EXAMINING INTEREST RATE LINKAGES AMONG ASEAN-5, CHINA AND INDIA
MOHAN, Ramesh* NANDWA, Boaz

Abstract
Interest rates play an important role, not only in attracting capital inflow, but also in macroeconomic stabilization and determining asset prices. Given the interdependent nature of the Association of South East Asian Nations (ASEAN) countries, it is crucial to examine whether there is any evidence of co-movement of short-term domestic interest rates within these economies. In addition, because of their significant economic influence in the region, we explore the Granger causality with China and India in determining their impact on interest rate movement in ASEAN-5 economies. We find evidence of cointegration; there is co-movement among the ASEAN interest rates. Further, based on the causality test, China exerts more influence on the direction of the interest rates in the region.
JEL Classification: F36
Key words: Interest rate, linkages, cointegration, ASEAN

1. Introduction
This study examines five senior members of the Association of South East Asian Nations (ASEAN-5 hereafter): namely Malaysia, Singapore, Thailand, Indonesia and the Philippines. The economic performance of these countries, better known as “Asian miracle”, before and after the 1997 Asian Financial Crisis, is the focal point of many researchers. The ASEAN region's tremendous economic success has been in their high savings and investment rates compared to the rest of the world. In recent years, liberalization of domestic financial markets and globalization of international

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financial markets forced the ASEAN countries to face many new ordeals.

In this study, the concentration is in examining the linkages of the inter-bank interest rates. Interest rates play an important role, not only in attracting capital inflow, but also in macroeconomic stabilization and determination of asset prices. Given the interdependent nature of the ASEAN-5, it is important to examine whether there is any evidence of co-movement of short-term domestic interest rates within these economies. China and India have an active market, which we characterize as impulsively bubbly. According to Asian Development Outlook 2007, 70% of the Asian region’s economic expansion in 2006 is due to China and India. Since opening their doors, a number of economists claim that China and India are diverting investments away from the ASEAN-5. The rise of China and India has both positive and negative ramifications for ASEAN-5. There could also be potential gains from Chinese/Indian investment in ASEAN firms, increases in exports to China/India’s fast growing consumer market and opportunities in the financial market. By monitoring financial market linkages of these two giants with ASEAN, we can paint a complete picture of the markets, thus providing a guiding tool for investment decisions in ASEAN-5.

This paper was guided by two research objectives that differ from other studies: First it investigates the possibility of interdependence between interest rates among the countries under investigation. Second, it incorporates China and India into the analysis to investigate the co-movement and Granger Causality of inter-bank interest rates among ASEAN-5 and China or India from 2001 to 2006. The rest of the paper is structured as follows. Section 2 presents the literature review and section 3 outlines data and empirical methodology. Section 4 presents and discusses the empirical results followed by the conclusion in section 5.

2. Literature review

A majority of the papers in the literature concentrate on the influence of Japan and the United States on the Asian countries (Chinn and Frankel, 1995; Fukasaku and Martineau, 1996; Anoruo et al., 2002; Chan et al., 2003; Park, 2004). Zhou (1996) in assessing
the level of economic links, found strong trade reliance and interest rate linkage among ASEAN countries. The author further asserts that Singapore has a vital role in the region. Further, the study also found that ASEAN countries are strongly linked with Japan and the United States.

Gil-Alana (2003), using quasi-maximum likelihood estimation procedure, studied the stochastic behavior of short run interest rates in selected Asian countries. The author found that only in Thailand and Singapore the interest rate reverts around the mean. On the other hand, for South Korea, Malaysia and the Philippines the orders of integration of the short run interest rates were oscillating around the unit root. Mills and Wang (2006) examined six Asian countries and found that real interest rates have been generally stable and only changing in reaction to international or country-specific shocks.

The emergence of China and India as global giants and trading partners with ASEAN has a big impact on the financial markets. China and India aspire to institute Asian economic grouping through a bilateral Free Trade Agreement (FTA) between India/China and the ASEAN. It is essential to study the impact of financial market growth of these two countries on the ASEAN-5. To our best knowledge, no other studies so far have concentrated on the interest rate linkages of China/India and the ASEAN-5. This paper attempts to fill that void and investigates the co-movement and Granger Causality of inter-bank interest rates among ASEAN-5 and China and India.

3. Data and empirical methodology

3.1 Data

The analysis is carried out using monthly data on nominal short-term (3-month interbank) domestic interest rates obtained from Datastream for Indonesia, Malaysia, Philippines, Singapore and Thailand over the 2001:1-2006:12 period. The countries under analysis in this study are the senior members of the ASEAN. The sample was selected on the basis that they have better financial markets compared to the other ASEAN countries and was also based on availability of data.
3.2 Empirical model

3.2.1 Cointegration

Johansen (1988) and Johansen and Juselius (1990) observed that if two or more variables are cointegrated, then stationary linear combinations of the variables may exist even though the variables themselves are separately non-stationary. This implies that variables that are cointegrated exhibit stable long-run relationships, analyzed by the vector autoregression (VAR), although in the short-run they can deviate from this relationship, analyzed by the error correction model (ECM). In this context, Johansen and Juselius (1990) suggested a maximum likelihood estimation methodology which provides estimates of the cointegrating vectors between a set of variables and derives a likelihood ratio test in testing the hypothesis that at least a certain number of vectors exist. Thus, an n-dimensional VAR model can be specified as:

\[
X_t = a + \sum_{i=1}^{k} \pi_i \Delta X_{t-i} + e_t
\]

(1)

where \(X_t\) is an \(n \times 1\) vector of \(I(1)\) variables, \(\pi_i\) is an \(n \times n\) matrix of parameters, and \(a\) is constant. The vector \(e_t\) is white noise, which may be contemporaneously correlated. We write the model in error correction form (ECM) as:

\[
\Delta X_t = a + \Gamma_1 \Delta X_{t-1} + \ldots + \Gamma_{k-1} \Delta X_{t-k+1} \ldots + \Pi X_{t-k} + e_t,
\]

(2)

where \(\Delta X_t\) is the vector of changes in period \(t\) and:

\[
\Gamma_m = -I + \sum_{i=1}^{m} \pi_i, \quad m = 1, 2, \ldots, k - 1
\]

\[
\Pi = -I + \sum_{i=1}^{k} \pi_i
\]

(3)

\(\Gamma\) is the short-run dynamics and \(I\) is the identity matrix. \(\Pi\) is the long-run matrix and the rank, \(r\), determines the number of stationary linear
combinations of $X_t$. Therefore, for $0 < r < n$, there exist $r$ cointegrating vectors; hence $\Pi$ can be factorized as

$$\Pi = \alpha \beta'$$

(4)

where both $\alpha$ and $\beta$ are $n \times r$ matrices. The model in (4) reflects a dynamic equilibrium relation in which the expression $\beta'X_{t-1}$ represents the extent to which the system is in disequilibrium (deviates from long-run equilibrium). Thus the series are linked together over time by the long-run relations in $\beta'$ while $\alpha$ denotes the error-correction parameters and take into account the speed of adjustment. Johansen and Juselius (1990) proposed two methods of estimating the number of cointegrating vectors, the $\lambda_{\text{trace}}$ and $\lambda_{\text{max}}$ eigenvalue tests. The $\lambda_{\text{trace}}$ test is a likelihood ratio test for maximum cointegration vectors against the alternative equal to $n$. The $\lambda_{\text{max}}$ test has an identical null hypothesis, while the alternative is $(r + 1)$ cointegration vectors.

### 3.2.2 Causality

Engle and Granger (1987) posited that if a set of variables are cointegrated, then there exists an error correction (EC) representation and vice versa, in which case there must be Granger-causality in at least one direction (Granger, 1969). In this study, we use the direct Granger causality test as follows:

$$\Delta Y_i = \phi_0 + \sum_{i=1}^{k} \phi_i \Delta Y_{t-i} + \sum_{j=1}^{n} \theta_j \Delta X_{t-j} + \eta_i$$

$$k = 2,3,6 \quad n = 2,3,6 \quad k \geq n$$

(5)

To test for simple causality from $X$ to $Y$ ($X \rightarrow Y$) we employ the $F$-test for the null hypothesis $H_0: \theta_1 = \theta_2 = \ldots = \theta_n = 0$.\(^1\)

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\(^1\) To test for causality from $Y$ to $X$, we interchanged the two variables in (5). To test for instantaneous causality between $X$ and $Y$, we included current values of the explanatory variables into the regression (5). However, the results remained qualitatively the same and are not reported here but can be obtained from the authors upon request.
4. Empirical results

Before examining whether the time series in our sample are cointegrated or not, it is important to analyze the time series properties, in order to examine the stationarity of the variables. Stationarity tests were conducted on the level and first difference of the interest rates using the Augmented Dickey Fuller (ADF) test proposed by Dickey and Fuller (1979):

$$
\Delta X_t = a + (\rho - 1)X_{t-1} + \sum_{i=1}^{k} \theta_iX_{t-1} + \eta_t
$$

(6)

For cointegration to occur, the series has to be integrated of the same order (i.e. differenced the same number of times to be stationary). The test is performed on both the levels and first difference of the variables. The null hypothesis of the presence of a unit root ($\rho - 1 = 0$) is tested against the alternative of stationarity. The results of the ADF tests, in levels and first difference, are presented in table 1.

<table>
<thead>
<tr>
<th>Countries</th>
<th>ADF Tests</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Levels</td>
<td>First difference</td>
<td></td>
</tr>
<tr>
<td>China</td>
<td>-0.314(3)</td>
<td>-0.213 (2)*</td>
<td></td>
</tr>
<tr>
<td>India</td>
<td>-2.429(2)</td>
<td>-1.301(1)**</td>
<td></td>
</tr>
<tr>
<td>Indonesia</td>
<td>-0.732(5)</td>
<td>-2.018(4)**</td>
<td></td>
</tr>
<tr>
<td>Malaysia</td>
<td>-4.093(3)</td>
<td>-1.032(2)**</td>
<td></td>
</tr>
<tr>
<td>Philippines</td>
<td>-1.515(2)</td>
<td>-1.914(1)**</td>
<td></td>
</tr>
<tr>
<td>Singapore</td>
<td>-2.203(4)</td>
<td>-1.322(2)**</td>
<td></td>
</tr>
<tr>
<td>Thailand</td>
<td>-3.289(3)</td>
<td>-2.402(2)*</td>
<td></td>
</tr>
</tbody>
</table>

Table 1: Augmented Dickey Fuller Unit Root Test

*Notes: The critical ADF and PP values are taken from Mackinnon (1991). The regressions were done with a constant term only; and the lag length, based on AIC, are in parentheses which are selected to eliminate serial correlations. ***, ** and * denotes 1%, 5% and 10% significance levels respectively. Seasonal dummies were included to control for seasonal unit roots (not reported here but available from the authors upon request).

Results on cointegration analysis are reported in Table 2. The Johansen maximum eigenvalue test rejects the null hypothesis of no cointegration, thus the test accepts the restriction that the rank of the cointegrating vector is not beyond one and rejects the null
hypothesis that the rank is maximum at the 5% level. Similarly, the trace test statistic rejects the null hypothesis of no cointegration of the vectors, accepting the restriction that the rank of the cointegrating space is not more than three.\(^2\)

<table>
<thead>
<tr>
<th>Lags</th>
<th>Null Hypothesis on the Rank</th>
<th>Max Test (95%)</th>
<th>Trace Test (95%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>(r = 0)</td>
<td>34.20**</td>
<td>89.85***</td>
</tr>
<tr>
<td>4</td>
<td>(r \leq 1)</td>
<td>35.15**</td>
<td>54.62***</td>
</tr>
<tr>
<td>3</td>
<td>(r \leq 2)</td>
<td>18.49*</td>
<td>34.57**</td>
</tr>
<tr>
<td>2</td>
<td>(r \leq 3)</td>
<td>11.37</td>
<td>26.32*</td>
</tr>
<tr>
<td>1</td>
<td>(r \leq 4)</td>
<td>1.29</td>
<td>2.64</td>
</tr>
</tbody>
</table>

Notes: The null hypothesis is in terms of the cointegration rank, \(r\). The critical values for maximum and trace were obtained from Osterwald-Lenum (1992), Table 1.***, ** and * denotes 1%, 5% and 10% significance levels respectively.

Results of the causality tests on the influence of interest rates of India and China on the selected ASEAN countries are reported in Tables 3 and 4. This is important in identifying of the two countries, which one of the ASEAN economies most economically linked. This can be examined via the causality test in determining whether India or China exerts greater influence on the movement of interest rates in the region. Overall, there is higher causality between the interest rates of the ASEAN countries with China than India. This can be explained by the emerging influence of China in the region. In addition, after China opens its doors for foreign investors, a large number of overseas Chinese start to invest in China. Nyaw et al. (2001) pointed out that majority of ASEAN investment to China is from overseas Chinese residing in ASEAN. In comparing the two giants, China is prominently a manufacturing powerhouse, whereas India has surfaced as provider of various services - especially back office, call centers, computer software and information technology.

\(^2\) The selection of the lag order of VAR is based on likelihood ratio test corrected for degrees of freedom and Akaike Information Criteria (AIC).
In China, a foreign firm could establish a wholly-owned subsidiary without any requirement for local participation in ownership. In India, on the other hand, there are sectors of the economy that are close to foreign investors or have restrictions on foreign ownership. In terms of labor law, it is easier comparatively to hire and fire workers in China than in India. India, the world's largest democratic nation, has a smaller economy than China and growing at a relatively slower pace.

### Table 3: Causality Tests on the Interest Rates Co-movement between China and ASEAN

<table>
<thead>
<tr>
<th>Countries</th>
<th>Unrestricted system</th>
<th>Restricted System</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indonesia, China</td>
<td>0.241 (4,2)* **</td>
<td>0.041 (4,2) ***</td>
</tr>
<tr>
<td>Malaysia, China</td>
<td>0.134 (3,2) **</td>
<td>0.521 (3,2) ***</td>
</tr>
<tr>
<td>Philippines, China</td>
<td>0.021 (5,2) ***</td>
<td>0.034 (5,2) ***</td>
</tr>
<tr>
<td>Singapore, China</td>
<td>0.017 (4,1) ***</td>
<td>0.072 (4,1) ***</td>
</tr>
<tr>
<td>Thailand, China</td>
<td>0.148 (6,3) ***</td>
<td>0.125 (6,3) ***</td>
</tr>
</tbody>
</table>

Notes: Marginal significance levels of F-tests are reported for both restricted and unrestricted system, estimated by OLS. The F tests are calculated for the joint hypothesis that the coefficients of the lags of the independent variable are zero. Optimal lag levels are reported in parentheses. ***, ** and * denotes 1%, 5% and 10% significance levels, respectively.

### Table 4: Causality Tests on the Interest Rates Co-movement between India and ASEAN

<table>
<thead>
<tr>
<th>Countries</th>
<th>Unrestricted system (OLS)</th>
<th>Restricted System (OLS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indonesia, India</td>
<td>0.002 (6,4)</td>
<td>0.153 (6,4)</td>
</tr>
<tr>
<td>Malaysia, India</td>
<td>0.219 (4,1)</td>
<td>0.471 (4,1)</td>
</tr>
<tr>
<td>Philippines, India</td>
<td>0.004 (12,4)</td>
<td>0.108 (12,4)</td>
</tr>
<tr>
<td>Singapore, India</td>
<td>0.180 (8,5)</td>
<td>0.131 (8,5)</td>
</tr>
<tr>
<td>Thailand, India</td>
<td>0.016 (6,2)</td>
<td>0.085 (6,2)</td>
</tr>
</tbody>
</table>

Notes: Marginal significance levels of F-tests are reported for both restricted and unrestricted system, estimated by OLS. The F tests are calculated for the joint hypothesis that the coefficients of the lags of the independent variable are zero. Optimal lag levels are reported in parentheses. ***, ** and * denotes 1%, 5% and 10% significance levels, respectively.
Hence, the empirical result of the influence of China on ASEAN interest rates is not surprising. Wattanapruttipaisan and Bakri (2006) pointed out that strong competition from China has crowded out some of ASEAN investments. In addition, Bhattacharya et al. (2001) using panel data, also found that increases in China’s world market shares has an adverse impact on some South East Asian countries since 1994. Wong and Chan (2003) contended that at present China and ASEAN are rivals rather than complements. The strong linkage of interest rates between China and the ASEAN-5 has important implications on the ASEAN financial market. The recent drop on the Shanghai exchange, if they continue, will influence the ASEAN market. Against the conditions of strong growth and higher inflation, China’s policy options for managing near-term risks include a mixture of monetary tightening through interest rate hikes or currency appreciation. The Chinese government’s effort to cool the sizzling stock market with interest rate hikes and taxes on speculative stock sales, if it persists, will have an impact on the ASEAN market too.

Yue (2005) contended that ASEAN faces risk and at the same time an opportunity from China’s economic achievement. ASEAN has initiated profound and faster integration toward an ASEAN Economic Community. However, ASEAN + China/India initiatives need to be carefully designed to improve economic efficiency and guard against market volatility.

From a policy perspective, it would be beneficial for the ASEAN countries to align their monetary and exchange rate policies to stabilize their economies against shocks originating from China. ASEAN aims to be a single regional common market by 2015. Given the strong interest rate causality with China, extensive steps to develop, liberalize and integrate the ASEAN region’s capital markets and financial services need to be accelerated earlier than the current target.

5. Conclusion

In this study, we investigated the co-movement and Granger relationships among ASEAN-5 economies, and relative to China and India from 2001 to 2006. We found evidence of co-movement in the inter-bank interest rates among the ASEAN-5 economies. Further,
the results showed strong Granger causality between China and the ASEAN-5 countries. Given that interest rates play an integral role in monetary, fiscal and exchange rate policy, these findings bodes well for these countries since they can effectively co-ordinate their macroeconomic and growth policies, which will enhance stable economies with rapid growth. Prudent macroeconomic management will help ASEAN-5 maintain a stable economy against looming risks of the global equity markets. Additionally, these findings shed light on the potential for extensive pan-Asian regional trade and economic integration in the mode of the European Union.

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