Real interest rates equalization: The case of Malaysia and Singapore

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Abstract

This study provides some evidences showing high degree of financial integration from both evidences of common shocks and real interest parity in the context of two small and open economies, that is, Malaysia and Singapore. Few key policy implications may be suggested from the findings in this study. First, foreign investors who invest in these two countries may need to look for sources of diversification to protect their wealth against the occurrence of contagion effect due to the strong trade and finance relationship between these two countries. Second, the banks and businesses that set rules for interest rates on deposits and loans should be kept consistently with commercial banking practices and key developments in the financial sectors for the betterment of both Malaysia and Singapore economies. Third and most importantly, as two financial markets are highly linked, the monetary and fiscal authorities of both countries should work hand-in-hand to avoid any potential macroeconomic instability in this region.

1. Introduction

Real Interest Rate Parity Hypothesis (RIPH) asserts that real interest rates between countries – where arbitrage forces are free to act in the goods and assets markets– will equalize if agents make their predictions using rational expectations. As such, the real interest rate of both countries will have long-run relationship and hence it can be identified as mean-reverting. For many decades, the validity of this hypothesis has formed the basis of many empirical researches for the reasons stated below. First, the real interest parity has long been an important field of study for monetary and fiscal policy and for financial theory. Economists always seek a better understanding of the dynamic behaviour of the ex ante real interest rate. This is due to its significance in influencing investment and output decisions. It also can crucially affect valuations of financial assets and macroeconomics dynamics. Rose (1998), for instance, has brought up the subject regarding the conceivable instability of the ex ante real interest rate and the implications toward the standard intertemporal asset pricing models.

Second, the linkages and cointegration of real interest rate across countries turns to be the crucial issue for policymakers. This is because the capabilities of domestic monetary and fiscal authorities will be limited in effectively stabilizing the domestic real rate relative to the world rates once the linkages exist (see, Pill and Prahdhan, 1997).

Third, a better understanding of real interest rate between countries has practical impact in developing international financial and economic models (Anoruo *et al*., 2002).

Fourth, the extent of market integration greatly affects the regulators to safely establish the financial institutions operation. For instance, if two or more economies possessing strong trading relationships, then it is likely that unfavorable economic situations from one economy will be transferred over to other countries. In other words, a contagion effect will have taken place. These side-effects will scare away the confidence of borrowers to make investment in these regions.

From the empirical perspective, early studies are undertaken using the regression methodology to determine the degree of interdependence of real interest rates in short horizons (Cumby and Obstfeld, 1984; Mishkin, 1984; Cumby and Mishkin, 1986; Gagnon and Unferth, 1995). Their results decisively rejected the RIPH. In contrast to earlier works, extensive studies in the literature based on the cointegration analysis and Granger causality test have provided empirical evidence for the short–run and long–run cointegration relationships among interest rates of various nations. For instance, Chinn and Frankel (1995) have applied Johansen (1988) method on the quarterly data (1982Q3-1992Q1) for Asian Countries and find evidence in favour of RIP between some Asian countries with respect to Japan and USA as based country. On the other hand, Siklos and Wohar (1997) found cointegration relationship between nominal interest rates of EMS countries. Anoruo *et al.* (2002) also have provided evidence of cointegration relationship between nominal interest rates of selected Asian countries, based on Johansen cointegration and multivariate causality test. More recently, Laurenceson (2003) uses nonparametric Philips–Perron unit root test to validate the highly integrated economies in between China and ASEAN-5 with a monthly sample data from 1996:1 to 2002:12.

Lately, Baharumshah *et al*. (2005) employed panel unit root and half-life analysis indicated RIP does hold strongly between Japan and Asian emerging markets.

It is worth pointing out that previous interest rate parity researchers have focused their attention in examining the relationship of interest rates in the context of the emerging countries with Japan or US as the base country, mainly because these two countries are the leading trading partners in this region. This study adopts a different approach in attempting to contribute to the existing literature. In particular, the validity of RIPH is investigated in the context of two small and open economies, that is, Malaysia and Singapore, based on the strong trading relationship between them.

This paper is organized as follows. The background of study is given in Section 2. The methodology and data of this study is described in Section 3 while the empirical results are presented in Section 4. Some concluding remarks and policy implications are offered in Section 5.

2. Background of Study

According to the Ministry of International Trade and Industry Malaysia (MITI, 2005), Malaysia's total trade increased by 8.4 % in the second quarter of 2005 to RM238.59 billion from RM220.14 billion in the first quarter of 2005. Exports increased by 6.6 % to RM130.73 billion, while imports increased by 10.6 % to RM107.86 billion, resulting in a trade surplus of RM22.86 billion. In this respect, Singapore turns to be Malaysia's major trading partner, accounting for RM7.99 billion, ranked the second highest trade surplus

after the United States of America. On the other hand, Singapore also contributed 15.3% to Malaysia's export markets (MITI, 2005) and 11.1% import markets in the second quarter of 2005 (MITI, 2005). From the statistical overview, there are evidences of both Malaysia and Singapore have achieved higher integration with respect to goods, capital and foreign exchange markets respectively.

Besides, it is noteworthy that both Malaysia and Singapore have pursued the financial liberalization and financial deregulation over past few decades enhancing competition among financial institutions and encouraging the creation and development of money and capital markets. As a consequence, there is substantial foreign capital flow into both regions. Emerging market liberalization was driven by fundamental structural changes such as the elimination of exchange controls, stabilization of exchange rates, control of inflation, removal of restrictions on capital inflows and outflows, removal of interest rates restrictions, and sovereign debt reduction coupled with the use of private debt and equity (Bekaert *et al*., 2002). In Singapore, the interest rates completely liberalized in the mid of 1970s, while Malaysia abolished capital controls in the early of 1980s. However, to encounter the 1997 Financial Crisis, which had hurt the Asian economy in various degrees, the Malaysian government had once again implemented the capital control besides the currency control in September 1998 (Ariff and Khalid, 2000). The controls are gradually lifted and as of July 2005, the Malaysian ringgit exchange rate is under the managed float regime. As for Singapore, free-float (July, 1997 onwards) and managed float (January, 1998 onwards) exchange rate policy and limited internationalization of Singapore dollar are adopted to face the financial crisis.

3. Methodology And Data

This study employs the conventional Augmented Dickey-Fuller (ADF) unit root test (Dickey & Fuller, 1981) and the improved version of ADF test due to Elliott *et al*., (1996) in order to test the real interest rate parity hypothesis in the context of Malaysia and Singapore. Besides, the Johansen and Juselius (1980) cointegration test is also carried out to examine the existence of cointegration relationship between Malaysia and Singapore real interest rates.

3.1 Unit Root Tests

The ADF test is conducted with and without a deterministic trend (t). The ADF test is estimated as following regression:

$$\Delta y_t = \delta + \alpha y_{t-1} + \sum_{k=1}^{p} \beta_k \Delta y_{t-k} + \varepsilon_t \qquad (1)$$

where δ is the difference operator and ε_t is a random error term. The null hypothesis of a unit root is represented by $\alpha = 0$. The ADF statistic is given by the usual *t*-statistic for the α coefficient.

The augmented Dickey-Fuller unit root test has a low power (see, Lai, 1997)[1]. To improve the power of the ADF test, Elliott *et al*., (ERS, 1996) suggested to used the ADF estimation test through the use of $\tilde{y}_t$ instead of y_t which is attained by adopting the

[1] Kwiatkowski *et al*. (1992) also mentioned that ADF test is in favour of non-rejection of the null hypothesis of unit root.

general least squares (GLS) method. Notably, the ERS test that allows for a linear time trend may be specified as:

$$\Delta\tilde{y}_t = \delta + \alpha\tilde{y}_{t-1} + \sum_{k=1}^{p}\beta_k\Delta\tilde{y}_{t-k} + \varepsilon_t \qquad (2)$$

where $\tilde{y}_t = y_t - z_t\beta$, with β being the least squares regression coefficient of $\hat{y}_t = [y_1, (1-\bar{\rho}L)y_2, ..., (1-\bar{\rho}L)y_T]'$ on $\hat{z}_t = [z_1, (1-\bar{\rho}L)z_2, ..., (1-\bar{\rho}L)z_T]'$ where L is the lag operator and $\bar{\rho} = 1 + \bar{c}/T$, with $\bar{c} = -13.5$ as suggested by Elliott *et al*., (1996).

In this ERS unit root test, the null hypothesis of unit root (α =0) may be tested against the alternative hypothesis of statoinary (α <0) by the *t*-statistic for the α coefficient. Equation (2) may be applying in the case without a time trend by setting z_t=1.

3.2 Johansen Cointegration Tests

To complement our unit root test results, the Johansen (1988) and Johansen and Juselius (1990) multivariate maximum likelihood approach is also adopted in this study. Consider y_t as a $m \times 1$ vector of I(1) variables, then one can estimate the following vector autoregression regression of order *p*, denoted as $VAR(p)$:

$$\Delta y_t = \mu + \Gamma_1\Delta y_{t-1} + ... + \Gamma_{p-1}\Delta y_{t-p+1} + \Pi y_{t-p} + Bx_t + \varepsilon_t \qquad (3)$$

where $\Gamma_1, \Gamma_2 ... \Gamma_{p-1}, \Pi$ are $m \times m$ matrices of unknown parameters, B is an $m \times s$ matrix, and ε is distributed $N(0, \Sigma)$. Π is a matrix has reduced rank, $r < m$ estimated by the Johansen maximum likelihood which subjected to the hypothesis written as followed:

$$H(r) : \Pi = \alpha\beta', \tag{4}$$

where α and β are $m \times r$ matrices. When the $r < m$ condition is met, the $\beta' x_t$ is stationary. Trace and the maximal eigenvalues of the Π matrix are two tests for reduced rank based. Johansen procedure allows one to test the hypothesis of the number of cointegrating vectors either 0 vs 1, or 1 vs 2, etc. In the bivariate system, the vector $x_t' = (r_t^M r_t^S)$.

After the number of cointegrating is decided, one can investigate the values of the estimated cointegrating vectors are consistent with real interest parity by calculating the likelihood ratio test statistic for the restriction, which is the asymptotically distributed χ^2.

Applying this cointegration test in our context, the real interest rate parity must fulfill two conditions (see, Chinn and Frankel, 1995): First, cointegration must be found. Second, the cointegrating vector with coefficients must be equal and in opposite signs. If only the first condition applies, then the two real interest rates are subjected to the same stochastic trend, but real interest parity does not hold in long run.

3.3 Data

The data are of monthly frequency and cover two countries namely Malaysia and Singapore are included in this study and covers the 1977Q1 – 2005Q3 period. The nominal interest rates are proxy by Interbank Overnight interest rates, 3 Months Treasury Bill rates, Saving Deposit Rates and 3 Months Fixed Deposit rates are drawn from the International Financial Statistics, IMF. The inflation rates used to generate the real interest rates are calculated by taking log-differences of a quarterly Consumer Price Indices (CPI).

The sample is divided into pre Asian currency crisis and post Asian currency crisis and the full sample periods: first quarter of 1977 through second quarter of 1997, third quarter of 1997 through third quarter of 2005 and first quarter of 1977 through third quarter of 2005.

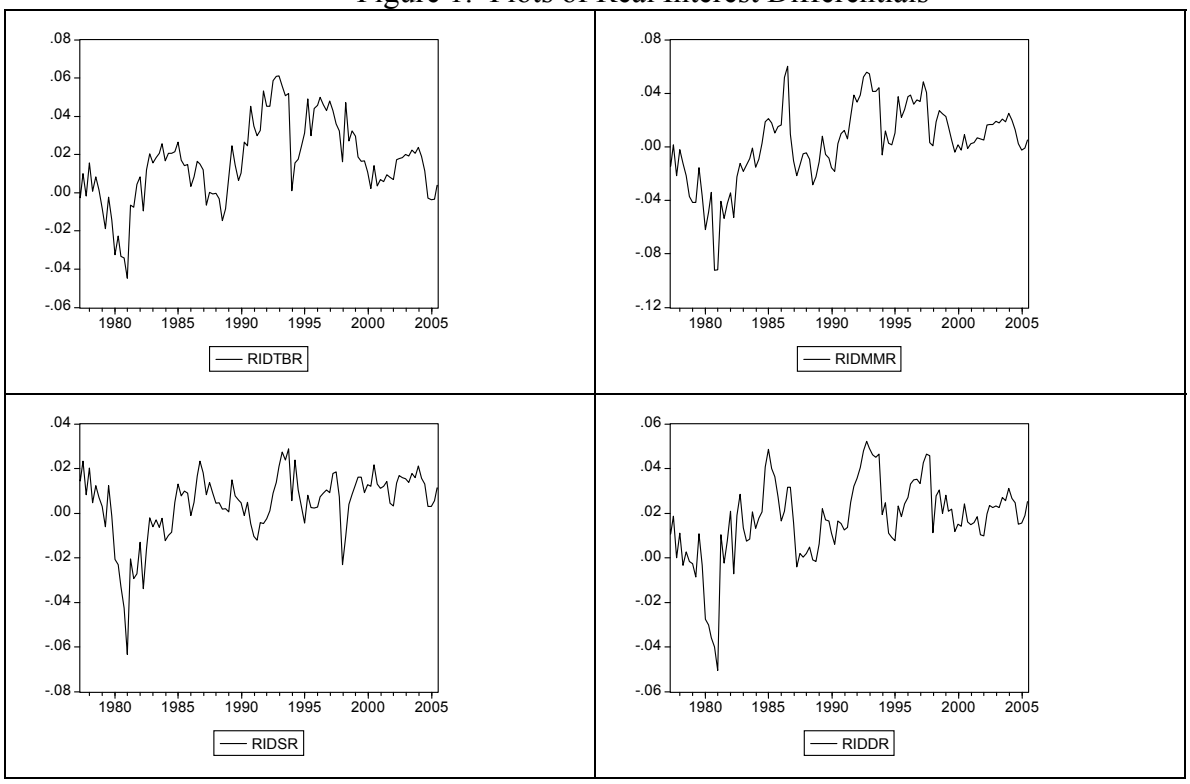
The real interest differential of the two countries are computed as follows:

$$y_t = \log(y_{Mt} / y_{St}) \tag{5}$$

where y_{Mt} and y_{St} are the real interests of Malaysian and Singapore respectively, which are in turn obtained by dividing the respective nominal interest rate by the inflation rate. The resulting interest rate differential for Treasury bill rate (denoted RIDTBR), money money rate (RIDMMR), saving rate (RIDSR) and deposit rate (RIDDR) for the full sample period are depicted in Figure 1. Two main features are observed in this figure.

First, these differentials tend to exhibit co-movement in general, thereby suggesting the existence of long-run relationship among various measures of interest rates. Second, there is a gradual but increasing trend in all series, signaling that trend component should be included in the testing procedures.

Figure 1: Plots of Real Interest Differentials



4. Results and Discussions

4.1 Unit Root Tests

This sub-section presents and interprets the estimated results for both the ADF and ERS unit root tests, in which a full sample and two sub-samples are involved. In performing each of the tests, the lag specification is determined based on the AIC. The variables under investigations are the real interest rate differentials for Treasury bill rate (denoted

RIDTBR), money market rate (RIDMMR), saving rate (RIDSR) and deposit rate (RIDDR). The results of both the ADF and ERS unit root tests for both level with and without trend for the full sample (1977:Q1 to 2005:Q3), pre-crisis period (1977:Q1 to 1997:Q2) and post-crisis period (1997:Q3 to 2005:Q3) are summarized in Tables 1 to 3 respectively.

Full Sample (1977:Q1 to 2005:Q3)

From Table 1, it can be observed that based on the ADF with no trend the null hypothesis of unit root has been rejected at 5% significance level in the case of RIDSR, implying evidence of real interest parity from the perspective of saving rates of Malaysia and Singapore. Similarly, evidence of real interest rate parity is also found in the case of RIDDR, which is significant at 1% level, by the ADF with no trend. In contrast, there is no evidence of RIP from the perspective of Treasury bill rate and money market rate.

On the other hand, the null hypothesis of unit root may be rejected at 10% or better significance level for all the differentials by the ERS unit root test with no trend. This indicates the presence of RIP in both countries under study. This finding should be more reliable than the previous ADF unit root tests results, as ERS is an improved version of ADF test.

When a linear time trend is taken into account, both the tests consistently suggest that RIDTBR and RIDMMR are non-stationary whereas RIDSR and RIDDR are trend stationary at 10% significance level or better.

In sum, this study has found evidence in favor of RIP in the context of Malaysia and Singapore from the perspective of Treasury bill rate, money market rate, saving rate and deposit rate, in the full sample.

Table 1
Results of Unit Root Tests (Full Sample: 1977:Q1-2005:Q3)

Differential	**ADF**		**ERS**	
Series	**No Trend**	**Trend**	**No Trend**	**Trend**
RIDTBR	-2.16[1]	2.15[1]	-1.84[1]*	-2.22[1]
RIDMMR	-2.14[2]	-2.45[2]	-1.90[2]*	-2.48[2]
RIDSR	-3.04[1]**	-4.32[0]***	-2.60[1]***	-2.89[1]*
RIDDR	-3.49[0]***	-3.94[0]**	-2.75[1]***	-3.91[0]***
Critical Values				
10%	-2.58	-3.15	-1.61	-2.73
5%	-2.89	-3.45	-1.94	-3.02
1%	-3.49	-4.04	-2.59	-3.57

Note: ***, ** and * denote the rejection of the null hypothesis at 1, 5 and 10% level respectively.

Pre-crisis Period (1977:Q1 to 1997:Q2)

The ADF test results as depicted in Table 2 suggest that out of the four differentials under study, only RIDDR is mean stationary, whereas only RIDSR is non trend stationary, at 10% significance level or better. These findings are supported by the ERS test, which yields the same conclusion. This amounts to the evidence in favor of RIP in the context of Malaysia and Singapore from the perspective of Treasury bill rate, money market rate and deposit rate but not saving rate in the pre-crisis period.

Table 2
Results of Unit Root Tests (Pre-Crisis: 1977:Q1-1997:Q2)

Differential	ADF		ERS	
Series	No Trend	Trend	No Trend	Trend
RIDTBR	-1.61[1]	-3.53[0]**	-1.33[1]	-3.47[0]**
RIDMMR	-1.37[2]	-3.58[0]**	-1.27[2]	-3.34[0]**
RIDSR	-2.29[1]	-2.92[1]	-1.93[1	-2.22[2]
RIDDR	-2.64[0]*	-3.49[0]**	-2.64[0]***	-3.34[0]**
Critical Values				
10%	-3.51	-3.16	-1.61	-2.80
5%	-2.90	-3.47	-1.94	-3.09
1%	-2.59	4.08	-2.59	-3.66

Note: See Table 1.

Post-crisis period (1997:Q3 to 2005:Q3)

The results of the ADF and ERS unit root tests both level with and without trend for the post-crisis period (1997:Q3 to 2005:Q3) are presented in Table 3. Both the ADF and ERS test suggest that all the four differentials under study are mean stationary at 5% significance level or better. On the other hand, the both tests show that RIDTBR and RIDSR are trend stationary. As for the other two differentials, contradicting results are obtained from both tests: ADF test suggests RIDMMR, whereas ERS test shows that RIDDR is trend stationary.

In general, Table 3 shows that RIP also holds in the post-crisis period from the perspective of Treasury bill rate, money market rate, saving rate and deposit rate, as in the full sample.

Table 3
Results of Unit Root Tests (Post-Crisis: 1997:Q3-2005:Q3)

Differential Series	ADF		ERS	
	No Trend	Trend	No Trend	Trend
RIDTBR	-3.49[9]**	-3.90[9]**	-2.05[0]**	-3.00[0]*
RIDMMR	-3.79[0]***	-3.66[0]**	-2.14[0]**	-2.88[0]
RIDSR	-3.31[4]**	-3.23[0]*	-3.29[4]***	-3.08[0]*
RIDDR	-4.51[0]***	-2.68 [4]	-2.45[0]**	-3.47[0]**
Critical Values				
10%	-2.63	-3.25	-1.61	-2.89
5%	-2.97	-3.62	-1.95	-3.19
1%	-3.69	-4.42	-2.64	-3.77

Note: See Table 1.

4.2 Cointegration Test

This sub-section presents and interprets the estimated bivariate cointegration test results for a full sample and two sub-samples. The notations MMR, TBR, DR and SR the pairwise real interest rates of Malaysia and Singapore as measured by Treasury bill rate, money market rate, saving rate and deposit rate respectively. The results for the Malaysia – Singapore real interest rates bivariate cointegration for the full sample, pre-crisis and post-crisis periods are reported in the Tables 4 to 6 accordingly.

Full Sample (1977:Q1 to 2005:Q3)

Table 4 indicates that according to both the trace test and maximal eigenvalue test, the null of no cointegration cannot be rejected for the case of MMR (full rank) and TBR (null rank). This implies that there is no evidence of long run relationship between the real interest rates of Malaysia and Singapore from the perspective of money market rate and Treasury bill rate. Nonetheless, cointegration relationship is observed in the real interest

rates as proxy by deposit rate as well as saving rate. The finding of cointegrating relationship, however, is the necessary but not sufficient condition for the RIP to hold in the long run. The sufficient condition is that the coefficients in the cointegrating vector must be equal and in opposite signs. However, for the cases of DR and SR where cointegration are found, the restriction on the cointegrating vector imposed by RIP is rejected. This means the real interest parity does not hold in these two countries. It can only be concluded that the real deposit rates of Malaysia and Singapore are subject to the same stochastic trend. In other words, they are driven by the same common shocks. Similarly conclusion may be made for two real saving rates.

Pre-crisis Period (1977:Q1 to 1997:Q2)

Table 5 indicates that the null hypothesis of no cointegration may be rejected in the case of MMR and SR (both with one cointegrating relations only), but not TBR and DR (both with null rank). This may be interpreted as evidence of long run cointegration between the two countries' real money market rate, and also between the two real saving rates. However, the restriction on the cointegrating vector imposed by RIP have been rejected at 1% significance level in both cases. Thus, the real interest parity does not hold in these two countries in the pre-crisis period. Rather, the two real money market rates, as well as the two real saving rates are driven by the same common shocks.

Table 4
Johansen Cointegration Results (Full Sample)

Variable	Lag	Number of Cointegrating Relations suggested by		Cointegrating Vectors[a]	RIP (-1, 1)
		Eigenvalue Statistic	Trace Statistic		
MMR	3	2	2	(-1 -0.390)	-
TBR	1	0	0	(-1 -5.052)	-
DR	1	1	1	(-1 0.932)	Reject at 1%
SR	3	1	1	(-1 0.789)	Reject at 5%

Notes: Lag indicates the lag order of the VAR. [a] Normalized on the Malaysia real interest rate; under RIP the vector should be (-1 1). 'RIP' indicated whether the null hypothesis of a (-1 1) vector is rejected according to a likelihood ratio test.

Table 5
Johansen Cointegration Results (Pre-Crisis)

Variable	Lag	Number of Cointegrating Relations suggested by		Cointegrating Vectors[a]	RIP (-1, 1)
		Eigenvalue Statistic	Trace Statistic		
MMR	1	1	1	(-1 -0.134)	Reject at 1%
TBR	1	0	0	(-1 -0.487)	-
DR	1	0	0	(-1 0.555)	-
SR	1	1	1	(-1 0.463)	Reject at 1%

Note: See Table 4.

Post-crisis period (1997:Q3 to 2005:Q3)

It is clear from Table 6 only the pairwise real saving rates are cointegrated in the post-crisis period. Besides, the restriction on the cointegrating vector imposed by RIP is not rejected in this case. Thus the real interest parity does hold in the two countries in terms real saving rates.

Table 6
Johansen Cointegration Results (Post-Crisis)

Variable	Lag	Number of Cointegrating Relations suggested by		Cointegrating Vectors[a]	RIP (-1, 1)
		Eigenvalue Statistic	Trace Statistic		
MMR	3	2	2	(-1 -0.036)	-
TBR	3	2	2	(-1 0.007)	-
DR	3	1	1	(-1 3.346)	Accept
SR	3	2	2	(-1 0.324)	-

Note: See Table 4.

5. Conclusion and Policy Implications

This paper employs the unit root tests and cointegration test to examine the real interest rate parity conditions to analyze the current level of capital and goods integration between Malaysia and the Singapore as the second major Malaysia trading partner after USA, using quarterly data for two sample period consisting of Pre-Asian currency crisis from First Quarter of 1977 through Second Quarter of 1997and Post-Asian currency crisis Third Quarter of 1997 through Third Quarter of 2005 and the full sample First Quarter of 1977 through Third Quarter of 2005.

In general, the unit root results suggest that RIP holds in all sample periods from the perspective of Treasury bill rate, money market rate and deposit rate. In addition, RIP also holds in the sense of saving rate in the post-crisis period and the full sample but not in the pre-crisis period. This indicates that Malaysia and Singapore have strong financial linkages especially after the 1997 Asian Financial Crisis.

The Johansen and Juselius (1990) cointegration test indicated that real Treasury bill rates of Malaysia and Singapore have never exhibit any long-run relationship before and after the 1997 Asian Financial Crisis. This suggests that certain degree of monetary policy independence may be achieved if Treasury bill rate is adopted as an intermediate policy tool. On the other hand, there are evidences to suggest that the two real money market rates and also the two real saving rates are driven by common shocks before the crisis. This shows that there is a fairly high degree of financial integration in these two countries,

when integration is defined as the presence of common stochastic trends in real interest rates. Importantly, evidence in favor of RIP came into sight only after the crisis from the perspective of deposit rate. This is interpreted in this study as the attainment of full integration in the financial markets of the two neighboring countries.

In summary, this study manages to find some evidences showing high degree of financial integration from both evidences of common shocks and real interest parity in the context of two small and open economies, that is, Malaysia and her neighbor, Singapore. Few key policy implications may be suggested from the findings in this study. First, foreign investors who invest in these two countries simultaneously may need to look for sources of diversification outside this region since the occurrence of any unfavorable economics event in either country may be transferred over to the other due to their strong trade and finance relationship. From another point of view, these two countries are competitors for exclusive foreign direct investment. Second, the banks and businesses that set rules for interest rates on deposits and loans should be kept consistently with commercial banking practices and key developments in the financial sectors for the betterment of both Malaysia and Singapore economies. Third and most importantly, as two financial markets are highly linked, the effectiveness of the monetary and fiscal authorities of either country will rest on the collaboration of the corresponding authorities from the other country. This reflects the importance of these two countries in working hand-in-hand to encounter any potential macroeconomic instability in this region.

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