Dynamic Financial Linkages of Japan and ASEAN Economies: An Application of Real Interest Parity

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ABSTRAK

Untuk menguji kebenaran pariti kadar bunga benar (RIP), kertas kajian ini membekalkan bukti-bukti empirik berkaitan hubungan dinamik kadar bunga benar antara ASEAN-5 dan pergerakan ulang-balik purata bagi pembezaan bunga benar antara ASEAN-Japan, semasa tempoh lepas-liberalisasi (1984-1997). Empat penemuan utama dirumuskan. Pertama, wujudnya pergerakan umum jangka panjang dan aliran penyebab dinamik jangka pendek kadar bunga benar antara ASEAN-5. Secara langsung, ini menandakan keeratan monetari serantau. Kedua, kebanyakan varians ralat ramalan kadar bunga benar di negara sendiri adalah diterangkan oleh innovasi ASEAN-4 yang lain (lebih daripada 50%), yakni menerangkan sebahagiannya kesan kontagion semasa krisis Asia 1997/98. Ketiga, pembezaan bunga benar didapati ulang-balik pada nilai purata, menyarankan bahawa RIP adalah benar antara ASEAN-Japan (kecuali Singapura). Keempat, 'half-lives' dilaporkan selama 6 hingga 11 bulan. Maka, sisihan daripada RIP adalah kecil. Sekaligus, penemuan kami menyokong integrasi kewangan serantau dengan peranan pimpinan Japan terbukti. Selanjutnya, kajian ini menyokong pembentangan matawang serantau dengan Yen Jepun diambil sebagai matawangan umum.

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ABSTRACT

To examine the validity of real interest parity (RIP), this study provides empirical evidences concerning the dynamic linkages of real interest rates among ASEAN-5 and the mean reversion behaviors of real interest differentials of ASEAN-5.vis-à-vis Japan during the post liberalization era (1984-1997). The upshots of our findings are four-fold. First, there were co-movement of ASEAN real rates in the long run and dynamic causalities in the short run, which explicitly indicated a monetary inter-dependency among the ASEAN tigers. Second, 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 explain the contagion effects during Asia crisis 1997/98. Third, the real interest differentials are mean reverting over time, implying that RIP holds between Japan and ASEANs (except Singapore). Forth, the half-lives are reported at approximately 6 to 11 months, which reflect the considerably small deviations from RIP. All together, the findings constitute towards regional financial integration with the Japan's leading role being confirmed. To great extent, this would support the recent proposal of Currency Union with Japanese Yen taken as common currency.

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

INTRODUCTION

In many settings, financing and investing decisions can be based on nominal interest rates. But with high or variable inflation rates, it is often useful to examine real interest rates, that is, interest rates adjusted for expected inflation. The present paper aims to examine one of the building blocs of international finance-the Real Interest Rate Parity (hereafter RIP), concerning the East Asian financial markets. If RIP holds in absolute form, real interest rates should be equalized across countries. In other words, financials assets are perfect substitution as returns on comparable financial assets traded in domestic and foreign markets are identical. However, real returns on bonds are hardly equalized and in many early studies, RIP is unfortunately a dismal empirical failure[1].

As yet, most studies have focused on the relationship of real interest rates rather than the RIP absolute equality condition. The extents to which rates of real interest are linked across countries and how these linkages progressed through time have gained researchers' attention for several reasons. First, 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 behavior. Second, RIP is a key working assumption in various models of exchange rate determination[2]. Third, due to its theoretical link to the Purchasing Power Parity (PPP), confirmation or rejection of RIP

[1] See Mishkin (1984), Merrick and Saunders (1986), and Shrestha and Tan (1998), among others for the rejection of RIP.

[2] 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.

can be viewed as indication of macroeconomic integration or autonomous. Indeed, recent researchers have referred the comovements and dynamic linkages of real interest rates across countries as an indicator of financial integration[3]. Nonetheless, it is worth pointing out here that the empirical evidences on the international financial linkages are not conclusive and the degree of international financial integration achieved by capital flows remains a matter of debate[4].

This study can be divided into two major parts. First, we examine the dynamic linkages of real interest among ASEAN-5[5]. Long run relationships are captured by the multivariate cointegration test whereas dynamic short run causal relationships are determined by the vector error-correction modeling (VECM). In addition, the degree of external shocks in one country being explained by other ASEAN members is analyzed by the forecast error Variance Decomposition (VDCs). Second, we seek to investigate the Japan's leading role in the ASEAN region by investigating the mean reversion behaviors of real interest differentials between Japan and ASEAN-5. If real interest differentials are mean reverting, RIP holds between Japan-ASEAN or otherwise. The half-life, as to measure the degree of mean reversion is computed as well. For both parts of the study, the post liberalization period prior to the Asia crisis (1984-1997) is being considered.

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[3] See Phylaktis (1999), Awad and Goodwin (1998) and Hassapis *et al* (1999) for details.

[4] Chinn and Frankel (1994, 1995) for instance found that although Indonesia and Thailand were integrated with Japan, RIP holds only for US-Singapore, US-Taiwan and Japan-Taiwan. On the other hand, Phylaktis (1997, 1999) found that the Asia Pacific capital markets are considerably integrated but the results regarding the US- and Japan-leading role in the regional market are contradicted. In a similar work on RIP, Chan (2001) confirmed the high degree of regional capital mobility and substantial financial integration among the East Asian economies but the US leading role was greater than that of Japan.

[5] ASEAN-5 refers to the five original members of the Association of Southeast Asian Nations including Indonesia, Malaysia, Philippines, Singapore and Thailand.

The present study differs from the existing literature in several significant aspects. First and foremost, ASEAN is a region of growing importance in the world economy but the financial linkages among its members have yet to be fully analyzed. While real interest linkage has been a major topic of analysis in the European community for the past decade, the literature on South East Asia is explicitly small, even if expanding. A different insight or perspective may be gained from examining ASEAN emerging economies with different regulatory regimes at different stages of development. Additionally, the advances of econometric that we deploy not only are capable of distinguishing the long- and the short-run dynamic relationships, but also proficient to determine the endogeneity and exogeneity of variables (or, countries), which for certain act as important tools in the policy modeling.

Second, whilst studies on RIP have appeared in abundance with the US or German taken as base country[6], the Japan-based studies have been meager although Japan happens to be the world second largest economy. Despite the ruling out of German's leading role in ASEAN countries, recent financial developments accompanied by signs that Japan has been increasing its financial influence in East Asia and possibly overshadowing that of the US. Since late 1980s, Japan has been the major trading partner and contributor of foreign investments in the ASEAN community. For instance, Japan's direct investments in ASEAN-5 peak in 1996, amount for more than US$ 6 billions as

[6] See Kirchgassner and Wolters (1993) and Moosa and Bhatti (1996) for the German-dominance hypothesis; Cumby and Mishkin (1986) and Modjtahedi (1988) for the US-dominance hypothesis; Pain and Thomas (1997) and Awad and Goodwin (1998) for the US- and German-dominance joint hypothesis.

compared to US$ 3.6 billions in 1991. In spite of being the main export market (above one-sixth of the export of the ASEAN), Japan is as well being the significant source of capital-intensive manufactures for most ASEAN countries.

Third, the half-life of a random disturbance as deviation from RIP is computed to measure the degree of mean reversion and the speed of adjustment back towards long run RIP. 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 Chan and Baharumshah (2002).

To examine the pertinent issue, we have our paper structured into the remaining sections. Section two dwells with the methodological issue and reviews of the RIP theory. Section three then reports the empirical results and discussion. Finally in section four, we conclude.

DATA 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, CIP and RPPP. Hence, to formulate RIP, non-zero country premium and non-biased prediction of future spot exchange rate should presence without any changes in expected real exchange rates between two countries. If RIP holds, by equation, real interest rates will equalized 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, and Eijffinger, 1995).

INSERT [Table 1]

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. First it indicates strong form integration with neither capital imperfections nor any arbitrage opportunities is allowed. Even in the absence of capital controls, 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 (see Phylaktis, 1999). Second, previous regression results that assume individual real rates to be stationary are not indicative for real interest rate equalization (see Mishkin, 1984). If the series are 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

Cointegration procedure that was developed by Granger (1986) to explore the long run relationship between two series has overcome these problems. Two non-stationary series say, 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 number of cointegrating vectors in Johansen-Juselius (JJ hereafter) procedure can be conducted using two likelihood ratio (LR) test statistic namely the trace statistic and maximum eigenvalue statistic as shown below:

Trace test : $L_{trace\,(r)} = -T \sum \ln (1 - \lambda_i)$ (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 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, 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 integration amongst these markets is suggested. 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:

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

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 (hereafter 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.

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

By imposing the restriction (0, 1) on the cointegrating regression in (1), we have a model of real interest differentials that can be specified as:

$$r_t^i - r_t^j = \varepsilon_t \tag{5}$$

where r_t^i represents the real interest rates of ASEAN country and r_t^j is the Japanese real rates. 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. 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:

$$\Delta Y_t = \beta_0 + \beta_1 Y_{t-1} + \sum_{i=2}^{k} \delta_1 \Delta Y_{t-i+1} + \varepsilon_t \tag{6}$$

$$\Delta Y_t = \beta_0 + \beta_1 Y_{t-1} + \beta_2 t + \sum_{i=2}^{k} \delta_1 \Delta Y_{t-i+1} + \varepsilon_t \tag{7}$$

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:

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

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:

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

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 strong form or weak form.

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 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. To assure the consistency and reliability of the data, we crosscheck with various sources such as the IMF International Financial Statistics, ADB Key Indicators and Central Banks of respective countries.

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 are *I(1)* but not *I*(2). To verify this, we subject all variables (real interest rates) to the classical ADF unit root tests of stationarity. As reported in Table 2, series are non-stationary in their level form since the null hypothesis of unit root failed to be rejected at conventional significant level. However, at first difference, we find no evidence of unit root for all cases. Thus, real rates of interest of ASEAN-5 and Japan are stationary after first differences, that is integrated of first order and thereby implying a clear *I(1)* process. Although the finding quite the reverse with the Fisher condition which would imply real interest rates are stationary in level, it is consistent with the recent empirical evidence that real interest rates follow a random walk (see 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.

INSERT [Table 2]

Likewise, the results of exclusion restrictions reported in Table 3 indicate that all selected countries are highly statistical significant and well fit for the ASEAN-5 model.

INSERT [Table 3]

Multivariate Cointegration Analysis

Table 4 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 level, 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 4]

Granger-causality and Vector Error Correction Modeling Analysis

Table 5 highlights that for both Malaysia and Singapore, the error correction terms (ECTs) are statistically significant at 95% 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 5]

The temporal Granger-causality channels are abstracted from Table 5 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 6 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 out-of-sample forecasted results are in line with the previous causality results that ASEAN-5 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 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 that due to its strong economic fundamentals and well-developed capital market. 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 have less explained the movement of real interest rates in ASEAN member countries.

INSERT [Table 6]

Real Interest Differentials Analysis

The real interest rates differentials are estimated through the specified regression (1) and (5) in section Three. If the differentials are stationary and reverting to the long run mean, RIP holds between Japan and ASEAN-5, or otherwise. Table 7 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, implying 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[7]. In fact, this finding is supported by Chinn and Frankel (1994, 1995) who found RIP holds for US-Singapore but not for Japan-Singapore.

INSERT [Table 7]

[7] 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 into the extent of deviations from RIP, we refer to Table 8. Clearly, the deviations from RIP are small and considerably less than those reported in the PPP studies. For the ASEAN-4 that RIP holds, the deviations from RIP have a smaller half-life of approximately 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 8]

CONCLUDING REMARKS AND POLICY IMPLICATIONS

Four major findings can be abstracted from the previous section. First, there were co-movement of ASEAN real rates in the long run and dynamic causalities in the short run, which explicitly indicated a monetary inter-dependency among the ASEAN tigers. Second, 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 explain the contagion effects during Asia crisis 1997/98. Third, the real interest differentials are mean reverting over time, implying that RIP holds between Japan and the ASEANs (except Singapore). Forth, the half-lives are reported at approximately 6 to 11 months, reflecting that deviations from RIP are considerably small.

To this end, our findings constitute towards ASEAN regional financial integration with the Japan's anchor role being confirmed. Although Singapore does not support the RIP condition, the half-life of 11 months would suggest that Singapore is fairly financial integrated with Japan. In one way, the findings may indicate the smaller scope of monetary autonomy that the domestic interest rates and aggregate price levels of an ASEAN country would be influenced by external factors, most probably from Japan. Consequently, this could have narrowed domestic policy options and constrained national choices over monetary and fiscal policies, which may facilitate excessive borrowing.

In another way, RIP holds between Japan-ASEAN countries intimate the financial assets substitutability and capital free flows that would prop up the regional economic growth and economic convergence. The high regional financial integration also uphold the potential of having closer economic cooperation and currency arrangements to provide a collective defense mechanism against systemic failures and regional monetary instability. Notably, countries with high integration across each other, with respect to international trade in goods and services, are likely to constitute an Optimal Currency Area (see Frankel and Rose, 1998). Indeed, in the single currency area with common monetary policy, strong linkage can be a force for stability and convergence, with expanding economies expanding economies would provide additional demand and export markets to members experiencing a downturn.

Realizing the importance of regional cooperation, various initiatives emerged recently such as the Manila Framework Group for macroeconomic and financial surveillance, the proposal of ASIAN Monetary Fund, and the Chiang Mai Initiative of ASEAN+3 on May 6 2000. Although ASEAN may not as committed as the European community, common similarity of most ASEAN countries which are well endowed with natural and human resources, has further supported the potential of forming currency area with Japanese Yen taken as common currency**.**

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Table 1 Interest Rate Parities and the Cumulative Assumptions

Interest Parities	**Assumptions**	
Covered interest rate Parity (CIP)		
$i_t - i_t^* = f_t^{t+k} - s_t$	$i_t - i_t^* - (f_t^{t+k} - s_t) = 0$	Zero country premium
Uncovered interest rate Parity (UIP)		
$i_t - i_t^* = E_t(s_{t+k} - s_t)$	$i_t - i_t^* = f_t^{t+k} - s_t$	Zero country premium
	$E_t(s_{t+k} - s_t) = f_t^{t+k}$	Forward exchange rate is an unbiased predictor of expected future spot exchange rate
Real interest rate Parity (RIP)		
$E_t(r_{t+k}) = E_t(r^*_{t+k})$	$i_t - i_t^* = f_t^{t+k} - s_t$	Zero country premium
	$E_t(s_{t+k} - s_t) = f_t^{t+k}$	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., $E(. \mid I_t)$

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

Notes:

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 $F_t^{t+k} / S_t = (1+ I_t) / (1+ I^*_t)$. 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: $i_t - i_t^* = f_t^{t+k} - s_t$

Table 2: Unit Root Tests of Stationarity

	ADF			
	Level		1st Difference	
	No Trend	Trend	No Trend	Trend
1984:Q1-1997:Q2				
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 3: 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 4: 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
r ≤ 4	r = 5	0.61	0.61	8.07	8.07

Notes: Asterisk (**) denote rejection of hypothesis at 95% significance level. (k = n) represents the optimal lag length selected according to AIC.

Table 5: 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

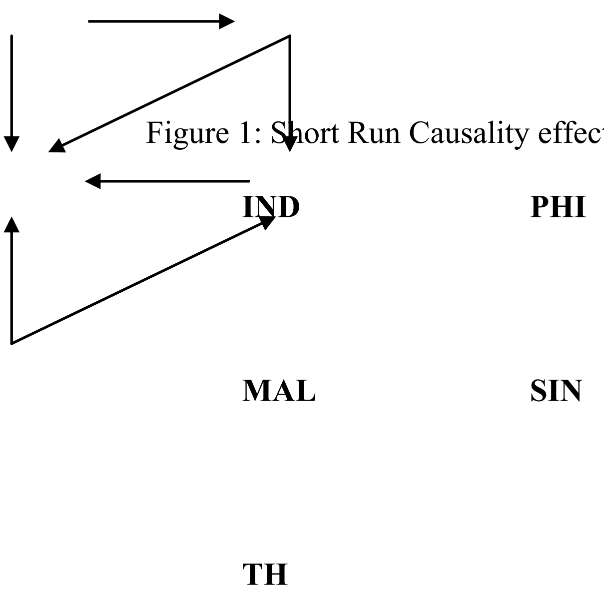

Table 6 Generalized Variance Decomposition for ASEAN-5 Model

Percentage of Variance	Horizon	IND	MAL	PHI	SIN	THAI	**Foreign**
		Explained by Innovation in					
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 7: 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 value for estimated residuals are computed based on MacKinon (1991). Optimal lags are selected based on modified AIC.

Table 8: Half-life Measurement of RIP

Model: Japan-ASEAN 5	$\widetilde{\beta}$	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.