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DYNAMIC FINANCIAL LINKAGES OF JAPAN AND ASEAN ECONOMIES: EVIDENCE BASED ON REAL INTEREST PARITY

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ABSTRACT

This article provides empirical evidence on the dynamic linkages of real interest rates among the ASEAN-5 during the post-liberalisation era (1984-1997). The upshots of our findings are four-fold. Firstly, there were co-movement of ASEAN real rates in the long-run and dynamic causalities in the short-run, which explicitly indicated monetary inter-dependency among the ASEAN countries. Secondly, most of the forecast error variance of real interest rates in own country can be attributed to other ASEAN-4's innovations (more than 50%), which partly explains the contagion effects during the Asia crisis of 1997/98. Thirdly, the real interest differentials are mean reverting over time, implying that RIP holds between ASEAN-Japan (except Singapore) and ASEAN-US. Forthly, the deviations from RIP have half-lives of around 6 to 11 months, meaning RIP adjustments change rapidly to its parity of equilibrium value. All in all, this finding supports the recent proposal of Currency Union with the Japanese yen taken as common currency.

Keywords: *Interest linkages; real interest differentials; mean reversion; half-life; financial integration.*
JEL Classification: F15, F36, C32, C51

ABSTRAK

Artikel ini memberi bukti empirik berkaitan hubungan dinamik kadar bunga benar antara ASEAN-5 semasa tempoh lepas-liberalisasi (1984-1997). Empat *penemuan utama dirumuskan. Pertama, wujudnya pergerakan bersama jangka panjang dan aliran penyebab dinamik jangka pendek kadar bunga benar antara negara-negara ASEAN, dengan jelas menunjukkan pergantungan monetari di antara negara-negara tersebut. Kedua, kebanyakan varians ralat ramalan kadar bunga benar di negara sendiri diterangkan oleh inovasi di negara-negara ASEAN-4 yang lain (lebih daripada 50%), yakni menerangkan sebahagian kesan kontagion semasa krisis Asia 1997/98. Ketiga, perbezaan bunga benar didapati berulang-balik pada nilai purata, membayangkan bahawa pariti kadar bunga benar (RIP) adalah benar antara ASEAN-Japan (kecuali Singapura) and ASEAN-US tidak dapat ditolak. Keempat, sisihan daripada RIP mempunyai separuh-hayat (half-life) di antara 6-11 bulan, bermakna pengubahsuai yang cepat kepada nilai pariti atau keseimbangan. Sekaligus, penemuan kami menyokong integrasi kewangan serantau dengan peranan pimpinan Jepun terbukti. Umumnya, kajian ini menyokong pembentangan mata wang serantau dengan Yen Jepun diambil sebagai mata wang bersama.*

INTRODUCTION

Theory suggests that in a perfect world where capital mobility and purchasing power parity holds, ex-ante real interest rates should move together in the long-run. Thus, the extent to which they move together over time provides the degree of capital mobility or real interest rate convergence. If real interest parity holds in absolute form, real interest rates should be equalised across countries. In other words, financial assets are perfect substitutes as returns on comparable financial assets traded in domestic and foreign markets, which are identical. The bulk of the literature, however, has shown that real returns on bonds are hardly equalised and hence the parity is unfortunately a dismal empirical failure (Mishkin, 1984; Merrick & Saunders, 1986; Chan, 2001).

The present article aims at examining one of the building blocks in international finance-the real interest rate parity (RIP). To this end, a sample from the financial markets of the East Asian countries over the past decade was drawn. Most of the countries in the region have taken positive steps toward liberalisation of their domestic financial system during the study period. Recently, the transformation has been further accelerated with the deregulation of money markets in both the developing and developed markets[1]. We test for the existence of the long-run relationship among real interest rates using the familiar Johansen's multivariate cointegration analysis and assess the degree of mean reversion of interest rates differentials by computing the half-life of the deviation from RIP. Additionally, we extend the analysis of previous studies by investigating the dominance of the Japan in the

developing Asian region using the Granger non-causality test. We also demonstrate how the addition of the US market to the system of the Asian interest rates affects the robustness of the empirical findings.
The extent to which real interest rates is linked across countries and how these linkages progress through time have gained considerable attention among researchers for several reasons. Firstly, real interest rates lie at the heart of the transmission mechanism of monetary policy and play an important role in influencing real activity through saving and investment behaviour. From a policy perspective, if RIP holds, a country may pursue a stance of monetary policy which entails a different interest rate from the world interest rate (under fixed exchange rate). Monetary alternative may be less able to achieve independent economic policy via interest rate (credit rate) and may not be determined on a local level. Secondly, from a theoretical perspective, RIP is a key working assumption in various models of exchange rate determination[2]. Thirdly, because of its theoretical link to the PPP, confirmation (rejection) of RIP can be viewed as indication of macroeconomic integration (autonomy) in the microeconomic and macroeconomic consequences of RIP (Fukao & Hanazaki, 1986). Indeed, some of the more recent studies on this topic have viewed the co-movements and dynamic linkages of real interest rates across countries as an indicator of financial integration (Phylaktis, 1999; Awad & Goodwin, 1998; Hassapis, Nikitas & Ryprianos, 1999).

From the East Asian perspective, most studies on capital market integration have focused on integration between Japan and the US. Interest in the other East Asian countries was investigated by Faruqee (1992), who uncovered the interest rate differential between Singapore, Korea, and Thailand, and US Japanese LIBOR – taken to represent the world interest rate. Phylaktis (1999) examined the extent of market integration in a group of countries (South Korea, Malaysia, Hong Kong, Taiwan, and Japan) which are closely linked with the world financial markets, and more so with Japan than the US. The article by Chinn and Frankel (1995) found that Hong Kong, Taiwan, and Malaysia, were linked to both the US and Japan, while Singapore's financial market is closely connected with the US. More recent findings on the host subject in the region were found in Anoruo'*et al*. (2002) and Baharumshah, Chan, and Stilianos (2005), among others. Nevertheless, the extent of market integration in the region is by no means a settled issue.

The present article differs from the existing literature in several important aspects. Firstly, ASEAN is a region of growing importance in the world economy, but the financial linkages among its members have yet to be systematically analysed. The ASEAN-5 refers to the five original members of the Association of Southeast Asian Nations, namely Indonesia, Malaysia, Singapore, Thailand, and Philippines.

While RIP has been a major topic of analysis in the European community for the past decade, literature on East Asia, ASEAN in particular, is scare. A different perspective may be gained from examining ASEAN emerging economies that have instituted different regulatory regimes at different stages of their development. Additionally, although regional initiatives have increased intra-regional trade and foreign direct investment in the East Asia, progress towards regional financial integration is still at its infancy stage (Park, 2002).

Secondly, whilst studies on RIP have appeared in abundance with the US or Germany taken as base or centre country[3], the Japanese-based studies have been meager, although Japan is now the world's second largest economy. Recent developments have been accompanied by signs that Japan has been increasing its trade and financial influence in East Asia (Yen Bloc) and possibly overshadowing that of the US. Japan has been the major trading partner and contributor of foreign investments in the ASEAN community since the 1980s. Japan's direct investments in ASEAN-5 peaked in 1996, and accounted for more than US$ 6 billion as compared to US$ 3.6 billion in 1991. In addition, Japan is also the main export market for most of the ASEAN countries (above one-sixth of the ASEAN's exports). Together, these developments imply substantial growth in regional trade and investment interdependency between ASEAN and Japan.

Thirdly, the half-life of deviations from RIP is computed to measure the speed of adjustment back towards the long-run RIP, where the half-life is defined as the number of years it takes for the deviation from RIP to settle permanently below 0.5 in response to a unit shock in the level of the series. If say, the half-lives of deviation from RIP are within months, RIP will hold firmly. Conversely, if the half-lives are four to five years, the strong form RIP is ruled out. We note that the computation of half-life is usually conducted for studies on PPP. In a seminal paper, Rogoff (1996) reported that three to five years are likely values for the half-life of shocks to the real exchange rate under the recent floating era, and that the deviations from PPP are dampen out at the rate of about 15% per year. In a recent article, Holmes (2002) had applied the concept of half-life measurement to RIP for a set of EU countries. Interestingly, Holmes found that the estimated half-life is about two to three months. We would expect the estimates to be longer for the ASEAN countries since the process of economic integration is far more complete in the EU compared to the ASEAN-5 member countries.

To examine these pertinent issues, this paper is structured in the following sequence. Section 2 dwells with a brief review of the RIP theory and the methodology utilised in the analysis. In section 3, the data is described, while section 4 reports and discusses the empirical results. Finally in section 5, the concluding remarks and some policy implications are presented.

THEORETICAL FRAMEWORK AND METHODOLOGY

Theoretical Framework

Notably, three strands of international finance theory, in particular, the uncovered interest parity (UIP), the relative purchasing power parity (RPPP), and the Fisher condition, form the basis of RIP. The theoretical workings on interest rate parities in Table 1 show that RIP links the cumulative assumptions of UIP, covered interest parity (CIP), and RPPP. Hence, to formulate RIP, a non-zero country premium and non-biased prediction of future spot exchange rate should be present without any change in the expected real exchange rates between two

Table 1

Interest Rate Parities and the Cumulative Assumptions

Interest Parities	Assumptions	
Covered interest rate Parity (CIP)	$i_t - i_t^* - (f_t^{t+k} - s_t) = 0$	Zero country premium
$i_t - i_t^* = f_t^{t+k} - s_t$		
Uncovered interest rate Parity (UIP)	$i_t - i_t^* = f_t^{t+k} - s_t$	Zero country premium
$i_t - i_t^* = E_{t(}s_{t+k} - s_{t)}$	$E_t(s_{t+k} - s_t) = f_t^{t+k}$	Forward exchange rate is an unbiased predictor of expected future spot exchange rate
Real interest rate Parity (RIP)	$i_t - i_t^* = f_t^{t+k} - s_t$	Zero country premium
$E_t(r_{t+k}) = E_t(r^*_{t+k})$	$E_t(s_{t+k} - s_t) = f_t^{t+k}$	Forward exchange rate is an unbiased predictor of expected future spot exchange rate
	$E_t(s_{t+k} - P_{t+k} + P^*_{t+k}) = s_t - P_t + P^*_t$	Zero expected real exchange rate change

Symbols:

i_t	= domestic nominal interest rate at time t on a k period bond held between time t and t+k
f_t^{t+k}	= forward exchange rate agreed at time t for the delivery of foreign currency at time t+k
s_t	= spot exchange rate at time t
$f_t^{t+k} - s_t$	= forward premium (+ve) or discount (-ve) on foreign currency at time t
$E_t(s_{t+k})$	= expected spot exchange rate at time t +k
$E_t(s_{t+k} - s_t)$	= expected spot exchange rate change of the domestic currency vis-à-vis the foreign currency between time t+k
P_t	= domestic price level at time t
$E_t(r_{t+k})$	= expected domestic real interest rate at time t on a k-period bond held between time t and t+k
E_t	= conditional expectations operator based upon the information available at time t, i.e., $E(.! I_t)$
μ_i	= a stochastic error term that captures all other determinants (besides interest rates) of the investment ratio uncorrelated with $E_t(r_{i,\ t+k})$ and $S_{i,\ t+k} / Y_{i,\ t+k}$
k	= holding period of the underlying debt period
*	= foreign variable
i	= domestic country i

Note: All variables except the interest rates are expressed in natural logarithms, represented by the lower case letters. Take for instance the exact CIP is expressed as $F_t^{t+k} / S_t = (1+ I_{t\neq}) / (1+ I^*_t)_{\neq}$. By taking natural logarithms of both sides, noting that $f_t^{t+k} = \ln (F_t^{t+k})$; $s_t = \ln (S_t)$; $\ln (1+ I_t) = I$; and $\ln (1+ I^*_t) = i^*$, the logarithm approximation of CIP will be: $i_t - i_t^* = f_t^{t+k} - s_t$

countries. If RIP holds, by equation, real interest rates will equalise across countries; by words, financial and non-financial assets should move unrestrictedly across countries in which any arbitrage opportunities or capital imperfections is not allowed. Since RIP involves the movement of real prices, RIP is often regarded as the price approach to measure financial integration and capital mobility (Lemmen & Eijffinger, 1995).

To examine the RIP condition that $E_t(r_{t+k}) = E_t(r^*_{t+k})$ as shown in Table 1, researchers have usually taken the form of estimating the following regression:

$$r_t^i = \alpha_0 + \alpha_1 r_t^j + \varepsilon_t \qquad (1)$$

where r_t^i and r_t^j represent the real interest rates in countries i and j respectively, and ε_t is the residual term. For RIP to hold, researchers used to test for the joint hypothesis that $\alpha_0 = 0$ and $\alpha_1 = 1$. However, the above test is subjected to several critics. Firstly, it indicates strong form of integration, with neither capital imperfections nor any arbitrage opportunity allowed. Even in the absence of capital control, the joint hypothesis that $\alpha_0 = 0$ and $\alpha_1 = 1$ can be rejected because of transaction costs and that will not imply any profitable arbitrage opportunity (Phylaktis, 1999). Secondly, previous regression results that assume individual real rates to be stationary are not indicative of real interest rate equalisation (Mishkin, 1984). If the series is non-stationary, then the estimation of parameters α_0 and α_1 could be consistent, but the estimated standard errors will not.

Estimation Procedure 1: Real Interest Rates of ASEAN-5

The cointegration procedure that was developed by Granger (1986) to explore the long-run relationship between two series has overcome the abovementioned problems. Two non-stationary series, such as real interest rates of Malaysia and Singapore, are cointegrated when there is some linear combination among them, which is a stationary process. Cointegrated variables move together over time so that any short-run deviation from the long-term trend will be corrected. Johansen and Juselius (1990) later extended the bivariate process to the multivariate system. The test for the number of cointegrating vectors in the Johansen-Juselius procedure can be conducted using two likelihood ratio (LR) test statistics, namely the trace statistic and the maximum eigenvalue (*l-Max*) statistic as shown below:

Trace test : $L_{trace\,(r)} = -T \sum \ln (1 - \lambda_i)$ (2)

Maximum eigenvalue test : $L_{max\,(r,\,r+1)} = -T \ln (1 - \lambda_{r+1})$ (3)

where λ_i is the estimated eigenvalues and T is the number of valid observations. The null hypothesis of the trace statistic tests that the number of distinct cointegrating vector is less than or equal to r against the general alternative in which it gives the result of at most r cointegrating vectors. The latter *λ-max* statistic tests the null hypothesis that there is *r* cointegrating vector (s) against the alternative of *r+1* cointegrating vectors.

In a multivariate cointegration context, let us first consider $Z_t \equiv [R_{IND}, R_{MAL}, R_{PHI}, R_{SIN}, R_{THAI}]'$ where R_{IND}, R_{MAL}, R_{PHI}, R_{SIN}, and R_{THAI} are the real rates of interest for Indonesia, Malaysia, Philippines, Singapore, and Thailand respectively. In what follows, a rejection of the non-cointegration hypothesis would imply that a considerable degree of integration amongst these markets is suggested. If cointegration is confirmed, the Granger-causality test based on vector error-correction model (VECM) is to be conducted to determine the temporal causalities and long-run adjustments of different financial markets. For Z_t that consists of real rates of interest from ASEAN-5, the following VECM can be generated:

$$\Delta Z_t = \mu + \sum_{i=1}^{k-1} G_i \Delta_{t-i} + G_k Z_{k-i} + \varepsilon_t \qquad (4)$$

where μ is 5×1 vector of drift, G's are 5×5 matrices of parameters, and ε_t is a 5×1 white noise vector. VECM analyses the short-run relationship, indicating the short-run adjustment to long-run equilibrium and the direction of causal effect from one variable to another. Nonetheless, VECM can be interpreted as within-sample causality tests (Masih & Masih, 1996) since it does not provide an indication of the dynamic properties of the system, nor does it allow us to gauge the relative strength of the Granger-causal chain or amongst the variables beyond the sample period. For this purpose, we rely on the forecast error Variance Decomposition (VDC) analysis.

VDC can be termed as an out-of-sample causality test that partitions the variance of the forecast error of a certain variable (in our case, a country) into proportions attributable to innovations (or shocks) in each variable in the system, including its own. A variable, say, Malaysia, which is optimally forecasted from its own lagged values, will have all its forecast error variance accounted for by its own disturbance and vice versa. In short, VDCs are employed to provide evidences on how well the own country's variance is explained by innovations in variances of the other countries.

Estimation Procedure 2: Real Interest Rate Differentials of Japan-ASEAN 5

By imposing the restriction $(a_0, a_1) = (0,1)$ on the cointegrating regression in (1), we have a model of real interest differentials that can be specified as:[4]

$$r_t^i - r_t^j = \varepsilon_t \qquad (5)$$

where r_t^i represents the real interest rates of ASEAN countries and r_t^j is the Japanese (foreign) real interest rate. Given the specification in (5), RIP holds in a long-run equilibrium condition if ε_t is stationary, implying that the real interest differential is mean reverting over time. Hence, both financial integration as well as good model integration can be tested from the deviation of RIP. To authenticate the stationarity process, we rely on the conventional single-equation based ADF unit root tests. The ADF procedure extends the Dickey-Fuller test by allowing a higher order of autoregressive process as shown below:

$$\Delta\varepsilon_t = \beta_0 + \beta_1\varepsilon_{t-1} + \sum_{i=2}^{k} \delta_1 \Delta\varepsilon_{t-i+1} + \upsilon_t \qquad (6)$$

$$\Delta\varepsilon_t = \beta_0 + \beta_1\varepsilon_{t-1} + \beta_2 + \sum_{i=2}^{k} \delta_1 \Delta\varepsilon_{t-i+1} + \upsilon'_t \qquad (7)$$

where k represents the number of lagged changes in ε_t necessary to make the residuals υ_t (υ'_t) serially uncorrelated. The first and the second equation are differentiated by a deterministic trend. By considering the null hypothesis of $\beta_1 = 0$, and the alternative $\beta_1 < 0$, we can decide on the absence or presence of a unit root. If the observed t-statistic exceeds the critical value at the standard level of significance, the null hypothesis of the unit root is rejected, or otherwise.

Several studies have focused on the half-life of deviation from the parity condition to bypass the many difficulties associated with the unit root tests. To assess the degree of mean reversion of real interest differentials, the half-life of deviation from RIP needs to be computed. Suppose that the deviation of the logarithm of real rate of interest differential y_t from its long-run value y_0, which is constant under RIP, follows an AR (1) process:

$$y_t - y_0 = \beta\,(y_{t-1} - y_0) + \varepsilon_t \qquad (8)$$

where is a usual white noise, then, at horizon h, the percentage deviation from equilibrium is β^h. The half life deviation from RIP is defined as the horizon at which the percentage deviation from equilibrium is one half, that is:

$$\beta^h = \frac{1}{2} \Rightarrow h = \frac{1n\,(1/2)}{1n\,(\beta)} \qquad (9)$$

The half-life measurement can be interpreted in two ways: the degree of deviation from its long-run mean or, the speed of adjustment back towards long-run RIP. Either one will indicate if RIP holds in a strong or weak form.

DATA

Following the Fisher equation, the real interest rate will take into account of the expected inflation, which is estimated from the actual inflation as measured by changes in consumer price index (CPI). In our case, the expected inflation is estimated by using the autoregressive distribution lag approach rather than the actual inflation as proxy. The nominal interest rates employed in the study are: the inter-bank money market rates for Indonesia, Singapore, Thailand, and Japan; the 3-month Treasury bill rates for Malaysia; and the inter-bank call loan rates for the Philippines. Only short-term interest rates are used due to the fact that long-term interest rates, such as government bond yield, are not available for most ASEAN countries The study sample spans from 1984:Q1 to 1997:Q2, considering the post-liberalisation era prior to the financial crisis. A crisis period that involves structural breaks in the series would bias our results and hence, not included in our study. To assure the consistency and reliability of the data, we cross check with various sources such as the IMF International Financial Statistics, the Asian Development Bank (ADB) Key Indicators, and the Central Banks of the respective countries.

RESULTS AND DISCUSSION

Univariate Analysis

A cointergrating relationship exists within a set of nonstationary time series when a linear combination of the variables can be identified that yields a stationary result. Hence, for one to proceed with cointegration tests, it is important to first examine the univariate properties of the individual time series. Notably, the Johansen-Juselius cointegration procedure requires that all the variables under investigation are of an *I(1)* but not *I*(2) process. To verify this, we subjected all series (in our case real interest rates) to the classical Augmented Dickey-Fuller (ADF) unit root tests. As reported in Table 2, the series are non-stationary in their level form since the null hypothesis of the unit root cannot be rejected at conventional significance levels. However, when the same tests are applied on the first difference, we find no evidence of unit root for all the series under investigation. Thus, real rates of interest of ASEAN-5 and Japan are stationary after first differences, that is, they are integrated of first order and thereby implying an *I(1)* process. Although the finding is consistent with the Fisher condition, which implies that real interest rates are stationary in their level, it is however also consistent with the most recent empirical evidence that real interest rates follow a random walk (Goodwin & Greenes, 1994; Chinn & Frankel, 1995; Baharumshah *et al.*, 2005). The confirmation by the univariate unit root tests that real interest rates follow an *I(1)* process has provided us a requisite for the forthcoming analysis.

Table 2
Unit Root Tests of Stationarity

1984:Q1-1997:Q2	ADF			
	Level		1st Difference	
	No Trend	Trend	No Trend	Trend
JAP	-2.33[4]	-3.11[4]	-5.20[2]*	-5.24[2]*
IND	-2.32[1]	-2.33[1]	-3.12[2]*	-3.44[2]*
MAL	-2.20[4]	-2.14[4]	-4.41[4]*	-4.39[4]*
PHI	-2.85[1]	-3.10[1]	-5.19[2]*	-5.27[2]*
SIN	-1.41[2]	-2.56[2]	-5.26[2]*	-5.24[2]*
TH	-2.69[1]	-2.77[1]	-4.27[4]*	-4.64[4]*

Note: (*) denotes 95% of significance level. Optimal lag lengths are determined by the modified AIC and are shown in the parentheses. The following notations apply in all the forthcoming tables: JAP=Japan, IND=Indonesia, MAL=Malaysia, PHI=Philippines, SIN=Singapore, TH=Thailand.

Multivariate Cointegration Tests

Next, we applied the cointegration tests to the set of interest rates from the ASEAN-5 countries. At this point, it is worth noting that the cointegration property is invariant to the extension of the information set. In other words, the finding of a particular cointegration relationship in a small set of variables, $Z_t \equiv [R_{IND}, R_{MAL}, R_{PHI}, R_{SIN}, R_{THAI}]'$ should also hold in an extended data set, say, the addition of real interest rates of the other Asian countries (Juselius & MacDonald, 2003).

We estimated a five-dimensional vector autoregressive (VAR) model and performed a variety of multivariate and univariate misspecification tests. Test results revealed no evidence of autocorrelation or autoregressive conditional heteroscedasticity (ARCH) effects, but in some equations we found violation of normality. Gonzala (1994) had argued that the cointegration estimates are robust to the deviation from normality assumption, hence we may proceed with the Johansen's multivariate test.

Table 3 summarises the JJ multivariate cointegration tests for the ASEAN-5 model. The null hypothesis of no cointegration (r=0) was easily rejected at the conventional significance levels, as confirmed by the λ-*Max* and *Trace* statistics. Both statistics indicated a unique cointegrating vector (r=1), suggesting the presence of four common stochastic ends (n-r) in real interest rates. In other words, there is a stable long-run relationship among the sets of the ASEAN real interest rates, meaning there is considerably interdependency among the ASEAN-5 capital markets in the long-run. To some extent, future fluctuations of real interest rates of an ASEAN member country can be forecasted using part of the information set provided by the other ASEAN countries. We also conduct the exclusion test as suggested in Johansen and Juselius (1992) to find out if some of the variables could be excluded from the long-run cointegrating space. The results of exclusion restrictions (LR statistic) as reported in Table 3, indicated that all selected countries are highly statistically significant and well fit for the ASEAN-5 model.

Table 3

Multivariate Cointegration Tests of Real Interest Rates

(k=6)		Trace		Critical Value	
Ho	H_1	λ -Max	Statistics	λ -Max	Trace
r = 0	R = 1	48.03**	94.95**	33.64	70.49
r " 1	R = 2	21.28	46.92	27.42	48.88
r " 2	R = 3	15.76	25.64	21.12	31.54
r " 3	R = 4	9.27	9.88	14.88	14.88

Exclusion Test (Log-likelihood Ratio)

ASEAN-5 Model	χ^2
IND	10.0537[0.00]**
MAL	18.7659[0.00]**
PHI	6.3518 [0.01]**
SIN	23.4590 [0.00]**
TH	20.4098 [0.00]**

Note: (**) denotes rejection of hypothesis at 95% significance level, (k = n) represents the optimal lag length selected according to AIC. Chi-square (χ^2) statistics with one degree of freedom is presented for the exclusion test. P-values are presented in the parentheses.

Granger-causality and Vector Error Correction Modeling Analysis

Table 4 highlights that for both Malaysia and Singapore, the error correction terms (ECTs) are statistically significant at the 95% level and the temporal causality effects are active. Consequently, these two financial markets are endogenously determined in the model and share the burden of short-run adjustment to long-run equilibrium. In contrast, Indonesia is found to be statistically exogenous as neither the ECT nor the channels of Granger-causality are significant or temporally active.

Table 4
Granger-causality within the VECM

k=6, r=1	Independent Variable				
Dependent Variable	ΔIND	ΔMAL Chi-square, "^{2}	ΔPHI	ΔSIN	ΔTH	ECT_{t-1} t-stat
ΔIND	-	0.11 [0.74]	0.19 [0.66]	0.10 [0.75]	1.17 [0.28]	-0.12
ΔMAL	5.95* [0.02]	-	8.66**Δ [0.00]	4.50* [0.03]	7.41** [0.01]	-3.17**
ΔPHI	6.15** [0.01]	1.44 [0.23]	-	1.15 [0.28]	0.18 [0.67]	1.61
ΔSIN	1.50 [0.22]	2.63 [0.11]	3.88* [0.05]	-	3.86* [0.05]	-2.24*
ΔTH	1.21 [0.27]	1.45 [0.23]	0.14 [0.71]	0.92 [0.34]	-	-1.80

Note: (*) and (**) denote 95% and 99% significance level respectively. Chi-square (χ^2) tests the joint-significance of the lagged values of the independent variables while t-statistics tests the significance of the error correction term (ECT). P-values are presented in the parenthesis.

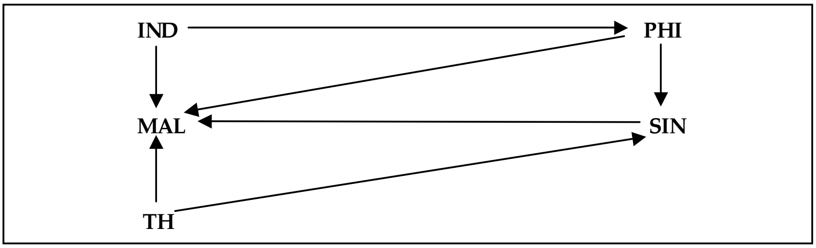

Figure 1
Short-run causality effects

The temporal Granger-causality channels abstracted from Table 4 are displayed in Figure 1. Notice that in the short-run changes of real interest rates in Malaysia are being led by movements of real rates in Indonesia, Philippines, Singapore, and Thailand, whereas those in

Singapore are being directly led by Philippines' and Thailand's markets. Also, there is a unidirectional causal effect running from Indonesia to the Philippines. The active temporal causality channels imply that financial integration in ASEAN countries is even greater in the short-run. Both domestic interest rates and aggregate price levels of a country would be influenced by regional developments.

Table 5

Generalised Variance Decomposition for ASEAN-5 Model

Horizon		Explained by Innovation in					
		IND	MAL	PHI	SIN	TH	Foreign
		Percentage of Variance					
IND	1	**57.38**	1.80	7.20	7.50	26.12	**42.62**
	4	**43.96**	5.45	6.55	13.99	30.06	**56.04**
	8	**43.35**	5.74	6.04	14.76	30.11	**56.65**
	12	**42.17**	4.78	7.06	15.90	30.10	**57.83**
	16	**41.42**	5.49	6.64	16.05	30.40	**58.58**
	20	**41.27**	5.36	6.56	16.08	30.73	**58.73**
	24	**40.88**	5.44	6.47	16.43	30.79	**59.12**
MAL	1	2.63	**73.45**	0.22	6.16	17.53	**26.55**
	4	23.67	**30.88**	3.30	4.60	37.54	**69.12**
	8	19.43	**29.81**	2.37	6.42	41.96	**70.19**
	12	19.76	**30.08**	6.76	6.11	37.30	**69.92**
	16	21.36	**25.63**	5.93	7.83	39.24	**74.37**
	20	19.55	**27.62**	6.49	7.64	38.70	**72.38**
	24	18.76	**27.81**	6.86	7.51	39.06	**72.19**
PHI	1	7.13	0.09	**74.23**	18.08	0.47	**25.77**
	4	26.53	0.09	**58.24**	13.74	1.40	**41.76**
	8	36.44	1.15	**42.73**	12.02	7.65	**57.27**
	12	34.63	1.43	**43.03**	12.52	8.39	**56.97**
	16	34.56	1.26	**45.03**	11.68	7.48	**54.97**
	20	35.01	1.80	**41.84**	12.96	8.38	**58.16**
	24	34.38	1.96	**42.61**	12.65	8.39	**57.39**
SIN	1	8.80	2.74	6.87	**67.58**	14.01	**32.42**
	4	24.55	1.09	11.66	**37.53**	25.18	**62.47**
	8	24.39	1.76	10.84	**35.85**	27.16	**64.15**
	12	22.82	2.05	10.04	**37.61**	27.48	**62.39**
	16	23.73	1.80	11.14	**36.56**	26.78	**63.44**
	20	23.61	1.99	10.54	**36.58**	27.29	**63.42**
	24	23.04	1.88	10.23	**37.37**	27.47	**62.63**
TH	1	16.56	9.01	0.73	14.12	**59.58**	**40.42**
	4	15.72	16.37	20.27	8.34	**39.30**	**60.70**
	8	32.96	8.92	29.67	6.89	**21.56**	**78.44**
	12	29.40	8.98	24.92	8.91	**27.79**	**72.21**
	16	27.31	10.78	27.42	8.45	**26.04**	**73.96**
	20	29.87	9.38	30.31	7.76	**22.68**	**77.32**
	24	27.92	10.29	29.04	8.09	**24.66**	**75.34**

Note: Horizon represents the quarterly time period. The last column labeled "Foreign" takes account of accumulated innovations in other countries without the own ones.

Variance Decomposition (VDC) Analysis

The VDC analysis enables us to gauge the extent that the external shocks in one country are being explained by those in the other ASEAN countries. Table 5 indicates that most of the forecast error variance of real interest rates in any ASEAN-5 country can be attributed to other ASEAN-4's innovations (more than 50%), rather than their own. The out-of-sample forecasted results are in line with the previous causality results that ASEAN-5 markets are financially interdependent. However, the findings also imply that ASEAN member countries are more vulnerable to regional shocks and partly explain the contagion effects during the financial turmoil of 1997/98.

All in all, real interest rates in Malaysia, Thailand, and Singapore appear to be more explained by the innovations of other ASEAN countries. Although Singapore's interest rate is also endogenously determined, it was hardly affected during the Asian financial crisis as compared to those of Thailand and Malaysia, due to its strong economic fundamentals and well-developed capital market. On the other hand, Indonesia's and the Philippines' financial markets are less interactive, since over 41-45% of their own variances are being explained by their own innovations. In addition, the forecast error variance of Malaysia's interest rate contributes the least to the other members of ASEAN countries, that is to say that shocks and innovations from Malaysia are less important in explaining the movement of real interest rates in the other member countries.

Real Interest Differentials Analysis

The real interest rates differentials were estimated through the specified regression (1) and (5) in section 2 previously. If the differentials are stationary and reverting to the long-run mean, RIP would hold between Japan and ASEAN-5, or otherwise. Table 6 reports the univariate ADF tests on the bilateral real interest differentials with respect to Japan from 1984:Q1 to 1997:Q2. Obviously, the null hypotheses of the unit root was rejected at the standard significance levels for most cases (except Japan-Singapore), indicating that the real interest differentials are mean reverting over time in a long proposition. In other words, RIP holds between Japan and ASEAN-4 but not between Japan-Singapore, implying that Singapore could be financially less integrated with Japan as compared to the other ASEAN-4. This is not surprising since the Singaporean capital market is more influenced by the US market rather than the Japanese market[5]. In fact, this finding is supported by Chinn and Frankel (1995), who found that RIP holds for US-Singapore but not for Japan-Singapore.

To have further insights on the extent of deviations from RIP, we refer to the results in Table 7. Clearly, the adjustment to deviations from RIP is rapid and the estimated half-lives are considerably smaller than those reported in the PPP studies (3-5 years). For the ASEAN-4 where the data are supportive of RIP, the deviations from RIP recorded a smaller half-life of approximately 1.9 to 2.7 quarters (or 6 to 8 months). It is worth noting that Indonesia and Malaysia showed the lowest half-lives of 1.90 and 1.74 quarters respectively, suggesting that they were very much influenced by Japan. Turning to the results for Singapore, where RIP condition failed to hold, we found that the half-life was approximately 11 months. Again, we considered the size to be small, but in general, they appear to be longer than those found for EU that cover over more or less the same time period (1986-1993). Thus, the results are reflecting the fact that for Japan and ASEAN-4, RIP holds in strong form. More importantly, our findings have to a great extent, confirmed the Japan's leading role in the ASEAN regional financial markets based on data that ended in 1997:Q2.

Table 6

ADF Unit Root Test of Real Interest Differentials for Japan-ASEAN 5

	Lag	Trend	Lag	Constant
INDO	0	-4.15**	0	-3.83**
MAL	0	-3.31	0	-3.29*
PHI	1	-3.59*	1	-3.67**
SIN	2	-2.20	2	-1.86
TH	3	-3.23	3	-3.56**
Critical value				
1%		-4.10		-3.53
5%		-3.48		-2.90

Note: (*) and (**) denote 5% and 1% statistically significant levels respectively. All real interest differentials are estimated with respect to Japan. The ADF critical values for estimated residuals are computed based on MacKinnon (1991). Optimal lags are selected based on modified AIC.

Table 7

Half-life Measurement of RIP

Model: Japan-ASEAN 5	$\tilde{\beta}$	Half –life (Quarter)
INDO	0.69	1.9
MAL	0.67	1.7
PHI	0.77	2.7
SIN	0.83	3.7
TH	0.76	2.5
Average	0.74	2.3

Note: ˜ The half-life measurement units are in quarters. A simple calculation would suggest that 2.3 quarters approximately equivalent to 7 months or 0.6 year.

Adding US and other regional markets to the system

As argued elsewhere, the Asia Pacific region is not a closed trading bloc. In fact, most of the countries in the region are strongly dependent on the US markets. Chinn and Frankel (1995), for example, argued that the degree of co-variability between the US and the local capital markets in the region is increasing over time. The article by Phylaktis (1999) also provided strong linkages between the ASEAN markets and the world capital markets for the sample period that ended in 1993. Nevertheless, Phylaktis went on to say that capital markets in the Pacific

Table 8

Cointegration Tests of RIP, 1984-1997

Model	Null H_0	Alternative H_1	λ-Max	Trace Statistics	Critical Value (95%)	
					λ-Max	Trace
Panel A						
ASEAN-5, (k=6)	r = 0	r = 1	48.03**	94.95**	33.64	70.49
	r ! 1	r = 2	21.28	46.92	27.42	48.88
	r ! 2	r = 3	15.76	25.64	21.12	31.54
	r ! 3	r = 4	9.27	9.88	14.88	14.88
	r ! 4	r = 5	0.61	0.61	8.07	8.07
Panel B						
Asia Pacific-10, (k=2)	r = 0	r= 1	66.14**	256.15**	63.32	234.98
	r ! 1	r= 2	52.65	190.01	57.20	194.42
	r ! 2	r = 3	40.13	137.36	51.15	157.80
	r ! 3	r = 4	31.47	97.22	45.63	124.62
	r ! 4	r = 5	21.79	65.76	39.83	95.87
	r ! 5	r = 1	15.33	43.96	33.64	70.49
	r ! 6	r = 2	10.57	28.63	27.42	48.88
	r ! 7	r = 3	10.24	18.06	21.12	31.54
	r ! 8	r = 4	6.82	7.82	14.88	14.88
	r ! 9	r = 5	1.01	1.01	8.07	8.07

Exclusion Test (Log-likelihood Ratio)

Model	ASEAN-5 Model	Asia Pacific-10 Model
	χ^2	
US	-	24.3489[0.000]**
JAP	-	26.2788[0.000]**
IND	10.0537 0.002]**	11.4893[0.003]**
MAL	18.7659[0.000]**	28.5541[0.000]**
PHI	6.3518[0.012]**	16.3420[0.000]**
SIN	23.4590[0.000]**	21.0116[0.000]**
TH	20.4098[0.000]**	14.7946[0.001]**
HK	-	24.285[0.000]**
6SK	-	16.8833[0.000]**
TW	-	3.1663[0.205]

Note: (**) denotes rejection of hypothesis at 5% significance level, (k=n) represents the optimum lag length selected according to AIC. Both models detested a unique cointegrating vector (r=1). Chi- square (χ) statistics with one degree of freedom are presented for the exclusion test and the critical value at 5% significance level is 3.84. P-values are presented in the parentheses.

Basin region are dominated by Japan as one moves to the post-liberalisation era. Thus, certain regularities may be missing for a system of ASEAN interest rates that exclude the US as well the other Asian neighboring markets[6]. To examine the effects of the US and the other regional markets (Hong Kong, South Korea, and Taiwan) on the robustness of the results reported earlier, we added the real interest rate of these countries to the basic system. This way, we were able to examine the effect on a large number of variables and their interactions with the non-US capital market without confronting the possible arbitrariness of modeling international interdependence.

In the remainder of this paper, we re-examine the degree of financial integration using interest rates from ten Pacific Basin countries: Malaysia, Thailand, Singapore, Indonesia, Philippines, South Korea, Taiwan, Hong Kong, US, and Japan. The sampling period chosen is the same as before. The results from the larger system show that there is one cointegrating vector among the interest rates. Thus, the main conclusion remains unchanged with the addition of capital markets of Hong Kong, South Korea, Taiwan and the US. This finding suggests the interdependence of the economies in the Pacific Basin region with the two major capital markets - the US and Japan. We also investigated whether some interest rates may be excluded from the long-run relationship. With one cointegrating vector, the likelihood ratio (LR) test statistic is distributed as a χ^2 random variable with one degree of freedom. As displayed in Table 5, we found that at the 5% significance level or better, none of the variables may be excluded from the long-

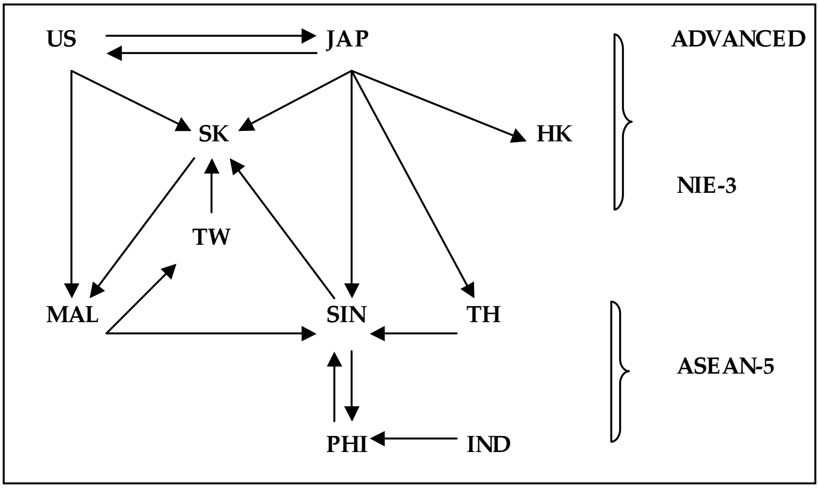

Figure 2
Causality of APC-10 model during post-liberalisation, 1984-1997

run relationship with the sole exception of Taiwan. This implies that all the nine interest rates series contribute significantly to the cointegrating relationship.

The important results from our investigation may be summarised as follows: Firstly, we found a feedback connection between Japan and the US. This outcome implies that the US and Japanese capital and good markets are closely linked (Figure 2). This feedback relationship coincides with the concerted efforts taken by the governments of these two developed nations to maintain parity of interest rate and exchange rates.

Secondly, the US directly affects South Korea's and Malaysia's capital markets while Japan has a direct unidirectional influence on Hong

Table 9

Granger-causality within the VECM for Asia Pacific-10 Model During Post-liberalisation, 1984-1997

Independent Variable											
Dept.	ΔUS	ΔJAP	ΔIND	ΔMAL	ΔPHI	ΔSIN	ΔTH	ΔHK	ΔSK	ΔTW	ECT_{t-1}
Variable	Chi-square, "^{2}										
k=s,r=1											
ΔUS	-	3.54* [0.06]	0.01 [0.92]	0.05 [0.82]	0.71 [0.42]	0.03 [0.86]	2.30 [0.13]	0.01 [0.93]	0.11 [0.74]	0.26 [0.61]	-0.0710
ΔJAP	5.17* [0.02]	-	0.01 [0.94]	0.10 [0.75]	2.34 [0.13]	0.41 [0.52]	0.26 [0.61]	0.02 [0.89]	0.03 [0.87]	0.06 [0.81]	-0.0317
ΔIND	0.09 [0.76]	0.03 [0.87]	-	0.05 [0.82]	0.18 [0.67]	0.16 [0.69]	1.16 [0.28]	1.71 [0.19]	0.19 [0.67]	2.30 [0.13]	0.5077
ΔMAL	4.19* [0.04]	0.01 [0.90]	0.80 [0.37]	-	0.74 [0.39]	2.12 [0.15]	1.39 [0.24]	0.06 [0.80]	4.99** [0.03]	0.40 [0.53]	2.1031
ΔPHI	0.24 [0.62]	0.22 [0.64]	7.34*** [0.01]	0.90 [0.34]	-	2.73* [0.09]	0.09 [0.76]	0.00 [0.99]	03.9 [0.54]	0.65 [0.42]	-1.0603
ΔSIN	0.40 [0.53]	7.33*** [0.01]	0.02 [0.90]	2.79* [0.09]	8.18*** [0.00]	-	2.60* [0.10]	0.55 [0.46]	1.13 [0.29]	0.75 [0.39]	-2.2719**
ΔTH	0.01 [0.93]	4.83** [0.03]	0.56 [0.45]	0.97 [0.33]	1.28 [0.26]	0.29 [0.59]	-	1.39 [0.24]	0.02 [0.89]	1.14 [0.39]	-0.2718
ΔHK	1.72 [0.19]	2.82* [0.09]	2.46 [0.12]	0.10 [0.75]	0.12 [0.73]	1.21 [0.27]	0.07 [0.79]	-	0.09 [0.77]	1.07 [0.30]	1.1837
ΔSK	3.73** [0.05]	13.80*** [0.00]	1.47 [0.23]	0.03 [0.87]	0.49 [0.48]	3.43* [0.06]	0.20 [0.65]	2.38 [0.12]	-	6.47** [0.01]	- 3.9648***
ΔTW	0.90 [0.34]	0.34 [0.56]	1.87 [0.17]	5.14** [0.02]	2.40 [0.12]	0.64 [0.43]	0.23 [0.63]	0.13 [0.72]	0.46 [0.50]	-	-0.1706

Note: (*), (**) and (***) denote 10%, 5%, and 1% significance levels respectively. Chi-square (χ^2) tests the joint-significance of the lagged values of the independent variables and t-statistics tests the significance of the error correction term (ECT). P-values are presented in the parenthesis. The ΔUS and ΔJAP represents real interest rates of the US and Japan respectively. ΔIND, ΔMAL, ΔPHI, ΔSIN, and ΔTH represent real interest rates of Indonesia, Malaysia, Philippines, Singapore, and Thailand respectively. ΔHK, ΔSK and ΔTW represent the real interest rates of NIEs, namely Hong Kong, South Korea, and Taiwan respectively.

Kong, Thailand, Singapore, and South Korea. In other words, the real interest rates in Hong Kong, Thailand, Singapore, and South Korea can be predicted using information on the past evolution of Japanese interest rate changes, but not conversely. We noted that the results presented in the previous section show that Japan does not have a significant financial influence, via its interest rates, upon Singapore. In the extended model (with the US in the system), the Japanese interest rate was found to Granger-cause the movement of interest rate in Singapore. However, the hypothesis of Granger non-causality from the US to Singapore is not rejected at the conventional significance levels. Hence, the dominant role of US influences on the Singapore's capital market is rejected by the data. The results also indicated that the causal relation between Japan and Malaysia is rather an indirect one through South Korea.

Table 10

Variance Decomposition for Asia Pacific-10 Model during Post-liberalisation

Horizon / % of Variance		Explained by Innovation in												
		US	JAP	IND	MAL	PHI	SIN	TH	HK	SK	TW	ASEAN	FOREIGN	Without US
IND	1	6.50	4.26	**62.57**	0.41	4.08	5.59	2.56	2.94	2.03	9.06	*12.64*	*37.43*	*30.93*
	4	7.34	4.56	**59.01**	0.59	3.75	7.08	2.09	4.25	1.88	9.44	*13.51*	*40.98*	*33.64*
	8	7.37	4.98	**57.76**	0.59	3.57	7.45	2.08	4.48	1.96	9.77	*13.69*	*42.25*	*34.88*
	12	7.39	5.14	**57.24**	0.59	3.49	7.59	2.07	4.59	1.99	9.91	*13.74*	*42.76*	*35.37*
	16	7.40	5.23	**56.96**	0.59	3.45	7.67	2.06	4.65	2.01	9.99	*13.77*	*4305*	*35.65*
	24	7.42	5.32	**56.66**	0.59	3.40	7.75	2.05	4.71	2.02	1.07	*13.79*	*34.33*	*26.91*
MAL	1	7.31	0.06	0.30	**57.50**	0.93	25.20	1.26	4.36	2.75	0.32	*27.69*	*42.49*	*35.18*
	4	12.40	1.45	0.26	**55.99**	0.49	23.83	0.66	2.97	1.57	0.39	*25.24*	*44.02*	*31.62*
	8	14.13	1.49	0.23	**55.91**	0.29	23.52	0.44	2.58	1.17	0.24	*24.48*	*44.09*	*29.96*
	12	14.79	1.52	0.21	**55.84**	0.20	23.47	0.35	2.42	1.02	0.18	*24.23*	*44.16*	*29.37*
	16	15.15	1.53	0.21	**55.80**	0.16	23.44	0.30	2.33	0.93	0.14	*24.11*	*44.19*	*29.04*
	24	15.54	1.55	0.20	**55.76**	0.11	23.40	0.25	2.24	0.84	0.11	*23.96*	*44.24*	*28.70*
PHI	1	2.33	0.18	2.58	2.27	**74.41**	4.70	7.09	4.91	1.32	0.21	*16.64*	*25.59*	*23.26*
	4	4.12	1.15	1.36	2.60	**63.80**	5.89	9.82	8.13	2.81	0.31	*19.67*	*36.19*	*32.07*
	8	4.54	1.24	1.03	2.67	**61.77**	6.34	10.35	8.78	3.01	0.28	*20.39*	*38.24*	*33.70*
	12	4.68	1.29	0.90	2.69	**61.03**	6.49	10.55	9.01	3.09	0.27	*20.63*	*38.97*	*34.29*
	16	4.76	1.32	0.83	2.70	**60.64**	6.57	10.65	9.14	3.13	0.27	*20.75*	*39.37*	*34.61*
	24	4.83	1.35	0.76	2.71	**60.24**	6.65	10.76	9.26	3.17	0.27	*20.88*	*39.76*	*34.93*
SIN	1	12.30	2.57	2.79	8.54	1.16	**37.01**	1.32	28.42	4.31	1.58	*13.81*	*62.99*	*50.69*
	4	11.90	1.48	4.83	8.40	0.56	**36.12**	1.09	29.46	4.31	1.85	*14.88*	*63.88*	*51.98*
	8	11.76	1.45	5.07	8.16	0.41	**36.17**	0.98	29.83	4.13	2.01	*14.62*	*63.80*	*52.04*
	12	11.77	1.41	5.14	8.03	0.36	**36.14**	0.96	30.00	4.12	2.07	*14.49*	*63.86*	*52.09*
	16	11.77	1.39	5.18	7.97	0.33	**36.13**	0.94	30.09	4.09	2.11	*14.42*	*63.87*	*52.10*
	24	11.78	1.37	5.23	7.90	0.30	**36.12**	0.92	30.18	4.07	2.14	*14.35*	*63.89*	*52.11*
TH	1	0.83	3.57	3.31	4.40	6.48	0.50	**75.59**	3.70	0.70	0.92	*14.69*	*24.41*	*23.58*
	4	0.79	1.99	4.67	5.13	8.82	0.49	**73.74**	3.43	0.50	0.43	*19.11*	*26.25*	*25.46*
	8	0.57	1.26	4.71	5.50	9.78	0.54	**73.47**	3.56	0.35	0.26	*20.53*	*26.53*	*25.96*
	12	0.50	0.95	4.74	5.67	10.23	0.56	**73.31**	3.57	0.30	0.18	*21.20*	*26.70*	*26.20*
	16	0.45	0.78	4.76	5.76	10.46	0.56	**73.23**	3.58	0.27	0.15	*21.54*	*26.77*	*26.32*
	24	0.41	0.60	4.79	5.86	10.71	0.57	**73.14**	3.59	0.23	0.10	*21.93*	*26.86*	*26.45*

Note: Horizon represents the quarterly time period. The last three columns labeled "ASEAN", "FOREIGN" and""Without US" takes account of accumulated innovations in ASEAN country only, accumulated innovations in other countries without the own ones and accumulated innovations in other countries without the own ones, and US respectively

Thirdly, except for Singapore (which is mostly affected by Hong Kong's real rate innovations), the link between real interest rates in the ASEAN members has strengthened considerably in the recent years. We observed that variation in interest rates in Malaysia is mainly due to disturbances in Singapore, while the variation in real interest rate in Thailand (the Philippines) is largely due to disturbances in the Philippines' (Thailand) market and the results hold both in the short as well as the long horizons. This finding supports the notion that there is considerable support for economic integration of the ASEAN countries.

Forthly, variance decompositions for the VAR model are reported in Table 10. The relationship selected for presentation includes the relationship between US and ASEAN, Japan and ASEAN, and the newly industrial economies countries (NIEs). The results of the VDCs show that US interest rates were observed to have some moderate impact upon ASEAN interest rates, while the Japanese interest rate had a somewhat smaller impact on the ASEAN interest rates.

Next, we looked at how long it would take for real interest rate parity to adjust to its equilibrium value following a one standard deviation shock in the US and Japanese interest rates. The first (second) column in Table 11 shows the number of quarters it takes the real interest rates in each of the Asian countries to converge to their equilibrium following an impulse in the US (Japanese) real interest rate. It is observed in this table that all the Asian countries (except for Indonesia and South Korea) converged to their equilibrium at a much faster rate following impulse from the US real interest rate, however, the difference in the speed is not large. For instance, Indonesia would take 18 quarters to converge to its parity following an impulse from the US real interest rate but it took about an additional quarter (19) following an impulse from the Japanese interest rate. This is an indication of the degree of capital market integration between the two financial centres. Thus, our findings do not support the results found in Phylaktis (1999) that show Japan's dominant influence in the region.

Table 11
Impulse Response, Analysis for Asia Pacific-10

Country	Speed of Adjustment following an Impulse in the	
	US RIP	Japan RIP
US	-	16
JAP	15	-

(continued Table 11)

Country	Speed of Adjustment following an Impulse in the	
	US RIP	Japan RIP
IND	18	19
MAL	18	20
PHI	16	21
SIN	16	18
TH	23	22
HK	16	18
SK	19	18
TW	19	22
CV	36	38

Note: The analysis refers to the post-liberalisation period. All data sets are in quarterly form. Figures shown represent the time length for real interest rates of each country to converge to their long-run equilibrium with Japan and US respectively. For CV, figures shown represent the impulse response of the multivariate system following a shock from Japan and US respectively.

CONCLUDING REMARKS

In this paper, we presented evidence on several questions regarding the movement in real interest rates in the ASEAN region: Is there a link between the Japanese rates and those in the ASEAN members? Are the real interest rates of ASEAN more closely link to Japan rather than the US?

As for our first question, the results of our analysis based on an array of econometric time series methods suggest that real interest rates in the ASEAN region are becoming increasingly integrated with those in the regional as well as the major financial centres. This means that the capital and goods markets in the region are well integrated with those in the global markets. We believe that with liberalisation and the opening up of the economy would have contributed to the linkages of the ASEAN markets to the international capital markets. From a policy perceptive, the strong linkage between the real domestic and foreign rates has implication on the ability of the domestic monetary authorities to control domestic economic activity. The positive correlation between the US (Japan) and the ASEAN countries indicates that the effectiveness on monetary policy is limited in the long-run. The central banks' ability to conduct independent monetary policy in these emerging markets is greatly hampered. As pointed by Chinn and Frankel (1995), this conclusion is conditional on the fact that interest rates used in the analysis are representative of the economy-wide interest rates facing most firms and consumers. Additionally, we found that most of the forecast error variance of real interest rates in own country can be attributed to other ASEAN-4's interest rate innovations. This observation partly explains the contagion effects during the Asian crisis of 1997/98. The 1997 financial crisis started in Thailand and quickly spread to Malaysia, Thailand, Indonesia, and the Philippines.

As for the second question, the answer is less decisive. The existing literature including Chinn and Frankel (1995) and Phylaktis (1999) suggested that while there is continued integration with the US, there is also a growing sphere of influence by the Japanese interest rates over time. All in all, our results suggest that the US has as strong influence as Japan on the movement of interest rates in the Asian Pacific region. This conclusion is in line with that by Shan and Pappas (2000), but is not totally in agreement with the work of Phylaktis (1997). Based on simple bivariate analysis, Phylaktis (1997) found that market integration was greater in the US than with Japan. One possible explanation for the conflicting results is the different sampling periods as well as methods utilised in the study.

Recent events in the US suggest that the current account deficits have reached unprecedented levels and there is a strong support to push up the interest rates. The implication of our finding is that if the US decides to increase its interest rates, this would also inevitably affect Japan and the ASEAN countries. In other words, the region is likely to be highly vulnerable to changes in the US's monetary stance.

Finally, the period of study does not include the Asian financial crisis, and many of these countries underwent structural reform since that time. A study on the impact of the structural change on the RIP, which requires cointegration tests that account for structural break, may be useful for future studies. Additionally, recent studies have used non-linear framework to model RIP and PPP. The evidence of non-linear stochastic dynamics should be useful in understanding the complexities of economic integration in the emerging ASEAN market economies. This leaves many avenues for future research on this interesting topic.

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END NOTES

[1] During the past two decades, financial institutions and markets have undergone major transformations. These include structural changes in markets for financial services, improved communications, and production technology, and increasing interdependence and integration of financial and economic systems. The transformation in the developing countries, and East Asia in particular, have been more profound since most of these countries were characterised as financially depressed and overly protected from external influence (Anoruo, Ramchander, & Thiewes, 2002).

[2] Frankel (1979) developed a general monetary exchange rate model based on real interest differentials. If there is a disequilibrium set of real interest rates, the real exchange rate will deviate from its long-run equilibrium value. If the real domestic interest rate is below the real foreign interest rate, then the real exchange rate of the domestic currency will be undervalued in relation to its long-run equilibrium value, so that there is an expected appreciation of the real exchange rate of the domestic currency to compensate.

[3] See Kirchgassner and Wolters (1993) and Moosa and Bhatti (1996) for the German-dominance hypotesis; Chumby and Mishikin (1986) and Modjtahedi (1988) for the US-dominance hypotesis; Pain and Thomas (1997) and Awad And Goodwin (1998) for the US- and German-dominance joints hypotesis.

[4] The strong version of RIP implied by real interest rate equalisation requires that the two interest rates given by [] should be cointegrated with a cointegrating vector equal to [1-1].

[5] The case of Singapore is an interesting one. In year 1999 for example, the US investments in Singapore amounted for US$ 24781 million, which are nearly half of the total US investments in ASEAN-5. At the same time, Japan's direct investments in Singapore only accounted for US$ 765 million. Classen (1992) noted that the period of 1981-1985 was one where the Singapore dollar stabilised vis-a-vis the US dollar. Classen argued that during this period, the Monetary

Authority of Singapore (MAS) switched from a "multicurrency peg" to a US-dollar peg to enhance its position as an international financial centre.

[6] The authors are grateful to an anonymous referee for pointing out this point.

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