Dynamic Financial Linkages among the Asia Pacific Economies: An Empirical Assessment of Real Interest Parity Condition

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ABSTRACT

Real Interest Parity (RIP) has been considered as the necessary rule to justify the exchange rates regime and the extent of financial integration among countries. This study of RIP condition is particularly important for the Asia Pacific economies that have undergone a series of currency crisis and financial turmoil. We incorporate three major analyses that cover the post liberalization period prior to the Asia financial crisis (1984-1997). First, we investigate the dynamic linkages of real interest rates among ASEAN-5 economies. Second, we assess the behavior of real interest differentials of Japan-ASEAN. Third, we examine the additional transmission channels of real interest rates from the US, Hong Kong, South Korea and Taiwan. Our findings suggest that there have been substantial integration among the ASEAN-5 and the East Asian with both the US and Japanese capital markets. However, the US-dominant hypothesis is more recognized. In addition, most countries are found vulnerable to external shocks and there is less monetary autonomy given that Asian economies have converged speedy to their equilibrium rates following the impulse from the US and the Japanese real interest rates. To great extent, our empirical evidence supports the recent proposal of common currency area as an alternative regime, not only to fight against systemic failures or monetary instability, but also to avoid the macroeconomic trilemma.

JEL Classification: *F15, F36, C32, C51*
Keywords: *Real interest parity, mean reversion, half-life, financial integration, common currency*

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1.0 INTRODUCTION

Prompted by technological breakthroughs, financial deregulation and intra-trade liberalization, East Asian has experienced the ever-greater regional integration that culminated in the manifestation of the ASEAN10+3 Free Trade Area in 2001. Such events, fuelled by the rapid growth of regional capital flows, are anticipated to facilitate the financial convergence substantially and hence hint the feasibility towards a single currency regime. Some economists including Mundell (2003) have by now advocated the use of a common currency in Asia preceded by anchoring to an existing currency or a group of currencies. The Euro dollar, as often as not, can be viewed as a blueprint.

Yet, the option of optimum exchange rate regime depends on the real interest differentials and purchasing power gaps among countries and their major trading partners[1]. Moreover, while most countries in East Asia have restored their stability against the US dollar prior to 1997, a considerable diversity of exchange rate regime is observed in the aftermath of the crisis. Indonesia, Philippines, Singapore, South Korea and Thailand have shifted to a more liberalized floating regime whereas Hong Kong, China and Malaysia follow the inverse route[2]. Hence, a further investigation on the Real Interest Rate Parity (RIP hereafter) condition will be pivotal and necessary to justify the extent of regional financial integration and their choice of the exchange rate regime. As a rule, RIP shall necessarily hold within a common currency area while monetary

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[1] Frankel (1979) developed a general monetary exchange rate model based on of 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.

[2] The Hong Kong currency board, backed by the China authority, has maintained the HK-US Dollar peg whilst Malaysia has fixed the Malaysian Ringgit at RM 3.80 since September 1998. Likewise, China has closely pegged the Renmimbi to the US dollar, approximately at 8.30 yuan since April 1994.

independency is narrowed. Likewise, under pegged exchange rates but unrestricted capital flows, RIP holds by the means that domestic interest rates must track closely those prevailing in the country to which the domestic currency is pegged (see Frankel *et al*, 2002).

Another issue, which is an essentially related, concerns the extent to which the Japanese or the US influence has dominated the Asian financial markets. For much of the 1980s and early 1990s, the bulk of the empirical research of RIP based on the US-dominance hypothesis was in conjunction with the supremacy of US in the world financial markets. Nevertheless, recent financial developments accompanied by signs that Japan has increased her financial influence in the Asia economies (especially ASEAN-5) and possibly overshadowing that of the US. Since late 1980s, Japan has been the major trading partner and contributor of foreign investments in the Asia economies. Despite being the main export destination (US$ 79 bil in 1999), Japan is also the major source of capital-intensive manufactures for most Asians. Japanese direct investments in the region peak in 1996, amount for more than US$ 6 bil in ASEAN-5 and US$ 3.5 bil in NIE-3 (Hong Kong, Korea and Taiwan). Additionally, Asia countries have subsequently shifted their dollar-denominated debts in the 1970s-1980s towards the yen-denominated debts (see Tavlas and Ozeki, 1992). To date, the empirical evidences of RIP are at best mixed and no clear conclusion emerged concerning the dominant role of external power in the Asia region. While the German-dominance hypothesis is ruled out, the relative influence of the US and Japanese real interest rates still remain a matter of debates. Thus, inclusion of both the Japanese and the US markets would be more of relevant in any study of financial integration in the Asia Pacific region.

To examine the pertinent issue, our study incorporates three major analyses that cover the post liberalization period prior to the Asia financial crisis (1984-1997). First, we investigate the dynamic linkages of real interest rates (RIR) among ASEAN-5. Second, we assess the behavior of real interest differentials (RID) of Japan-ASEAN[3]. Third, we examine the possible transmission channels of real interest rates from the US, Hong Kong, South Korea and Taiwan. Such analyses on RIR linkages and the RID are necessary and sufficient to verify the RIP condition and the extent of financial integration in the region.

The outline of the remainder of this paper is as follows. In the next section, a brief review of previous literature is provided. In Section 3, we dwell with the methodological issue and the international parity conditions applied in this study. Section 4 then reports and discusses the empirical results. Finally in Section 5, we conclude.

2.0 LITERATURE REVIEW

The seminal study by Mishkin (1984) has shown unfavorable evidence against RIP such that the hypothesis of real interest equality across European countries is overwhelmingly rejected. Also, the joint hypothesis of uncovered interest parity and ex-ante relative PPP were strongly rejected. Later, Meese and Rogoff (1988) perform stationary tests on the real interest differentials of the US, UK, Japan and Germany. They fail to reject the unit root hypothesis, suggesting that RIP is

[3] The corresponding half-life of a random disturbance is as well computed. The half-life is defined as the number of years that it takes for deviation from RIP to substitute 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 4 to 5 years, the strong form RIP is ruled out. The half-life measurement is usually engaged with the works of purchasing power parity (PPP). Rogoff (1996) in particular conjectures that that 3 to 5 years are likely values for the half-life of shocks to the real exchange rate under the recent floating era and the deviations from PPP dampen out at the rate of about 15 percent per year. However, recent studies demonstrate the application of half-life measurement on the RIP theory, as advocated by Holmes (2002) and Baharumshah *et al* (2002).

violated at least in the long run. Likewise, numerous preceding studies on G-7 and the European countries have also decisively rejected RIP (Cumby and Obstfeld, 1984; Mark, 1985; Frankel and MacArthur, 1988; Taylor, 1991, among others). By and large, these studies point to currency risk, consisting of a foreign exchange risk premium and the expected real currency depreciation, as the factors driving the wedge between real interest rates. On the contrary, more favorable evidence on RIP was obtained with the recent use of unit root tests and cointegration techniques (e.g., Goodwin and Grennes, 1994; Wu and Chen, 1998; Wu and Fountas, 2000, to name a few). In addition, Fujii and Chinn (2001) discover that the examination of the longer maturity yields obtains results in favor of RIP, suggesting that over long horizons, international financial and goods arbitrage conditions become more valid as the economic variables are driven by the fundamentals. Correspondingly, Obstfeld and Taylor (2002) underline that the real interest differentials may varied widely over time, but have stayed relatively close to a zero mean, implying that RIP holds in long run with varying deviation in the short run.

Based on the Asian experience, Chinn and Frankel (1995) showed that though Indonesia and Thailand were integrated with Japan, RIP holds only for US-Singapore, US-Taiwan and Japan-Taiwan. On the other hand, as documented by Phylaktis (1997, 1999), the Asia Pacific capital markets are considerably integrated but the results pertaining to the US- and the Japan-dominant roles in the regional market are contradicted when different estimation of speed adjustments are being conducted. In a similar work on RIP, Chan (2001) confirms the high degree of regional capital mobility and substantial financial integration among the East Asian economies but the US dominant role was greater than that of Japan. More recent, Baharumshah, *et al.* (2004) apply the panel unit root tests to recognize that the real interest differentials among

Japan and ten Asian economies have exhibited mean-reverting behaviors which characterized by long-memory dynamics, even when the post-crisis period is included. Their findings thus bespeak the power deficiency of classical unit root tests and to great extent, provide evidence in favor of regional financial convergence, a fundamental requirement for an optimal currency area.

3.0 DATA AND METHODOLOGY

Theoretical Framework

Often, financial integration is referred to the ease with which assets are traded across borders and currency denominations, whereas confirmation or rejection of RIP can be viewed as indication of a higher financial integration or autonomous. Following Fuji and Chinn (2001), a decomposition of the interest differential on instruments of comparable default attributes is helpful in this point:

$$i_t^k - i_t^k * \equiv [i_t^k - i_t^k * - fd_t^k] + [fd_t^k - (s_{t,t+k}^e - s_t)] + (s_{t,t+k}^e - s_t) \quad (1)$$

and $fd_t^k \equiv f_t^k - s_t$

where i_t^k denotes the interest rate for a domestic debt instrument of maturity k, $i_t^k *$ is the foreign counterpart, f_t^k symbolizes the (log) forward exchange rate at time t for a trade at time t+k, s_t is the (log) spot exchange rate at time t and $s_{t,t+k}^e$ is the (log) spot exchange rate expected for period t+k, as of time t. fd_t^k represents the forward discount while $(s_{t,t+k}^e - s_t)$ denotes the expected depreciation rate. The first two terms on the right hand side of equation (1) are referred to as a covered interest differential and an exchange risk premium respectively. A zero covered interest differential is denoted as ‘perfect capital mobility’ whereas the absence of an exchange risk premium constitutes ‘perfect capital substitutability’.

While financial capital apparently moves with some ease to locations where the rate of return is highest, it is not so clear that movements of capital are sufficient to equalize real rates of return. To see that this is a more stringent requirement, consider the situation where Uncovered Interest Parity (UIP) holds, or:

$$\Delta s^{e}_{t,t+k} = i^{k}_{t} - i^{k*}_{t} \tag{2}$$

If goods prices are also equalized and, in particular, assume relative purchasing power parity (PPP) holds in expectation so that expected depreciation equals the expected inflation differential, we have:

$$\Delta s^{e}_{t,t+k} = \pi^{e}_{t,t+k} - \pi^{e*}_{,t+kt} \tag{3}$$

By equating (2) and (3),

$$i^{k}_{t} - i^{k*}_{t} = \pi^{e}_{t,t+k} - \pi^{e*}_{,t+kt} \tag{4}$$

and rearranging (4) yields:

$$i^{k}_{t} - \pi^{e}_{t,t+k} = i^{k*}_{t} - \pi^{e*}_{,t+kt} \tag{5}$$

hence the ex ante RIP is given by:

$$E_t(r_{t+k}) = E_t(r^{*}_{t+k}) \tag{6}$$

where r is the real interest rate, while an asterisk refers to the foreign country. It is straightforward to show that, assuming rational expectations, ex post RIP implies also ex ante RIP. Researchers have usually taken the form of estimating the following model:

$$r_t = \alpha_0 + \alpha_1 r_t^* + \varepsilon_t \tag{7}$$

where r_t represents the ex post or observed real rate of interest in selected Asian countries and r_t* the ex post or observed real rate in the base country, which in the present case is Japan. Or, by imposing the restriction $(\alpha_0, \alpha_1) = (0, 1)$ on the cointegrating regression (7), we have a model of real interest differentials (RID) that can be specified as:

$$r_t - r_t^* = \varepsilon_t \qquad (8)$$

Given the specification in (8), RIP holds in a long-run equilibrium framework if ε_t is stationary and the real interest differential is essentially mean reverting over time.

Estimation Procedure 1: Real Interest Rates linkages among ASEAN-5 and Asia Pacific-10

To capture the long run movements of real interest rates (financial linkages) among countries, we utilize the multivariate cointegration procedure developed by Johansen and Juselius (1990). The test for number of cointegrating vectors be conducted using two likelihood ratio (LR) test statistic namely the trace statistic and maximum eigenvalue statistic as shown below:

Trace test : $L_{trace\,(r)} = -T \sum \ln (1 - \lambda_i)$ (9)

Maximum eigenvalue test : $L_{max\,(r,\, r+1)} = -T \ln (1 - \lambda_{r+1})$ (10)

where λ_i is the estimated eigenvalues and T is the number of valid observations. The null hypothesis of trace statistic tests that the number of distinct cointegrating vector is less than or equal to r against a general alternative in which it gives 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 (e.g. ASEAN-5), 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}, R_{THAI} are the real rates of interest for Indonesia, Malaysia, Philippines, Singapore and Thailand respectively. The rejection of the non-cointegration hypothesis would imply a considerable degree of financial integration amongst these markets. If cointegration is confirmed, the Granger-causality test based on 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 vector error-correction model (VECM) can be generated:

$$\Delta Z = \mu + \sum_{i=1}^{k-1} G_i \Delta Z_{t-i} + G_k \Delta Z_{k-i} + \varepsilon_t \tag{11}$$

where μ is 5×1 vector of drift, G's are 5×5 matrices of parameters and, ε_t is 5×1 white noise vector. VECM analyze 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 and Masih, 1996) since it does not provide an indication of the dynamic properties of the system, nor allow us to gauge the relative strength of the Granger-causal chain or amongst the variables beyond the sample period. Thus we proceed to the forecast error Variance Decomposition (VDCs) analysis.

VDCs can be termed as out-of-sample causality tests, by partitioning 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 forecast from its own lagged values will have all its forecast error variance accounted for by its own disturbance and vise versa. In short, VDCs is employed to provide evidences on how well own variance of one country being explained by innovations in variances of other countries. Then, the impulse response function is utilized to gauge the dynamic response path of each endogenous variable to a one period standard deviation shock to another variable contained in a cointegrating VAR system.

Estimation Procedure 2: Real Interest Rates Differentials (RID) of Japan-ASEAN 5

The RID model as specified in (8) can be examined using the conventional single-equation based ADF unit root test. ADF procedure extends the Dickey-Fuller test by allowing a higher order of autoregressive process as shown below:

$$\Delta Y_t = \beta_0 + \beta_1 Y_{t-1} + \sum_{i=2}^{k} \delta_1 \Delta Y_{t-i+1} + \varepsilon_t \qquad (12)$$

$$\Delta Y_t = \beta_0 + \beta_1 Y_{t-1} + \beta_2 t + \sum_{i=2}^{k} \delta_1 \Delta Y_{t-i+1} + \varepsilon_t \qquad (13)$$

where k represents number of lagged changes in Y_t necessary to make ε_t serially uncorrelated. The first and the second equation are differentiated by a deterministic trend. By considering a null hypothesis of $\beta_1 = 0$, and alternative $\beta_1 < 0$, we can decide on the absence or present of unit root. If the observed t-statistic exceeds critical value at standard level of significance, the null hypothesis of unit root is rejected, or otherwise. In assessing the degree of mean reversion of real interest differentials, the half-life of deviation from RIP is to be computed. Suppose the deviations 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:

$$y_t - y_0 = \beta(y_{t-1} - y_0) + \varepsilon_t \qquad (14)$$

where ε_t is a 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:

$$\beta^h = \frac{1}{2} \quad \Rightarrow \quad h = \frac{\ln(1/2)}{\ln(\beta)} \qquad (15)$$

Data Description

Following the Fisher equation, real interest rates of one country will take account of the expected inflation, which are estimated from actual inflation as measured by changes of consumer price index (CPI). In our case, the expected inflation is estimated by using the autoregressive distribution lag approach rather than having the actual inflation as proxy. The nominal interest rates employed in the study are: interbank money market rates for Indonesia, Singapore, Thailand and Japan; 3 month Treasury bill rates for Malaysia and interbank call loan rates for the Philippines. Only short-term interest rates are being used due to the fact that long-term interest rates such as government bond yield are not applicable for most ASEAN countries. The study sample spans from 1984:Q1 to 1997:Q2, considering of the post-liberalization era prior to the financial crisis. Crisis period that involves structural breaks would have violated the RIP theory and hence, not included in our study.

4.0 RESULTS AND DISCUSSION

Univariate Analysis

For one to proceed with cointegration tests, it is important to first examine the univariate properties of the individual time series. Notably, Johansen-Juselius cointegration procedure requires that variables follows a $I(1)$ but not $I(2)$ process. To verify this, we subject all series to the classical ADF unit root tests. As reported in Table 2, the null hypothesis of unit root failed to be rejected for series at level form However, at first difference, we find no evidence of unit root. The real interest rates of ASEAN-5 and Japan are integrated of first order and thereby, implying a clear $I(1)$ process. Although the finding quite the reverse with the Fisher condition which imply that real interest rates are stationary in level, it is consistent with the recent empirical evidence that real interest rates follow a random walk (e.g. Goodwin and Grennes, 1994; Chinn and Frankel, 1995). The confirmation of *I(1)* process has provided us a requisite for the forthcoming cointegration analysis[4]. **[Insert Table 1.1]**

Multivariate Cointegration Analysis

Table 1.3 summarizes the Johansen-Juselius multivariate cointegration tests for ASEAN-5 model. The null hypothesis of no cointegration (r=0) is easily rejected at conventional statistical significant levels, as confirmed by the λ-Max and Trace statistics. Both statistics indicate a unique cointegrating vector (r=1), suggesting the presence of four common stochastic trends (n-r) in real interest rates. In other words, there was a considerably long run financial interdependency among the ASEAN-5 financial markets. To some extent, future fluctuations of real interest rates of an ASEAN member country can be determined or forecasted, using a part of the information set provided by the other ASEAN countries. **INSERT [Table 1.3]**

Granger-causality and Vector Error Correction Modeling Analysis

Table 1.4 highlights that for both Malaysia and Singapore, the error correction terms (ECTs) are statistically significant at 95% confidence level and the temporal causality effects are active. Consequently, both countries are endogenously determined in the model and share the burden of short-run adjustment to long-run equilibrium. By contrast, Indonesia is statistical exogenous as neither the ECT is significant nor the channels of Granger-causality is temporally active. **INSERT [Table 1.4]**

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[4] Additionally, the results of exclusion test reported in Table 1.2 indicate that all selected countries are highly statistical significant and well fit for the ASEAN-5 model.

The temporal Granger-causality channels are abstracted from Table 1.4 and summarized in Figure 1. Changes of real interest rates in Malaysia are being led by movements of real rates in Indonesia, Philippines, Singapore and Thailand whereas Singapore is being led by Philippines and Thailand respectively in the short run. Also, there is a unidirectional causal effect running from Indonesia to 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. **INSERT [Figure 1]**

Variance Decomposition Analysis

The generalized forecast error variance decompositions (VDCs) analysis enables us to gauge the extent of external shocks in one country being explained by other ASEAN countries. Table 1.5 indicates that most of the forecast error variance of real interest rates in any ASEAN-5 countries can be attributed to other ASEAN-4's innovations (more than 50%) rather than their own. These forecasted results (out-of-sample) are in line with the previous causality results that ASEAN-5 are financially interdependent. The findings also imply that ASEAN member countries are vulnerable to regional shocks and thus partly explain the contagion effects during the financial turmoil 1997/98.

Among all, Malaysia, Thailand and Singapore appear to be more explained by innovations of other ASEAN countries. Although Singapore is also endogenous determined, it was hardly affected during the Asia crisis as compared to Thailand and Malaysia. This is due to its strong economic fundamentals as well as the fact that Singapore has the most developed capital market in the region. On the other hand, Indonesia and Philippines are being less interactive as over 41%-45% of their own variances are being explained by their own innovations. In addition, forecast error variance of Malaysia contributes the least to the other members of ASEAN countries, suggesting that shocks and innovations from Malaysia are less transmitted to the other ASEAN member countries. **INSERT [Table 1.5]**

Real Interest Differentials Analysis

The real interest rates differentials are estimated through the specified regression (8), (12) and (13) in Section 3. If the differentials are stationary and reverting to the long run mean, RIP holds between Japan and ASEAN-5, or otherwise. Table 2.1 reports the univariate ADF tests on the bilateral real interest differentials with respect to Japan during 1984:Q1 to 1997:Q2. Obviously, the null hypotheses of unit root are rejected at conventional significant level 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, suggesting that Singapore could be financially less integrated with Japan as compared to other ASEAN-4. This is not surprising since the Singapore 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 RIP holds for US-Singapore but not for Japan-Singapore. **INSERT [Table 2.1]**

[5] 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, Japanese direct investments in Singapore only accounted for US$ 765 million.

To have an insight of the degree of deviations from RIP, we refer to Table 2.2. Evidently, the deviations from RIP are considerably small and the half-lives are ranged approximately from 1.9 to 2.7 quarters (or 6 to 8 months). Of all, Indonesia and Malaysia report the lowest half-lives of 1.90 and 1.74 quarters respectively, suggesting that they both are comparably more financially influenced by Japan. For Singapore that does not support the RIP condition, the degree of deviation is greater but still relatively small, approximately 11 months. Yet, to a certain extent, Singapore and Japan are considered financially integrated. The results are consistent and imply a high degree of mean reversion of real interest differentials in which the adjustments to long run mean are fast. The results are thus reflecting the facts that for Japan and ASEAN-4, RIP holds in strong form. More important, our findings have to great extent, confirmed the Japanese leading role in the ASEAN regional financial market. **INSERT [Table 2.2]**

Additional Transmission Channels through US and Other Regional Markets

As argued elsewhere the Pacific Asian region is not a closed trading bloc. In fact, most of the countries in the region are strongly dependent on US markets. Chinn and Frankel (1995), for example argued that the degree of co-variability between US and the local capital markets in the region is increasing over time. The article by Phylaktis (1999) also provides strong evidence of how close these markets are connected with world financial markets. Nevertheless, Phylaktis went on to say that capital markets in the Pacific Basin region are dominated by Japan in the post-liberalization era. Thus, certain regularities may be missing for a system of ASEAN interest rates which exclude the US as well the other Asian neighboring markets. 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 add the real interest rate of these countries to the basic system. In this way we are able to examine the effect on a large number of variables and their interactions with the non-US capital market without confronting possible arbitrariness of modeling international interdependence.

In the remainder of this paper, we reexamine the extent of financial integration using real interest rates from ten Pacific Basin countries: Malaysia, Thailand, the Philippine, Singapore, Indonesia, South Korea, Taiwan, Hong Kong, Japan and the US in our system. The sampling period chosen is the same as before. The results from the larger system show that there is a unique cointegrating vector in the multivariate framework. Thus, the conclusion remains unchanged with the addition of capital markets of Hong Kong, South Korea, Taiwan and the US. This finding suggest the interdependence of the Pacific Basin economies with the two major capital markets – the US and Japan. We also investigate whether some real interest rates may be excluded from the long-run relationship. With one cointegrating vector, the likelihood ratio (LR) teststatisticisdistributedas χ^2 random variable with one degree of freedom. As shown by Table 3.1, none of the variables may be excluded from the long-run relationship at the 5% significance level or better, i.e. all the nine real interest series contribute significantly to the cointegrating relationship. **[Insert Table 3.1, Table 3.2]**

A few upshots emerge from our investigation. First, 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. This feedback relationship coincides with the concerted efforts taken by the governments of these two nations to maintain parity of interest rate and exchange rates.

Second, the US directly affects South Korea and Malaysia while Japan has a direct-unidirectional influence on Hong Kong, Thailand, Singapore and South Korea (see Figure 2). 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 real interest rate changes, but not conversely. We note that the results presented in the previous section showed that the real interest differential of Japan-Singapore does not hold. Nonetheless, in the extended multivariate model (with the US in the system), Japanese real rate has Granger-caused the movement of the Singapore real rates. Conversely, the hypothesis of Granger non-causality from the US to Singapore is not rejected, thus rejecting the US-dominant role of in Singapore (see Table 3.3). We note the results also indicate that the causal relation between Japan and Malaysia is rather an indirect one through South Korea.

Third, except for Singapore (mostly affected by Hong Kong real rate innovations), the link between real interest rates in the ASEAN member's rates has strengthened considerably. We observed that variation in interest rates in Malaysia is mainly due to disturbance 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 economic integration in the ASEAN countries.

Forth, selected variance decompositions for the VAR model are reported in Table 3.4. The dynamic relationships selected for presentation incorporate the linkages between US-ASEAN, Japan-ASEAN and regional markets-ASEAN. The results of VDCs show that US interest rates were have some moderate impact upon ASEAN interest rates, while the Japanese interest rate had somewhat smaller impact on the ASEAN interest rates. **[Insert Table 3.4]**

Next, we look at how long it takes 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 3.5 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 much faster rate following impulse from the US real interest rate, however, the difference in the speed is not large. For instance, Indonesia took 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 Japanese interest rate. This is an indication of the degree of capital market integration between the two financial centers. Thus, our findings do not support the results found in Phylaktis (1999) that show Japan's dominant influence in the region. **[Insert Table 3.5]**

5.0 CONCLUDING REMARKS AND POLICY IMPLICATIONS

In this paper we present evidence on several questions regarding the movement in real interest rates in the ASEAN region: Has there been a link between the Japanese rates and those in the ASEAN members? Have the real rates with ASEAN been more closely linked together than they are with the real rates of US or other members in the Asia Pacific region? Does RIP hold sufficiently to justify the regional exchange rates options?

As for our first question, the results of our analysis based on an array of econometric time series methods suggests that real interest rates in the ASEAN region is increasingly becoming integrated with the regional as well as the major financial centers. This means that the capital and goods markets in the region are well integrated with the global markets. From the 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 US (Japan) and the ASEAN countries indicates that the effectiveness on monetary policy is limited in the long-run. As pointed by Chinn and Dooley (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 innovations. This observation partly explains the contagion effects during the Asia crisis 1997/98. The financial turmoil started in Thailand and quickly spread to Malaysia, Thailand, Indonesia and the Philippines and later, the East Asian region.

As for the second question the answer is less decisive. The existing literature including Chinn and Frankel (1995) and Phylaktis (1995) suggest that while there is continued integration with US, there is also growing sphere of influence for Japanese interest rates over time. All in all, our results suggest that US has strong influence as Japan upon the movement of real interest rates in Asian Pacific region. This conclusion is in line with Shan and Pappas (2000) but is in sharp contrast with the work of Phylaktis (1999). One possible explanation for the conflicting results is the sampling period utilized in these studies differs. The US is still playing a leading role in the region in the aftermath of Asian financial crisis. Recent events in the US suggest the current account deficits have reached unprecedented levels and there is a strong support for pushing up interest rates. The implication of our finding illustrates that if there is an upward pressure of the US real rates, it would also affect the ASEAN countries.

Answer for the third question is, perhaps, the hardest piece of all our interpretation but probably the most appealing part for policy makers, as well as for academia. In open macroeconomics, a classical term-trilemma, implies that countries will not achieve concurrently the capital mobility, the fixed exchange rates and the monetary autonomy (Obstfeld *et al*, 2004; Masih, 2004). Malaysia, for instance, when choose to fix her currency against US$ can only lift the capital control by given up monetary independency. Simply, RIP necessarily holds by tapering the real interest differentials between Malaysia-US. This have inevitably narrowed domestic policy options and constrained national choices over monetary and fiscal policies, which may facilitate excessive borrowing. Alternatively, a positive move towards a common currency area (scarifying the exchange rate flexibility) can be seen as practical step to shun the macroeconomic trilemma. Despite the potential gains of intra-trade expansion, an optimum currency area will provide the collective defense mechanism against systemic failures and monetary instability. Nevertheless, Asian countries lack the political will evident in the European Union while income divergence and purchasing power disparity still persist. Moreover, cross-border bank credit flows within Asia remain at a low level and government or corporate bond markets are not well integrated (Baharumshah, *et al.,* 2004). Putting together, the practice of such regime for the whole Asia contingent may not be recognized in the near decades. Yet, given our evidence of financial integration among ASEAN-5 and among the East Asian economies, a promotion of currency bloc (e.g. ASEAN Bloc, Yen Bloc) would be considerably pragmatic.

Last but not least, recent studies have shown that nonlinear framework can be further applied to model the real interest parity and purchasing power parity. The evidence of nonlinear stochastic dynamics should be useful in understanding the complexities of economic integration. This leaves many avenues for future research.

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Table 1.1: 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]*
THAI	-2.69[1]	-2.77[1]	-4.27[4]*	-4.64[4]*

Notes: Asterisk (*) 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, THAI=Thailand.

Table 1.2: Restrictions Tests

Model	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]**
THAI	20.4098 [0.00]**

Notes: Asterisk (**) denotes statistical 99% of significance level. Chi-square (χ^2) statistics with one degree of freedom are presented for the exclusion test. P-values are presented in the parentheses.

Table 1.3: Multivariate Cointegration Tests of Real Interest Rates for ASEAN-5

Null H_0	Alternative H_1	λ -Max	Trace Statistics	Critical Value (95%)	
				λ -Max	Trace
(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

Table 1.4: Granger-causality within the VECM

k=6, r=1	Independent Variable					
Dependent Variable	ΔIND	ΔMAL	ΔPHI	ΔSIN	ΔTHAI	ECT_{t-1}
	Chi-square, χ^2					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** [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*
ΔTHAI	1.21 [0.27]	1.45 [0.23]	0.14 [0.71]	0.92 [0.34]	-	-1.80

Notes: Asterisk (*) 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

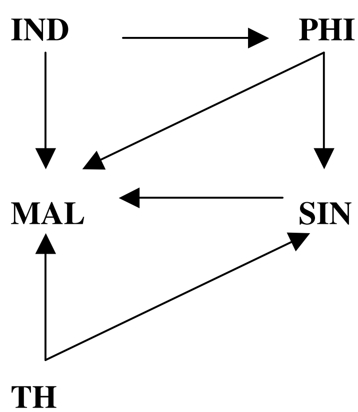

Table 1.5: Generalized Variance Decomposition for ASEAN-5 Model

	Horizon	Explained by Innovation in					
		IND	MAL	PHI	SIN	THAI	**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**
THAI	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.

Table 2.1: 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
THAI	3	-3.23	3	-3.56**
Critical value				
1%		-4.10		-3.53
5%		-3.48		-2.90

Notes: Asterisk * and ** denote 5% and 1% statistic significant level 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 2.2: 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
THAI	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.

Table 3.1: Tests of Exclusion Restrictions for Asia-Pacific 10 Model

Model	Asia Pacific-10 Model
	χ^2
US	24.3489[0.000]**
JAP	26.2788[0.000]**
IND	11.4893[0.003]**
MAL	28.5541[0.000]**
PHI	16.3420[0.000]**
SIN	21.0116[0.000]**
TH	14.7946[0.001]**
HK	24.285[0.000]**
SK	16.8833[0.000]**
TW	3.1663[0.205]

Notes: Asterisk (*) and (**) denotes statistical 5% and 1% of significance level respectively. Chi-square (χ^2) 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.

Table 3.2:Multivariate Cointegration Tests of RIP during Post-liberalization

Null H_0	Alternative H_1	λ -Max	Trace Statistics	Critical Value (95%) λ -Max	Critical Value (95%) Trace
(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

Notes: Asterisk (**) denotes rejection of hypothesis at 5% significance level. (k=2) represents the optimum lag length selected according to AIC.

Table 3.3: Granger-causality within the VECM for Asia Pacific-10 Model

Dependent Variable	Independent Variable ΔUS	ΔJAP	ΔIND	ΔMAL	ΔPHI	ΔSIN	ΔTH	ΔHK	ΔSK	ΔTW	ECT_{t-1}
	Chi-square, χ^2										
k=s, r=1											
ΔUS	-	3.54*	0.01	0.05	0.71	0.03	2.30	0.01	0.11	0.26	-0.07
		[0.06]	[0.92]	[0.82]	[0.42]	[0.86]	[0.13]	[0.93]	[0.74]	[0.61]	
ΔJAP	5.17*	-	0.01	0.10	2.34	0.41	0.26	0.02	0.03	0.06	-0.03
	[0.02]		[0.94]	[0.75]	[0.13]	[0.52]	[0.61]	[0.89]	[0.87]	[0.81]	
ΔIND	0.09	0.03	-	0.05	0.18	0.16	1.16	1.71	0.19	2.30	0.51
	[0.76]	[0.87]		[0.82]	[0.67]	[0.69]	[0.28]	[0.19]	[0.67]	[0.13]	
ΔMAL	4.19*	0.01	0.80	-	0.74	2.12	1.39	0.06	4.99**	0.40	2.10
	[0.04]	[0.90]	[0.37]		[0.39]	[0.15]	[0.24]	[0.80]	[0.03]	[0.53]	
ΔPHI	0.24	0.22	7.34***	0.90	-	2.73*	0.09	0.00	03.9	0.65	-1.06
	[0.62]	[0.64]	[0.01]	[0.34]		[0.09]	[0.76]	[0.99]	[0.54]	[0.42]	
ΔSIN	0.40	7.33***	0.02	2.79*	8.18***	-	2.60*	0.55	1.13	0.75	-2.27**
	[0.53]	[0.01]	[0.90]	[0.09]	[0.00]		[0.10]	[0.46]	[0.29]	[0.39]	
ΔTH	0.01	4.83**	0.56	0.97	1.28	0.29	-	1.39	0.02	1.14	-0.27
	[0.93]	[0.03]	[0.45]	[0.33]	[0.26]	[0.59]		[0.24]	[0.89]	[0.39]	
ΔHK	1.72	2.82*	2.46	0.10	0.12	1.21	0.07	-	0.09	1.07	1.18
	[0.19]	[0.09]	[0.12]	[0.75]	[0.73]	[0.27]	[0.79]		[0.77]	[0.30]	
ΔSK	3.73**	13.80***	1.47	0.03	0.49	3.43*	0.20	2.38	-	6.47**	-3.96***
	[0.05]	[0.00]	[0.23]	[0.87]	[0.48]	[0.06]	[0.65]	[0.12]		[0.01]	
ΔTW	0.90	0.34	1.87	5.14**	2.40	0.64	0.23	0.13	0.46	-	-0.17
	[0.34]	[0.56]	[0.17]	[0.02]	[0.12]	[0.43]	[0.63]	[0.72]	[0.50]		

Notes: Asterisk (*), (**) and (***) denote 10%, 5% and 1% significance level 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. ΔHK, ΔSK and ΔTW represent the real interest rates of NIEs namely Hong Kong, South Korea and Taiwan respectively.

Figure 2: Causality of APC-10 Model during Post-liberalization

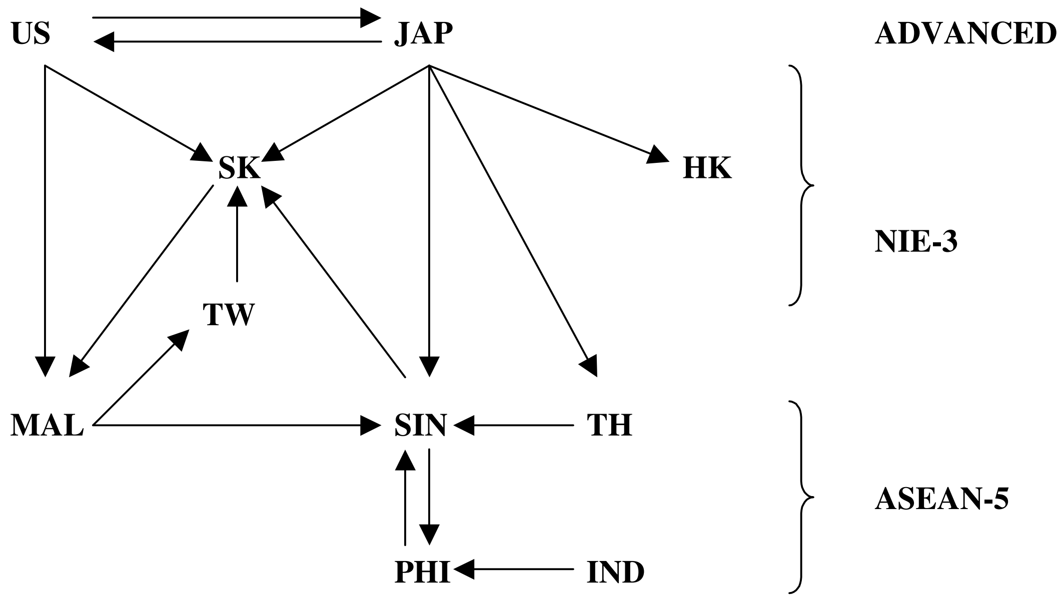

Table 3.4: Variance Decomposition for Asia Pacific-10 Model during Post-liberalization

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*

Notes: 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.