{e,d} \equiv (p_{t,t+1}^{d,e} - p_t) \cdot 12 \cdot 100, \quad (3)$$

where $p_{t,t+1}^{d,e}$ and $p_t$ are the price in logarithm expected at time $t + 1$ and the price in logarithm at $t$ respectively.

In ex ante sense; the term $(i_{t,j}^{d} - i_{t,j}^{f} - \Delta s_{t,j}^{e})$ is the expected Uncovered Interest Parity (UIP) differential while $[\pi_{t,j}^{e,d} - \pi_{t,j}^{e,f} - \Delta s_{t,j}^{e}]$ is the expected relative Purchasing Power Parity (RPPP) differential.

Unfortunately, in practice data on expected parity differentials are unavailable so we adopt ex post parity differentials instead assuming rational expectations hold. We have:

$$r_{t,j}^{d} - r_{t,j}^{f} \equiv (i_{t,j}^{d} - i_{t,j}^{f} - \Delta s_{t,j}) - [\pi_{t,j}^{d} - \pi_{t,j}^{f} - \Delta s_{t,j}]. \quad (4)$$

The above equations imply that a *necessary* condition for real interest parity to hold is that uncovered interest parity and relative purchasing power parity have to hold simultaneously. The existence of uncovered interest parity implies financial integration as supported by arbitrage activities. On the other hand, evidence in support of relative purchasing power parity implies real market integration. Therefore, real interest parity is a function of *both* financial and real market integration (Frankel 1991). In the following section, we will provide empirical results on the real and financial integration between China and her main trading partners.

## 3. Empirical methodology and results

### 3.1. Summary statistics

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 European Union, Japan, the United Kingdom, and the United States, from January of 1997 to January of 2005. Appendix 1 provides detailed description about data sources.

The parity differential of PPP, UIP, and RIP are plotted in Figs. 1–3 in annualized percentages. Some preliminary phenomena can be observed on the degree of integration though time. First, in Figs. 1 and 2, we can observe that the RIP and UIP differentials are decreasing from 1997:01 to 1999:12, and then fluctuate around mean zero. Second, in Fig. 3, PPP differential fluctuate around mean zero without large volatility for the whole sample period. Third, in Figs. 1, 2, and 3, we observe that the parity differential of all countries shows signs of co-movement over the same sample period.

Table 1 presents descriptive statistics of parity differentials. Some preliminary results can also be derived from the degree of integration. For example, China and the US exhibit the smallest mean, range (maximum minus minimum), and standard deviation for UIP differential. If we use these descriptive statistics to infer the degree of integration, we may conclude that China and the US maintain the highest degree of financial integration while evidence for the RIP and PPP differential are not clear. We should note that mean for the UIP differential is the highest for Japan among the four countries, implying that the financial market is not well integrated between China and Japan. Moreover, the mean of the PPP differential is the highest for the UK, implying that the commodity market is also not well integrated between China and UK.

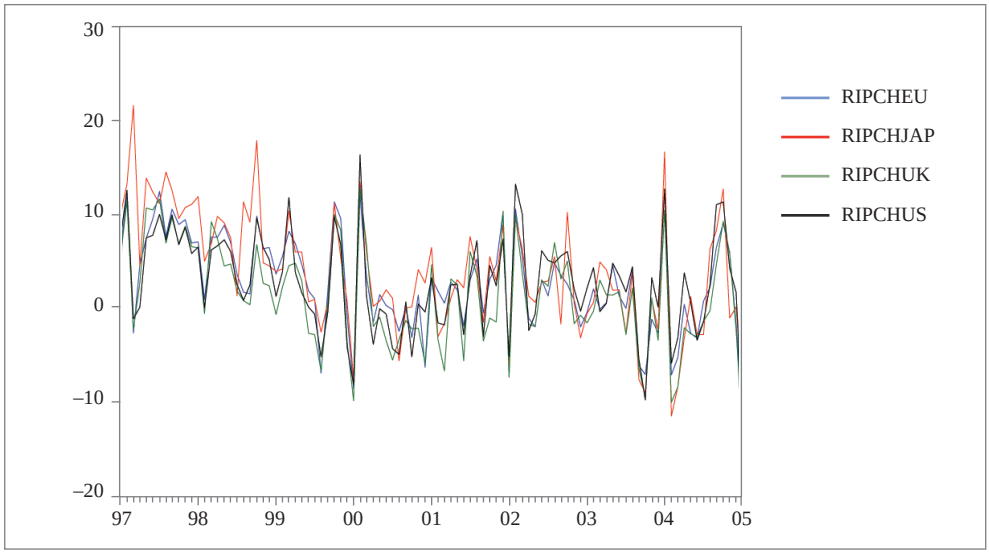


**Fig. 1.** Real interest rate parity

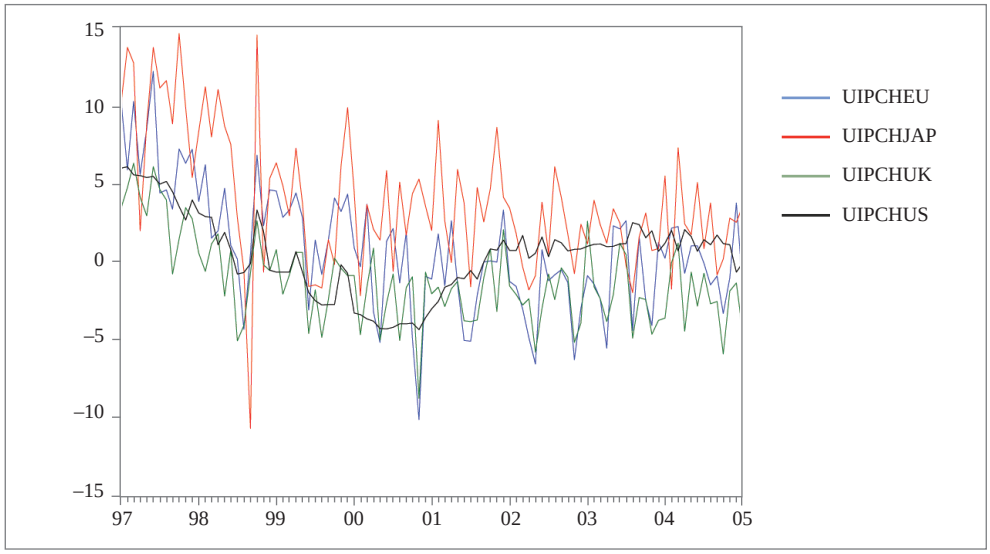


**Fig. 2.** Uncovered interest rate parity

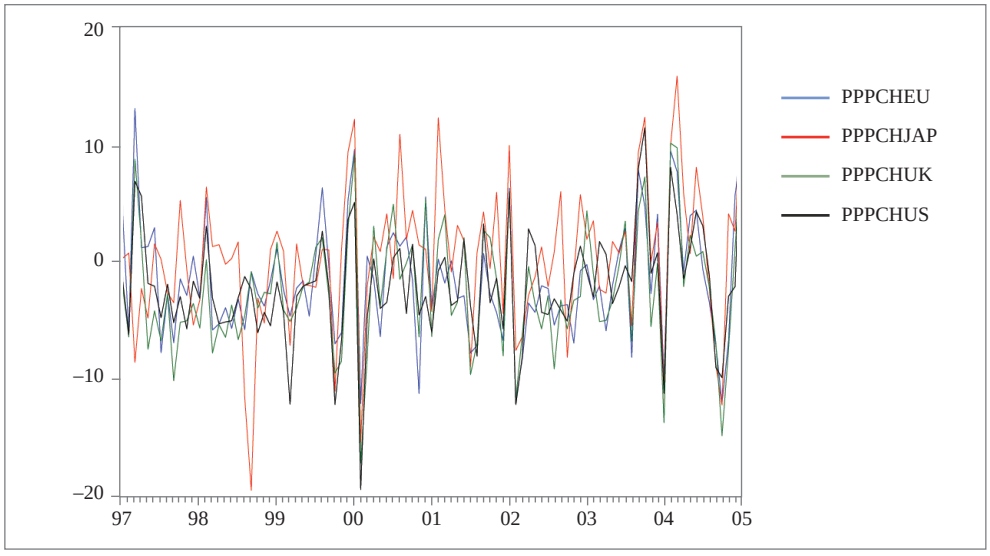


**Fig. 3.** Purchasing power parity

The central idea of mean reversion was used as a conceptual context to assess the parity conditions. The idea resides on the possibility that *real* interest parity differentials are temporary and therefore may exist in the short run, however real interest differentials may revert to their equilibrium value over a longer period. In contrast, if real interest differentials

**Table 1.** Descriptive statistics

| RIP | RIPCHEU | RIPCHJAP | RIPCHUK | RIPCHUS |
|---|---|---|---|---|
| Mean | 2.112** | 3.325** | 0.870 | 2.15** |
| Median | 1.667 | 3.20 | 0.879 | 1.948 |
| Maximum | 11.91 | 21.07 | 12.27 | 15.81 |
| Minimum | –11.22 | –12.05 | –14.0 | –12.16 |
| Std. Dev. | 5.144 | 6.364 | 5.611 | 5.317 |
| **UIP** | **UIPCHEU** | **UIPCHJAP** | **UIPCHUK** | **UIPCHUS** |
| Mean | 0.863** | 3.951** | –1.176** | 0.495* |
| Median | 0.928 | 3.504 | –1.514 | 0.788 |
| Maximum | 12.25 | 14.672 | 6.352 | 6.131 |
| Minimum | –10.092 | –10.65 | –8.725 | –4.310 |
| Std. Dev. | 3.941 | 4.399 | 2.804 | 2.575 |
| **PPP** | **PPPCHEU** | **PPPCHJAP** | **PPPCHUK** | **PPPCHUS** |
| Mean | –1.249** | 0.626 | –2.046** | –1.66** |
| Median | –1.893 | 1.213 | –2.0591474 | –1.75 |
| Maximum | 13.5 | 16.28 | 10.57 | 12.08 |
| Minimum | –11.79 | –19.26 | –16.92 | –19.17 |
| Std. Dev. | 5.147 | 6.206 | 5.369 | 4.926 |

* The sample mean is significant at the 5% level.

** The sample mean is significant at the 1% level.

are not stationary shocks then they will lead to short run (temporary) as well as long run (permanent) deviation from the hypothetical equilibrium value. Therefore, "Parity Conditions" will be evaluated using several unit root tests and "Parity Conditions" are supported whenever parity differentials are found to be stationary.

### 3.2. Univariate augmented dicky-fuller (ADF) test

Consider a series at time *t*,

$$\Delta q_t = \alpha_0 + bq_{t-1} + \delta\Delta q_{t-1} + \varepsilon_t, \tag{5}$$

where $\Delta q_t$ is the series of interested items in first difference. $\Delta q_{t-1}$ is the augmenting term and $\varepsilon_t$ is the IID error term, i.e. $\varepsilon_t \sim id(0,\sigma^2)$. Equation (5) are estimated by Ordinary Least Square (OLS) and the unit root null hypothesis is rejected when the ADF-statistic is found to be significant for the null: $b = 0$ against the alternative $b < 0$.

**Table 2.** Summary of ADF unit root test for parity conditions

| **Sample Period: 01:1997–01:2005** | | | | |
|---|---|---|---|---|
| **RIP** | CHEU | CHJAP | CHUK | CHUS |
| $B^{\mu}$ | –0.678 | –0.508 | –0.723 | –0.907 |
| p-value | 0 | 0 | 0 | 0 |
| $ADF^{\mu}$-Stat | –5.285 | –4.317 | –5.551 | –6.72 |
| p-value | 0 | 0.0007 | 0 | 0 |
| Conclusion | I(0) | I(0) | I(0) | I(0) |
| **UIP** | | | | |
| $B^{\mu}$ | –0.36 | –0.50 | –0.48 | –0.08 |
| p-value | 0.0002 | 0 | 0 | 0.017 |
| $ADF^{\mu}$-Stat | –3.902 | –4.555 | –4.538 | –2.413 |
| p-value | 0.0029 | 0.0003 | 0.0003 | 0.1407 |
| Conclusion | I(0) | I(0) | I(0) | I(1) |
| **PPP** | | | | |
| $B^{\mu}$ | –0.994 | –0.966 | –1.149 | –1.082 |
| p-value | 0 | 0 | 0 | 0 |
| $ADF^{\mu}$-Stat | –6.592 | –6.952 | –7.806 | –7.56 |
| p-value | 0 | 0 | 0 | 0 |
| Conclusion | I(0) | I(0) | I(0) | I(0) |

**Note:** Regression with linear time trend provides the same conclusion and results are available upon request.

Table 2 presents ADF t-statistics for parity differentials. Since one lagged augmentation term was sufficient to clear up any problems of residual serial correlation, inferences are based on this specification. It indicates that all parity differentials except the UIP differential for the pair of China and the US may be stationary with 5% significance level[1]. Some implications for financial and real integration can be drawn from the above reported results. With regard to real integration, we conclude that real integration was well established between China and the other four countries; however, there is evidence of financial integration between China and the other countries with the US being an exception. As Ng and Perron (1995) concluded the selection of lag length is important when using unit root test. If the number of lags included in Eq(5) is too large the power of the test will suffer and the null hypothesis of a unit root will be accepted too often. We also estimate Eq(5) by using AIC as lag selection criteria, and not surprising all series are found to be are I (1) series because the number of augmented terms selected is too large[2].

[1] Unit root test is also imposed on the first differenced data of the UIP differential between China and the US. The result shows that it's I(0) therefore we can exclude the possibility of explosive root.

[2] Results are available upon request.

### 3.3. Some more powerful unit root tests

However, it's well documented in the literature that the ADF test has low power against the stationary alternative. Maddala and Kim (1998) among others have criticized univariate unit root tests for having low power against stationary alternative. This problem becomes even more severe when the sample sizes used are relatively small. Two solutions are being considered so far in the literature. The first approach is to adopt the modified version of UADF tests advocated by Elliott *et al.* (1996), Perron and Ng (1996), Park and Fuller (1995) based on a weighted symmetric estimator, the max test suggested by Leybourne (1995) and also Kwiatkowski *et al.* (1992) suggested that taking stationarity as the Null can improve power. Table 3 therefore provides the result of some popular univariate unit root tests as alternatives to ADF test on UIP differential between China and the US. Unfortunately, the results of those tests are similar to ADF test in concluding that the UIP differential between China and the US is nonstationary.

**Table 3.** Alternative unit root tests for China interest rate & UIPCHUS

| **Sample Period: 01:1997–01:2005** | | | | | |
|---|---|---|---|---|---|
| **UIPCHUS** | **A** | **B** | **C** | **D** | **E** |
| Test statistics | –2.40125 | –0.753546 | 0.980652 | 22.81051 | –1.31357 |
| Test critical values: | | | | | |
| 1% level | –3.49991 | –2.589531 | 0.739 | 1.9452 | –13.8 |
| 5% level | –2.89187 | –1.944248 | 0.463 | 3.1016 | –8.1 |
| 10% level | –2.58302 | –1.61451 | 0.347 | 4.1544 | –5.7 |
| Conclusion (5% sig. level) | I(1) | I(1) | I(1) | I(1) | I(1) |
| **Differenced UIPCHUS** | | | | | |
| Test statistics | –10.9664 | –8.456247 | 0.209884 | 0.359136 | –62.1597 |
| Test critical values: | | | | | |
| 1% level | –3.50067 | –2.589795 | 0.739 | 1.9436 | –13.8 |
| 5% level | –2.8922 | –1.944286 | 0.463 | 3.0988 | –8.1 |
| 10% level | –2.58319 | –1.614487 | 0.347 | 4.1492 | –5.7 |
| Conclusion (5% sig. level) | I(0) | I(0) | I(0) | I(0) | I(0) |

**Note:**
A – Phillips-Perron tes
B – Elliott-Rothenberg-Stock DF-GLS test
C – Kwiatkowski-Phillips-Schmidt-Shin test-H0:I(0)
D – Elliott-Rothenberg-Stock test
E – Ng-Perron test

The second approach is to explore more information by combining time (T) and space (N) dimension. This kind of panel unit root tests were advocated by Levin and Lin (1993), Im *et al.* (1997), Maddala and Wu (1999) and Taylor and Sarno (1998) among others. This paper follows the second approach and presents a panel data estimation procedure that is of

more practical importance to researchers. The primary motivation behind the application of panel data unit root tests, as opposed to standard univariate unit root tests is to explore more information by combining time and space dimension to get more powerful procedures. The general model for $N$ series and $T$ time periods that of interest is

$$\begin{aligned} \Delta q_{1,t} &= \alpha_1 + b_1 q_{1,t-1} + \delta_1 \Delta q_{1,t-1} + \mu_{1,t} \qquad t = 1,\ldots,T, \\ &\vdots \qquad \vdots \qquad \vdots \qquad \vdots \qquad \vdots \\ \Delta q_{N,t} &= \alpha_N + b_N q_{N,t-1} + \delta_N \Delta q_{N,t-1} + \mu_{N,t} \qquad t = 1,\ldots,T. \end{aligned} \tag{6}$$

Based on the mean of the individual ADF $t$-statistics of each member in the panel, Im *et al.* (1997) assume that all series have a unit root under the null hypothesis while there are at least one series is stationary as its alternative. That is:

$$H_{0,IPS} : b_i = b = 0 \quad (i = 1,2,\ldots,N),$$
$$H_{1,IPS} : b_i = b < 0 \quad \text{for } i = 1,2,\ldots,N_1 \quad \text{and } \beta_i = 0 \quad \text{for } i = N_1 + 1,\ldots,N.$$

Table 4 reports IPS statistics, which indicates that at least one series is I(0) but fails to indicate which one is indeed I(0) series.

**Table 4.** Summary statistics of IPS panel data unit root test

| | RIP | UIP | PPP |
|---|---|---|---|
| $IPS^{\mu}$-Stat | –9.123 | –5.380 | –13.201 |
| p-value | 0 | 0 | 0 |
| Conclusion | At least one series is I(0) | At least one series is I(0) | At least one series is I(0) |
| $IPS^{\tau}$-Stat | –11.606 | –6.009 | –13.588 |
| p-value | 0 | 0 | 0 |

However, the IPS panel data unit root test has three drawbacks. Firstly, the IPS test assumes the data generating process are generated independently across individuals so that the error term $\mu_{N,t}$ is not cross-correlated. Unfortunately, when shocks occurred in one country, it is likely that the degree of parity differential will be affected in other countries. When this assumption of no cross-correlation was violated, the IPS test statistics follow an unknown distribution and therefore the statistical inferences are not reliable. Secondly, if a panel contains both I(0) and I(1) series, rejecting the null hypothesis can only suggest that there is at least one stationary series in the panel, but they do not indicate how many and which particular panel members are stationary. Thirdly, ignoring the possibility of structural break in the DGP may bias the IPS test towards the unit root null hypothesis of I(1).

The time series of parity differentials may exhibit structural break as indicated in Figs 1–3. The consequence of ignoring the presence of structural break could be serious when testing unit root. Perron (1989) and Amsler and Lee (1995) concluded that the null hypothesis of unit root was accepted too often when structural break occurs in the true Data Generating Process (DGP). Therefore, there is consensus that the failure of taking into account structural breaks is likely to be one reason that leads to the low power of unit root tests.

### 3.4. The Seemingly Unrelated Structural Change ADF (SUSADF) test

One solution to the above problems is to develop a panel data unit root test that takes into account of contemporaneous cross-sectional dependence and structural break. The test proposed is named as Seemingly Unrelated Structural Change ADF (SUSADF) test. Firstly, Seemingly Unrelated Regressions (SUR) can take contemporaneous cross-correlation into account when testing the null hypothesis of having a unit root as developed by Breuer *et al.* (2001) and Lau (2009). Unavoidably, the bootstrapping technique must be used in order to get the empirical distribution of SUSADF statistics. The new test proposed in this paper automatically indicates how many and which particular panel members are stationary if there are any while taking into account structural break. In our setup, we take into account the obvious break point at January-2000 when testing the null hypothesis of having a unit root in the parity differentials. SUSADF test is based on the following regression:

$$\begin{aligned}
&\Delta q_{1,t} = \alpha_1 + t\cdot T + d\cdot Dum_{1:2000} + td\cdot T\cdot Dum_{1:2000} + b_1 q_{1,t-1} + \delta_1 \Delta q_{1,t-1} + \mu_{1,t} \\
&\quad\vdots \qquad \vdots \quad \vdots \qquad \vdots \qquad \vdots \qquad \vdots \qquad \vdots \qquad \vdots \qquad \vdots \quad t = 1,\cdots,T \\
&\Delta q_{N,t} = \alpha_N + t\cdot T + d\cdot Dum_{1:2000} + td\cdot T\cdot Dum_{1:2000} + b_N q_{N,t-1} + \delta_N \Delta q_{N,t-1} + \mu_{N,t},
\end{aligned} \tag{7}$$

where $t$ is the estimated coefficient on time trend $T$, $d$ is the estimated coefficient the dummy variable, *Dum* with break point at January 2000, *td* is the estimated coefficient on the interaction term of time trend and the dummy variable. Contemporaneous cross-correlation is allowed for the error terms. We have the following null hypothesis that individual series $i$ has a unit root against its alternative of stationarity.

$$H_{0,SUSADF} : b_i = 0, \quad H_{1,SUSADF} : b_i =< 0 \quad (i = 1,2,\ldots N).$$

Table 5 presents SUSADF test statistics. Since all parity differentials are found to be I(0) we conclude that real and financial integration was well established between China and other four countries. The critical values adopted in Table 5 were obtained from 10000 simulations. Critical values must be simulated with sample error covariance structure, the coefficients on the lagged difference estimated based on I(1) environment (Null hypothesis) assuming no drift unit root process. That is:

$$\begin{aligned}
&\Delta q_{1,t} = \alpha_1 + t\cdot T + d\cdot Dum_{1:2000} + t\cdot dT\cdot Dum_{1:2000} + \delta_1 \Delta q_{1,t-1} + \mu_{1,t} \\
&\quad\vdots \qquad \vdots \quad \vdots \qquad \vdots \qquad \vdots \qquad \vdots \qquad \vdots \qquad \vdots \qquad \vdots \quad t = 1,\ldots,T \\
&\Delta q_{N,t} = \alpha_N + t\cdot T + d\cdot Dum_{1:2000} + td\cdot T\cdot Dum_{1:2000} + \delta_N \Delta q_{N,t-1} + \mu_{N,t}.
\end{aligned} \tag{8}$$

First, model (8) was estimated applying Seemingly Unrelated Regression. The estimated vector of parameters such as $\hat{\delta}^{H_0,Hist}$ and $\hat{\mu}^{H_0,Hist}$ was gathered. We next bootstrap randomly $\hat{\mu}^{H_0,Hist}$ to get the cross correlated artificial vector of residuals, $\hat{\varepsilon}^{H_0,Hist*}$. Finally we use $\hat{\varepsilon}^{H_0,Hist*}$ to generate artificial series, $q^*$. The artificial series, $q^*$ is generated as:

$$q^*_{1,t} = \alpha_1 + t \cdot T + d \cdot Dum_{1:2000} + t \cdot dT \cdot Dum_{1:2000} + q^*_{1,t-1} + \delta_1 \Delta q^*_{1,t} + \hat{\varepsilon}^{H_0, Hist^*}_{1,t}$$
$$\vdots \quad \vdots \quad \vdots \quad \vdots \quad \vdots \quad \vdots \quad \vdots \quad \vdots \quad \vdots \quad t = 1, \ldots, T \quad (9)$$
$$q^*_{N,t} = \alpha_N + t \cdot T + d \cdot Dum_{1:2000} + t \cdot d \cdot T \cdot Dum_{1:2000} + q^*_{N,t-1} + \delta_N \Delta q^*_{N,t} + \hat{\varepsilon}^{H_0, Hist^*}_{N,t}.$$

With these bootstrapped series we can obtain the bootstrapped estimates like $\hat{b}^*, \hat{t}^{*SUSADF}_{\beta}$, after estimating model (4), where $\hat{t}^{*SUSADF}_{b}$ is the SUSADF statistics under the null hypothesis environment. After 10000 simulations, we have a distribution table under I(1) environment and hence the critical values of this SUSADF test.

**Table 5.** SUSADF test-parity conditions (structural break 2000:1)

| | CHEU | CHJAP | CHUK | CHUS |
|---|---|---|---|---|
| **RIP** | | | | |
| $b^s$ | –1.07 | –1.205 | –1.12 | –1.2 |
| p-value | 0 | 0 | 0 | 0 |
| Time | –0.2060 | –0.0486 | –0.013 | 0.032 |
| p-value | 0.519 | 0.185 | 0.711 | 0.359 |
| Dummy | 6.378 | 12.61 | 8.667 | 9.186 |
| p-value | 0.025 | 0 | 0.007 | 0.003 |
| dummy*time | –0.116 | -0.359 | –0.234 | –0.2076 |
| p-value | 0.168 | 0 | 0.014 | 0.025 |
| $SURADF^s$-Stat | –12.774[0.0] | –11.217[0.0.] | –13.405[0.0] | –14.534[0.0] |
| Conclusion | I(0) | I(0) | I(0) | I(0) |
| **UIP** | | | | |
| $b^s$ | –0.9834 | –0.9822 | –1.1368 | –0.3079 |
| p-value | 0 | 0 | 0 | 0 |
| Time | 0.0179 | –0.0208 | –0.00059 | 0.0291 |
| p-value | 0.369 | 0.425 | 0.969 | 0.003 |
| Dummy | 9.456 | 7.559 | 7.4318 | 3.6338 |
| p-value | 0 | 0.003 | 0 | 0.003 |
| dummy*time | –0.1985 | –0.2654 | –0.2262 | –0.0974 |
| p-value | 0 | 0.001 | 0 | 0.004 |
| $SURADF^s$-Stat | –9.132[0.0] | –6.765[0.0] | –9.142[0.0] | –3.797[0.098] |
| Conclusion | I(0) | I(0) | I(0) | I(0) |
| **PPP** | | | | |
| $b^s$ | –1.024 | –1.08 | –1.176 | –1.174 |
| p-value | 0 | 0 | 0 | 0 |
| Time | 0.0380 | 0.02 | –1.477 | 6.474 |
| p-value | 0.303 | 0.643 | 0.656 | 0.027 |
| Dummy | 3.758 | –2.81 | –1.477 | 6.474 |
| p-value | 0.242 | 0.458 | 0.656 | 0.017 |
| dummy*time | –0.098 | 0.0216 | 0.0126 | –0.21 |
| p-value | 0.309 | 0.848 | 0.899 | 0.017 |
| $SURADF^s$-Stat | –10.831[0.0] | –9.631[0.0] | –13.16[0.0] | –12.87[0.0] |
| Conclusion | I(0) | I(0) | I(0) | I(0) |

**Note:** one tail P-value for $SUSADF^s$ are based on 10000 simulations.

## 4. Concluding remarks

In this paper, we developed a new panel unit root test to overcome the pitfalls of the old-fashioned panel unit root tests like that of IPS panel unit root test by making it possible for researchers to test individual series for a unit root while taking contemporaneous cross-sectional dependence and structural break into account. The SUSADF test avoids researchers drawing conclusions only about the panel as a whole and making bias towards the null hypothesis of having a unit root when structural breaks exists. Using the SUSADF unit root test we examine the status of real and financial integration of China within Japan, the European Union, United Kingdom, and the United States based on the empirical validity of real interest parity, uncovered interest parity, and relative purchasing power parity.

We found that real and financial integration between China and other four countries was well established. Lei (2006) also mentioned that the unit-root tests indicate higher degrees of real and financial integration in the long run. However, the tests for autocorrelation give evidence against instantaneous financial integration. Moreover, the findings of Chan *et al.* (2007) demonstrate financial integration among the ASEAN-5 and South Korea with their major trading partners. Conversely, they found that the real and financial integration among China-US and China-Japan are not yet empirically recognized notwithstanding the recent surge of capital flows into the mainland. Cheung *et al.* (2006) found that Hong Kong is highly integrated with the mainland. They also found that evidence is positive for integration with the US. Finally, their regression results suggest that the degree of financial and real integration depend upon the extent of capital controls, FDI linkages as well as exchange rate volatility.

There are several implications for policy makers and investors when planning economic policies and investment decisions. Firstly, the high degree of integration of China into global real and financial markets raises international competitiveness of China, and the imposition of tariff and non-tariff barriers on particular commodities will not have significant impact on the overall degree of integration in the Chinese markets. However, we should note that the mean of the UIP differential is the highest for Japan among the four countries, implying that the financial market is not well integrated between China and Japan. Moreover, the mean of the PPP differential is the highest for UK, implying that the commodity market is also not well integrated between China and UK. This implies that governments should work closely to improve the degree of integration on the real and financial markets so as to achieve a win-win situation.

Secondly, China may pull the world, especially the developed countries out of recession in occurrence of economic shocks, for example like, the current financial crisis, provided that China could be the engine of the world economy in future. We found evidence that China maintains a strong link with developed economies, a necessary condition for China to become the engine of the world economy. Since both commodity and financial markets are integrated between China and developed economies, this implies Chinese real and financial markets are relatively efficient, and therefore the Chinese markets may have growth potentials for both corporate and individual investors. Finally, the process of integration with other economies will continue, and requires more political engagement and cooperation. We suggest further research on the determinants of integration, such that resources could devote to those determinants in an efficient way.

## Appendix 1-data sources

The data are gathered from China Information Bank, Data-Stream (electric version), and International Financial Statistics (IFS). The monthly series retrieved from the China Information Bank are the China 1-month interbank offer rate (before Jan, 2002), Euro-RMB exchange rate (before Dec, 1998), and China CPI. The monthly series retrieved from the Data Stream are the 1-month interbank interest rate of Europe (code no. EMINT1M), Japan (code no.JPIBO1M), UK (code no..BBGBP1M), US (code no.BBUSD1M), and China (CHIB1MO-available only after Jan, 2002), the exchange rate of Euro-RMB (code no. CHEURSP-available only after Dec, 1998), the Japanese Yen-RMB (code no. CHXRJPYE), the UK-China exchange rate (code no. CHIYUAN), the US-China exchange rate (code no. CHIYUA$), and the EU CPI (code no. EMCP…F). The monthly series retrieved from the IFS are the CPI of Japan (code no. 15864…ZF), the UK (code no. 11264…ZF), and the US (code no. 11164…ZF) from January 1997 to January 2005. The X-12 routine (with multiplicative factors on the levels) available in Eviews5.0 was used to seasonally adjust all the CPI series.

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## AR KINIJA INTEGRUOTA SU SAVO PAGRINDINIAIS PREKYBOS PARTNERIAIS: ĮRODYMŲ APIE FINANSINĘ IR REALIĄJĄ INTEGRACIJĄ PAIEŠKOS

**M. H. Bilgin, C. K. M. Lau, M. Tvaronavičienė**

Santrauka

Straipsnyje ieškoma įrodymų apie finansinę ir realiąją integraciją tarp Kinijos bei jos tarptautinės prekybos partnerių. Autorių patobulinta ekonometrikos metodo (*panel unit root test*) versija leidžia ekonomistams atsižvelgti į nagrinėjamų šalių tarpšakinių ryšių bei ekonomikos struktūrų specifiką. Finansinei bei realiai integracijai tarp Kinijos ir pagrindinių jos prekybos partnerių, t. y. Japonijos, Jungtinės Karalystės, Europos Sąjungos bei Jungtinių Amerikos Valstijų, vertinti buvo naudoti tokie kintamieji, kaip nepadengtų palūkanų paritetas, palūkanų normų paritetas bei santykinis perkamosios galios paritetas. Tyrimo rezultatai patvirtino prielaidą apie gana didelę minėtų paritetų svarbą ir leido konstatuoti, kad Kinija yra gana stipriai finansiškai bei realiai integruota su savo pagrindinėmis prekybos partnerėmis.

**Reikšminiai žodžiai:** finansinė ir reali integracija, nepadengtų palūkanų paritetas, palūkanų normų paritetas, perkamosios galios paritetas, užsienio prekyba, Kinija.

**Mehmet Huseyin BILGIN.** Dr, Associate Professor, chair of the Department of International Finance at Kadir Has University. His scientific interests include macroeconomics, international economics, labor economics, and Turkish economy. Author of more than 20 papers in peer reviewed scientific journals and other publications.

**Chi Keung Marco LAU.** Dr, Lecturer at Hang Sang School of Commerce. His scientific interests include macroeconomics, finance, econometrics, and international economics. Author of 15 papers in peer reviewed scientific journals and other publications.

**Manuela TVARONAVIČIENĖ.** Dr, Professor at Vilnius Gediminas Technical University. Research interests include international economics, FDI, foreign trade, economic growth. Author of more than 40 papers in peer reviewed scientific journals and other publications.