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2008

Online at <https://mpra.ub.uni-muenchen.de/7291/>  
MPRA Paper No. 7291, posted 22 Feb 2008 06:39 UTC

# **Real interest rate parity: evidence from East Asian economies relative to China**

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## **Abstract**

This study examines the real interest rate parity (RIP) hypothesis in the case of East Asian economies by taking China as foreign counterpart. Results obtained from panel unit root tests are in line with previous findings that are supportive of the hypothesis. The estimated half-life of the RIP deviations is 3.21 quarters, indicating RIP holds strongly in this region with respect to China. This implies that the choices and effectiveness of the monetary and fiscal policies in the East Asian economies will be very much influenced by the external factors originating from China, in addition to Japan and US as identified in other studies. Furthermore, judging from the another finding of this study that East Asian economies is more integrated with Japan than China, China has yet to further liberalize its financial system before it can overtake Japan as leading financial centre or as anchor country for common currency area in this region.

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## **Real interest rate parity: evidence from East Asian economies relative to China**

### **I Introduction**

The real interest rate parity hypothesis (RIPH) postulates that the real interest rates of different countries should be identical; provided markets are frictionless and economic agents' expectations are rational. Whether the hypothesis holds or not has several vital economic implications. Importantly, verification of real interest rate equalization across countries implies evidence of capital mobility and financial integration. Another key implication is the loss of independent in the individual monetary authorities in controlling the internal real interest rates. Due to its importance, the hypothesis has been subjected to the intensive studies. Commonly, this RIPH is scrutinized by checking the stationarity of the real interest rates differentials (RIDs) using, among others, conventional unit root tests of Dickey and Fuller (1979, 1981).

Recently, more and more empirical work have shown that conventional unit root tests tend to produce unreliable results using short spans of data (Rapach and Wohar, 2002; Baharumshah *et al.* 2005). Few studies have used long spans of data to enhance the power of these tests. In related area of study, Lothian (2002) is able provide evidence supportive of RIPH (France, Netherlands, Germany, U.S, Belgium, Sweden, Switzerland, Canada, Italy, Norway relative to the US and UK) using Dickey and Fuller (DF) unit root test, by employing three centuries data (1690 to 2000). Nevertheless, using shorter spans of data (1957 to 2000), Goldberg *et al.* (2003) cannot find result in favor of the hypothesis for the Canada, France, Germany, Japan, and the United Kingdom with

respect to the U.S., by the augmented DF (ADF) unit root test<sup>2</sup>. Panel analysis is another alternative to overcome the problem arising from short spans of data<sup>3</sup>. Moreover, the adoption of panel analysis allows us to consider cross-country variations, which is more realistic in this era of international markets globalization and integration. Wu and Chen (1998, 2001), for instance, shows that by exploiting cross-sectional information in examination, panel analysis can yield higher power as compared to univariate analysis. Due to its significant novelty, a small number of researchers have adopted panel analysis in the study of stationarity of RIPH, for instance (Wu and Chen 1998 and Holmes, 2002 in developed countries) and (Baharumshah *et al.*, 2005 in East Asian economies relative to Japan). Their results are particularly in favor of RIPH. Nonetheless, more empirical studies are needed to explore the usefulness of panel analysis in related area of study.

This study attempts to contribute to the literature of RIPH from the panel analysis perspective. The objective of this study is to examine the stationarity of East Asian real interest rates with China as foreign counterpart. East Asian economies, which possess similar characteristics after undergoing various stages of financial liberalization provides a good platform for the study of financial integration (Baharumshah *et al.* 2005). Furthermore, the rising of China economy in the recent decades and the rigorous liberalization of the China financial system following the entrance of China into the World Trade Organization in 2001 has attracted few of the researchers to examine the regional financial integration with respect to China. As for empirical results, Cheung *et*

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<sup>2</sup> The authors is able to obtain favorable results by the Phillip and Perron (1988) unit root test, as well as the Zivot and Andrew (1992) unit root test that accounts for structural break, however.

<sup>3</sup> Most developing economies, in particular, have a history of about half a century after gaining independent from their colonies.

*al.* (2003 and 2006), for example, find that Hong Kong is highly cointegrated with China but Taiwan exhibits stronger linkages with respect to Japan and US as compared to China. In a separate endeavor, Cheung *et al.* (2005) find that Hong Kong, Japan and Singapore are cointegrated relative to China. Laurenceson (2003), on the other hand, shows that the financial linkages between China and ASEAN-5 (Indonesia, Malaysia, Singapore, Thailand and the Philippines) remain weak. Disregarding the fact that these studies use univariate unit root tests, they remain the first few to reveal the nature of regional financial integration with respect to China, a relatively neglected research area as compared to U.S. and Japan<sup>4</sup>. Nonetheless, in order to gain more insights into the RIPH in the context of increasing international financial liberalization in this region, this study resorts to panel unit root tests for more robust results.

## **II. Data and Methodology**

This study analyses the stationarity of RIDs of ten East Asian economies, namely China, Hong Kong, India, Indonesia, Malaysia, Singapore, South Korea, Taiwan, Thailand, and the Philippines. The sample data, which are obtained from the International Financial Statistics and various Central Banks, spans from the first quarter of 1987 to the third quarter of 2006. Various short-term interest rates are used in estimation: deposit rate (China), money market rate (India, Indonesia, South Korea, Taiwan and Thailand), 3-Months Treasury bill rate (Malaysia and Philippines) depending on availability of data. Inflation rate is calculated as the percentage change in the consumer price index. The real interest rate used in this study is obtained by subtracting inflation rate from the

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<sup>4</sup> The work of Baharumshah *et al.* (2005) is based on panel unit root tests, however.

nominal interest rate. The RID is then derived as the difference of the domestic and foreign real interest rates with China serves as the foreign country.

For the RIPH to hold, the resultant RID must possess stationary time series property. For this purpose, several panel unit root tests due to Maddala and Wu (1999), Breitung (2000), Choi (2001), Levin, Lin and Chu (2002), and Im, Pesaran, and Shin (2003) are adopted in this study. Brief descriptions of panel unit roots methodologies can be found in Wu and Chen (1998) and Baharumshah *et al.* (2005). For comparison purpose, the conventional univariate augmented Dickey-Fuller (ADF) and its improved version known as Generalized Least Squares augmented Dickey-Fuller (ADF-GLS, due to Elliot *et al.*, 1996 and Ng and Perron, 2001) unit roots are included in this study.

### **III. Results and Discussion**

Table 1 summarizes the univariate unit root tests results for the real interest rates under study. It is clearly shown in Table 1 that the null hypothesis of unit root can be rejected for all cases except Indonesia, India and the Philippines by the ADF test, and Thailand, Taiwan and the Philippines by the ADF-GLS test. This suggests that the RIPH is valid for Hong Kong, Indonesia, India, Malaysia, Singapore and South Korea based on ADF-GLS test, which is more robust than ADF test. However, univariate unit roots may not be informative enough as they do not allow for the consideration of international financial markets interactions. As such estimation of panel unit root is in order and the results are reported in Table 2.

Table 1: Univariate Unit Root Tests Results

Economy	ADF	ADF-GLS
Hong Kong	-4.2135 [2]** (T)	-3.7963 [2]** (T)
Indonesia	-2.8352 [1]	-2.8617 [1]**
India	-3.1157[9] (T)	-3.5321 [8]* (T)
Malaysia	-3.9592 [1]* (T)	-3.4893 [1]* (T)
Singapore	-3.8941 [2]* (T)	-3.615718 [2]* (T)
South Korea	-3.8664 [1]* (T)	-3.1526 [1]* (T)
Thailand	-4.0906 [2]** (T)	-3.0267 [1] (T)
Taiwan	-3.6392 [5]* (T)	-2.8263 [5] (T)
The Philippines	-3.3143 [0] (T)	-2.1304 [0] (T)
Critical Values (without trend)		
1%	-3.5190	-2.5957
5%	-2.9001	-1.9451
Critical Values (with trend)		
1%	-4.0833	-3.6712
5%	-3.4700	-3.1068

Notes: \*\* and \* indicate the rejection of the null hypothesis of non-stationary at 1 and 5% significance levels respectively. The optimal lag lengths in ADF and DF-GLS tests are selected based on the AIC and Modified AIC respectively. (T) indicates the trend is included as indicated by the significant of the trend terms in the estimation.

It is observed from Table 2 that the null hypothesis of nonstationarity has been rejected at 5% significance level or better. Thus, it can be concluded that by incorporating cross-country interactions, the East Asian RIDs are stationary. This finding is consistent with Wu and Chen (1998), Holmes (2002) and Baharumshah *et al.* (2005) who provide more convincing evidence supportive of RIPH from the panel rather than univariate unit root tests. Besides, the current finding may be taken as evidence of financial integration in the East Asian region with respect to China, in complement to the findings of goods and services markets integration in most of the economies in this region (specifically, ASEAN-5) with respect to China as reported in Laurenceson (2003)<sup>5</sup>.

<sup>5</sup> The author, who uses data up to December 2002, also finds that financial market integration remains significantly incomplete. Thus, he urges for greater degree of financial liberalization in the China in particular. In this concern, the current finding of significant financial integration among East Asian with

Table 2: Panel Unit Root Tests Results

Unit Root Test <sup>a</sup>	<i>t</i> -statistics [Probability]
Levin, Lin & Chu (2002)	-1.9091 [0.0281]*
Breitung (2000)	-5.9053 [0.0000]**
Im, Pesaran and Shin (2003)	-5.7746 [0.0000]**
Maddala and Wu (1999)	64.6379 [0.0000]**
Choi (2001)	35.4992 [0.0082]**

Note: <sup>a</sup> In all cases, constant and trend has been included in the estimation. \*\* and \* denote the rejection of the null hypothesis of nonstationarity at 1 and 5% significance levels respectively.

Upon the validation of RIPH in this region, the half-life of the RIP deviations is calculated to measure the speed of adjustment back towards long-run parity as well as the strength of the parity. In particular, the shorter is the half-life, the faster is the speed of adjustment and hence the stronger the RIP holds (Holmes, 2002; Baharumshah *et al.*, 2005). From the calculated half-lives based on univariate and panel unit root tests as shown in Table 3, it can be said that the speed of adjustment is faster when international interactions are considered. From the panel test, the estimated half-life for the deviations of China-based East Asian real RIDs is about 3.21 quarters (equivalent to 9.6 months), which is much slower than the estimated value of 6 – 7 months for the Japan-based East Asian real interest rate differentials as reported in Baharumshah *et al.* (2005). This may suggest that, as compared to Japan, there has been less financial integration between East Asian economies with respect to China<sup>6</sup>. This is not surprising as Japan has been the leading economy long before the rising of China.

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respect to China may be seen as a result of the increasing degree of financial liberalization in China following the entrance of China into the World Trade Organization in 2001.

<sup>6</sup> Our finding is in line with Cheung *et al.* (2003 and 2006), who find that Taiwan is more integrated with U.S. and Japan than China.



Table 3: Speeds of Adjustment towards Real Interest Parity

Unit Root Test	Average $\beta_i^a$	Half-life (quarters) <sup>b</sup>
Univariate <sup>c</sup>	-0.1628	3.8997
Panel <sup>d</sup>	-0.1941	3.2124

Notes: <sup>a</sup> Estimates of average  $\beta_i$  are derived from the demeaned and detrended regression  $\Delta y_{it} = \alpha_i + \phi_i y_{it-1} + \sum_{k=1}^p \rho_{ik} \Delta y_{it-k} + \mu_{it}$ , where  $\phi_i = \beta_i - 1$ . Subscript  $i$  stands for individual economies under study. <sup>b</sup> Half-life is calculated as  $\ln(0.5)/\ln(\text{average } \beta_i)$ . <sup>c</sup> Half-life is calculated based on ADF-GLS test, which is more accurate size and power than ADF test (Elliot *et al.*, 1996). <sup>d</sup> Following Holmes (2002), half-life is estimated based on Levin, Lin and Chu (2002) test.

#### IV. Concluding Remarks

All-in-all, this study is able to enrich the previous findings of financial integration between East Asian economies relative to China using panel unit root tests, which account for international financial linkages. Particularly, this study provides further insights into the extent of capital mobility and financial integration in this region. Two major implications should be highlighted: First, given the evidence of strong RIPH, the choices and effectiveness of the monetary and fiscal policies in the East Asian economies will be very much influenced by the external factors originating from China, in addition to Japan and US as identified in other studies. Second, judging from the finding that East Asian economies is more integrated with Japan than China, China has yet to further liberalize its financial system before it can overtake Japan as leading financial centre or as anchor country for common currency area in this region.

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