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Financial Liberalization in ASEAN and the Fisher Hypothesis

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ABSTRACT

This study examines the long-run relationship between inflation and nominal interest rates in the 1990s by utilizing the Johansen-Juselius multivariate cointegration technique. The evidence supports the tax-adjusted form of Fisher hypothesis for three ASEAN *countries, namely Singapore, Malaysia and Thailand. Thus, the assumption of a stable real interest rate appears to have empirical support for these low-inflation economies. We also demonstrate that inflation rate is both weakly and strongly exogenous in these three systems. However, the weak form of the hypothesis is decisively rejected for the inflation prone countries like the Philippines and Indonesia. In general, our results suggest that in a deregulated environments real interest rate is insulated from nominal shocks and money is neutral.*

ABSTRAK

Kajian ini meneliti hubungan jangka panjang antara inflasi dengan kadar bunga nominal dalam tahun 1990an dengan menggunakan teknik kointegrasi Johansen-Juselius. Keputusan kajian menyokong bentuk pelarasan cukai Hipotesis Fisher untuk tiga buah negara ASEAN, *iaitu Singapura, Malaysia dan Thailand. Maka andaian kestabilan kadar bunga benar nampaknya menerima sokongan empirik di negara yang kadar inflasinya rendah. Artikel ini juga menunjukkan bahawa kadar inflasi adalah 'weakly' dan 'strongly exogenous' dalam ketiga-tiga negara tersebut. Walaubagaimana pun, bentuk hipotesis 'weakly' ini ditolak bagi negara yang cenderung kepada inflasi yang tinggi seperti Filipina dan Indonesia. Umumnya, keputusan kajian menerangkan bahawa di dalam suasana deregulasi, kadar bunga benar tidak dipengaruhi oleh kejutan nominal dan wang adalah 'neutral'.*

INTRODUCTION

Irving Fisher (1930) hypothesizes that nominal interest rates adjust one-for-one with respect to the changes in the expected inflation rate and it forms the foundation to the interest rates theory. It implies that real interest rates will not be affected by changes in expected inflation. Changes in inflation will be reflected in nominal rates, leaving real rates constant, *ceteris paribus*. However, this does not suggest that real rates will be constant over time. In fact, changes in real interest rates may be influenced by real economic factors (Kinal & Lahiri 1988). This hypothesis is often referred to as the Fisher effect and has an important implication for monetary policy. Indeed, if the hypothesis is upheld then inflation has no real impact on the real sector. In other words, inflationary movements will be absorbed in nominal rates and cannot be influenced by monetary policy.

The behavioral relationship between real interest rate and inflation has received a great deal of attention in the past several decades; see for instance, Fama (1975), Silvapulle (1987), Atkins (1989), Rose (1988), Garcia (1993), Yuhn (1996), Thornton (1996), Payne and Ewing (1997) and Law (1997). With the exception Garcia (1993), Inder and Silvapulle (1993), Thornton (1996), Payne and Ewing (1997) and Law (1997), studies on the validity of the Fisher hypothesis were based on sample of the developed countries with low inflation rates. Nevertheless, the results based on the data for the United States are far from conclusive with Fisher effect estimates significantly less than the implied value of 1.0 or greater, depending upon whether taxes are included or not in the model (see, Summers 1983; Crowder and Hoffmen 1996). The conflicting results obtained from previous studies in part are due to methodology formation of inflationary expectations, treatment of taxes, shift in monetary regime, as well as the country examined. The empirical evidence seems to suggest the possibility that economic agents suffer from money illusion, which is a clear violation of rational expectations.

Recent advancement in time-series analysis particularly the cointegration technique provides some advanced techniques to test for the Fisher hypothesis as a long-run proposition. Unfortunately, studies that have utilized the techniques have also produced mixed results, and hence the validity of the hypothesis remains an empirical issue. For instance, Rose (1988) and Inder and Silvapulle (1993) reject cointegration (long-run) relationship between inflation and nominal interest rates, while Atkins (1989) and Thornton (1996) show strong evidence of cointegrating relationship between them. Garcia (1993) and Thornton (1996) report that the Fisher hypothesis holds for Brazil and Mexico, respectively, whereas Dutt and Ghosh (1995) also using the cointegration methods observe that the hypothesis is overwhelmingly rejected for the Canada under both fixed and floating exchange regimes. Contrary to this study, MacDonald and Myrphy (1989) found mixed results with the Fisher relation being upheld (not upheld) under fixed (floating) exchange rate system.

Mishkin (1992) conducts the test on U.S. data to show that the Fisher effect appears to be strong only for particular sample period but not for others. Hawtrey (1997) using Australian data shows that while the Fisher effect fails prior to the financial deregulation of the 1980s, there is evidence following deregulation that the relationship is restored. Thus, implying that the test results are sensitive to time period over which the relation is estimated. Similarly, Evans and Lewis (1995) show the long-run relationship between nominal interest rates and inflation but reject the strong form of the hypothesis. They ascribed their observed less-than-unity expected inflation coefficient to the changing dynamics of inflation over the chosen sample period. Payne and Ewing (1997) examined the Fisher hypothesis for a sample of nine less developed countries and rejected the weak form of the hypothesis for five countries of which include Argentine, Fiji, India, and Thailand. Indeed, they argued that the source for the absence of cointegration in these countries was that real interests were non-stationary in levels. For Singapore, the evidence suggests that long-run Fisher relationship is upheld but the strong form is rejected at the 10% significance level. The data provides evidence of unit proportional relationship between pre-tax nominal rates and inflation for Malaysia, Pakistan and Sri Lanka.

The primary purpose of this study is to investigate the empirical relationship between nominal interest rates and inflation, in five ASEAN economies: Singapore, Malaysia, Thailand, Indonesia, and the Philippines. IMF classifies Malaysia, Indonesia, Thailand and the Philippines as emerging markets while Singapore is included as developed financial market. In this paper the analysis is based primarily on the after-tax rate of interest since earlier studies that run the Fisher equation using before-tax nominal rates are in general not supportive of the Fisher hypothesis for the ASEAN economies for 1975-96 period, except for Singapore (see also Law 1997). In this study, the weak form of the hypothesis is upheld for the period 1990-1996. Nevertheless, the strong form of the hypothesis is decisively rejected for all of the ASEAN countries, except for Singapore. In addition, we utilized the Johansen cointegration approach to overcome the problem of non-stationarity of time series data.

Several reasons have motivated this study: First, as pointed by Hawtrey (1997), the real rate of interest is important in determining economic growth, saving and investment, and any distortion in post-tax real financial asset will have adverse impact on economic performance. The real rate of interest affects the real exchange rate, an in turn trade and capital flows. It is of interest to economists, therefore, whether the macroeconomic determination of the real rate is 'pure' and undistorted. Second, if the Fisher neutrality hypothesis holds then nominal interest rates is an unbiased predictor of future expected inflation. Businesses and government may use the relationship for decision-making purposes. Third, the ASEAN countries have taken major steps in 1990s to liberalize their financial markets in order to promote economic efficiency. Financial liberalization is expected to have some impact on the interest rate-inflation relationship. Specifically, we expect to find the Fisher effect to hold in the post deregulation era. Thus, the results in this paper throw some lights into this debate.

The ASEAN-5 shares the mix characteristics of both the developed and developing economies. The currencies of these countries are managed floats with varying weights given to major trading partner currencies. The five economies adopted different degree of financial liberalization as they took major steps to reform their financial system in the past decades. While most of these countries have relatively open capital account during the period of study, the Philippines still maintained control over capital movements. Hence, it is interesting to investigate whether their past and current reforms have any impact on the interest rates-inflation relation. Uncertainty in the regional financial crisis in the first three quarters of 1998 forced Malaysia to implement selective capital controls. On September 1st 1998, the Malaysia ringgit was made internationally non-convertible, and was fixed at RM3.80/US dollar. At the same time, capital had to stay on short for at least 12 months and not more than RM10, 000 could be taken out of the country.

In this study, the standard classical unit root procedures are employed, in the first step, to examine the time series properties of the time series. Next, the Johansen multivariate cointegration procedure is utilized to determine the presence (or absence) of a long-run equilibrium relationship between after-tax nominal interest rate and inflation. The dynamic behavior of interest rates and inflation is also examined by vector-error-correction model. Recent papers by Atkins (1989), Owen (1993), as well as Dutt and Ghosh (1995) have, for example, used similar approach to test the validity of the Fisher hypothesis.

The following section of this paper discusses the interest rates and inflation in the ASEAN countries. Section 3 explains the econometric methodology employed and the source of data. Section 4 reports the estimated results, and in the last section the conclusions are drawn.

THE INTEREST RATES AND INFLATION IN THE ASEAN ECONOMIES

The past two decades have witnessed ASEAN as one of the world's fastest growing regions. Average GDP growth rate of the five countries was recorded at 6.4 percent for the period 1980-96. By contrast, the worlds average growth rate was recorded at 2.8 percent over the same period. The impetus to growth emanated mainly from higher exports, and strong domestic consumption and investment. The prolonged boom in economic activity is partly fueled by heavy capital inflows and credit creation. All have maintained reasonable macroeconomic stability through small government and deficits.

The global recession, which started around 1981-82, brought stagnation to these countries for several years around the mid-1980s and inflation reached the highest level in three decades. However, ASEAN economies rebounded strongly after the economic crisis in 1987. The buoyant economic expansion that followed after the recession was accompanied by a build-up of price pressures and price stability was controlled to a certain extent through tight monetary policy.

Singapore, Malaysia and Thailand have been able to experience rapid growth with low inflation rates. Among the ASEAN-5, Singapore has maintained the lowest inflation rate, followed by Malaysia, Thailand, Indonesia and the Philippines. Inflation in the early 1980s was due mainly to the external factors such as the oil price shock, the rapid increase in the prices of the imported intermediate and capital goods. Inflation followed a declining path as the economies of Malaysia, Singapore and Thailand recovered from these external shocks. In contrast, the inflationary pressure continues to be high in the Philippines and Indonesia. Both countries also experienced extremely high interest rates during the inflationary period. Interest rates in the Philippines and

Indonesia reached as high as 15 percent and 30 percent respectively, during the episode of currency and financial instabilities.

In 1990s, the main thrust of policies in the ASEAN counties was to steer the economies to a sustainable growth path while ensuring that inflation remained under control. The monetary authorities of the low inflation economies of Singapore, Malaysia, and Thailand had adapted a conservative monetary policy to help to maintain financial stability and to curb inflation in the 1990s. Nearly all ASEAN countries pursued with major steps towards liberalization in finance and trade in periods of macroeconomic stability. In the early 1990s, these countries deregulate the domestic banking sector and eliminate international movements. These reforms were necessary in order to remain competitive as a location for direct foreign investment, and in response to the changes in world trading rules. Figures 1 to 5 show the time plots for the nominal interest rates and inflation over 1990-96 period for each of the five countries. The nominal interest rate is higher than inflation rate for Malaysia, Indonesia, Philippines and Thailand, suggesting that the real rate of interest is positive throughout the 1990s. However, this is not the case for Singapore, especially for the time period of 1992-96. In general, movements in inflation rate are reflected in nominal rates at least in most of the sample period.

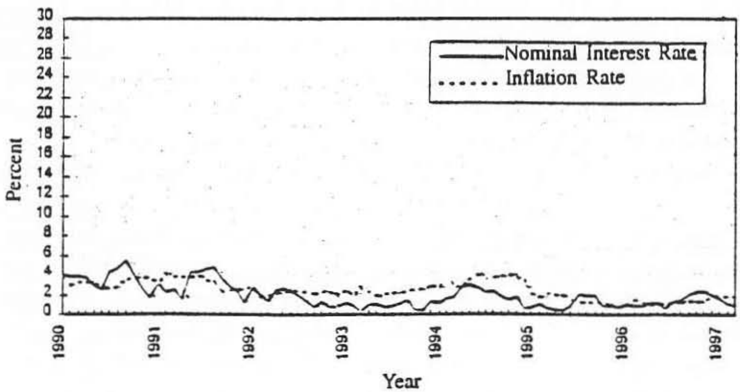

FIGURE 1. Three-month treasury bill rate and CPI inflation of Singapore

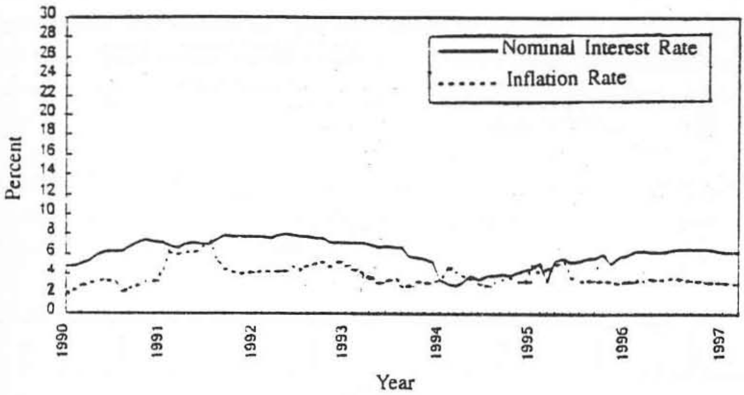

FIGURE 2. Three-month treasury bill rate and CPI inflation of Malaysian

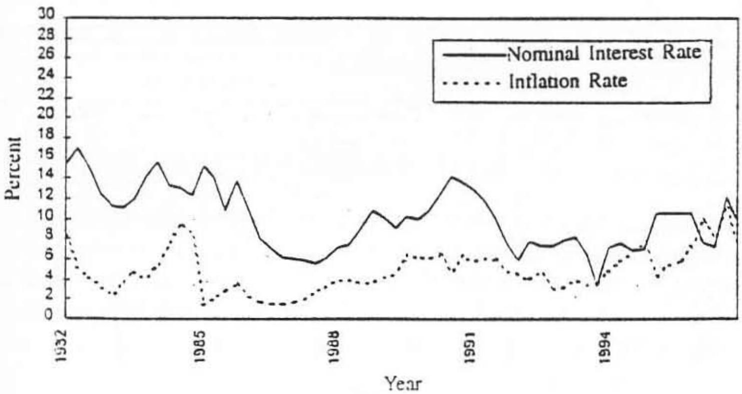

FIGURE 3. Money market rate and CPI inflation of Thailand

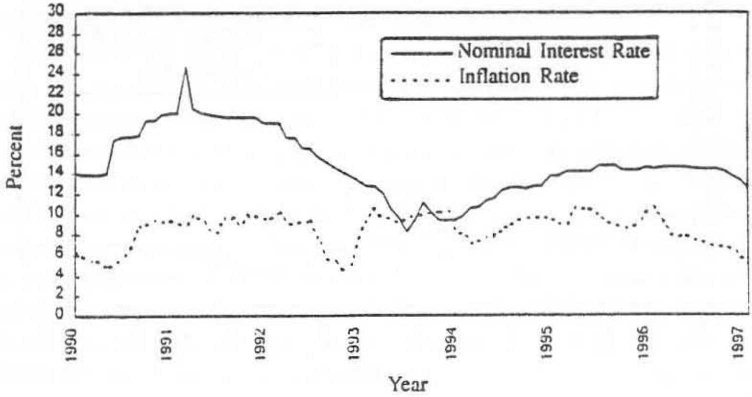

FIGURE 4. Three-month SBI rate and CPI inflation of Indonesia

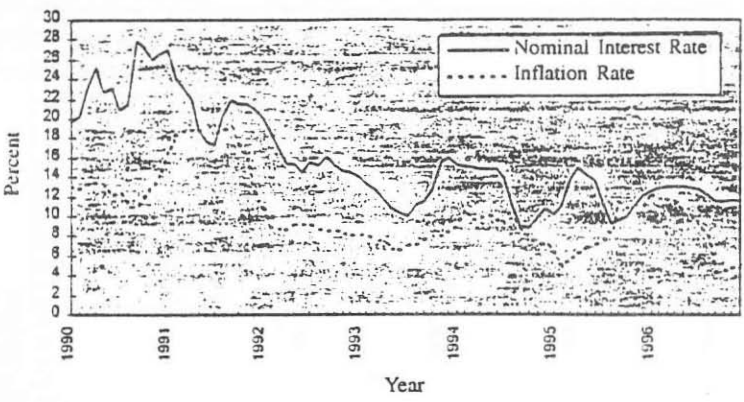

FIGURE 5. Three-month treasury bill rate and CPI inflation of the Philippines

METHODOLOGY AND DATA

This study employs the multivariate cointegration analysis to examine the long-run equilibrium relationship between the nominal interest rates and expected inflation rates. As pointed out by Dutt and Ghosh (1995) and others the procedure has the added advantage of distinguishing between the weak form of the Fisher hypothesis (long-run comovement) between interest rates and inflation from the strong form (unit proportional comovement). The weak form of the Fisher hypothesis is said to be upheld if the two variables are found to be cointegrated. The strong form of the hypothesis can easily be tested within the Johansen-Juselius framework by computing the likelihood ratio (LR) test as decribed in Johansen and Juselius (1990).

UNIT ROOT TESTS AND ORDERS OF INTEGRATION

It is important to determine the characteristic of the individual series before conducting the cointegration analysis. This is due to the fact that only variables of the same order of integration may constitute a potential cointegration relationship. In this study, two asymptotically equivalent procedures, the Augmented Dickey Fuller (ADF) and the Phillips and Perron (PP) tests are employed to determine the order of integration for all the series. The critical values for these tests are provided in MacKinnon (1991). In applying both of these tests, the optimal lag structures are determined using the Akaike information criteria (AIC) and Schwarz criteria (SC).

JOHANSEN MULTIVARIATE COINTEGRATION TEST

The cointegration analysis is performed if the variables in the system have the same order of integration as indicated by the unit root tests. If the series are integrated of different orders, they cannot be cointegrated. Cointegration among variables means that one or more linear combination of these variables is stationary, even though the variables might not be stationary individually. If these variables are cointegrated, they cannot move 'too far' apart from each other. From a statistical perspective, a long-run equilibrium relationship means that the variables move together over time so that any short-run deviation from the long-term trend will be corrected. These series are said to be cointegrated and therefore shared a common root stochastic trend.

In this study, the multivariate maximum likelihood cointegration procedure developed by Johansen (1988) and Johansen and Juselius (1990) is used to determine the number of cointegrating vectors (cointegration rank) in the system. This procedure has improved some of the limitations of the bivariate model introduced by Engle and Granger

(1987). Gonzalo (1994) has shown that the Johansen method performs better than the single equation methods as well as alternative multivariate methods (see also Johansen 1988; Enders 1995). This procedures reconsider the n-variable first-order VAR given by

$$x_t = A_1 x_{t-1} + \varepsilon_t. \tag{1}$$

By subtracting x_{t-1} from each side of the equation, Equation (1) can be rewritten as

$$\begin{aligned} \Delta x_t &= A_1 x_{t-1} - x_{t-1} + \varepsilon_t \\ &= (A_1 - I)\, x_{t-1} + \varepsilon_t \\ &= \pi\, x_{t-1} + \varepsilon_t \end{aligned} \tag{2}$$

where x_t and ε_t are (n x 1) vectors; A is an (n x n) matrix of parameters; I is an (n x n) identity matrix; and π is defined to be $(A_1 - I)$. The rank of π equals the number of cointegrating vectors.

The model in equation (2) can be generalized to allow for a higher-order autoregressive process, that is

$$\Delta x_t = \sum_{i=1}^{m-1} \pi_i \, \Delta x_{t-i} + \pi\, x_{t-m} + \varepsilon_t \tag{3}$$

and the key feature is still the rank of π which is equal to the number of independent cointegrating vectors. As we know that the rank of a matrix is equal to the number of its characteristic roots that differ from zero, thus the number of distinct cointegrating vectors in this model can be determined by checking the significance of the characteristic roots of π. The test for the number of characteristic roots that are insignificantly different from zero can be conducted using the following two test statistics:

$$\lambda_{trace}(r) = -T \sum_{i=r+1}^{n} \ln(1 - \hat{\lambda}_i) \tag{4}$$

$$\lambda_{max}(r, r+1) = -T \ln(1 - \hat{\lambda}_{r+1}) \tag{5}$$

where $\hat{\lambda}$ are the estimated values of the characteristic roots or eigenvalues obtained from the estimated π matrix, and T is the number of usable observations. The first statistic tests the null hypothesis that the number of cointegrating vectors is less than or equal to r against a general alternative. It is referred to as the trace test. The second statistic tests the null that the number of cointegrating vectors is r against the alternative of $(r + 1)$ cointegrating vectors. It is known as the maximum eigenvalue test. Critical values for both the tests are tabulated in Osterwald-Lenum (1992).

VECTOR ERROR-CORRECTION MODELING (VECM)

When a system of variables are cointegrated, their time paths are influenced by the extent of any deviation from long-run equilibrium. If the system is to return to the long-run equilibrium, the movements of at least some of the variables must respond to the magnitude of the disequilibrium. The main purpose of vector error-correction modeling (VECM) is to focus on the short-run dynamics of the variables, while the adjustment on long-run disequilibrium is also captured through the setup of error-correction terms in the model.

The testing of causal relationship in the environment of VECM can be represented by the following example:

$$X_t = \begin{pmatrix} \Delta x_{1t} \\ \Delta x_{2t} \\ \vdots \\ \Delta x_{nt} \end{pmatrix} = \begin{pmatrix} \alpha_1 \\ \alpha_2 \\ \vdots \\ \alpha_n \end{pmatrix} + \begin{pmatrix} \beta_{11}(L)\beta_{12}(L)\cdots\beta_{1n}(L) \\ \beta_{21}(L)\beta_{22}(L)\cdots\beta_{2n}(L) \\ \vdots \\ \beta_{n1}(L)\beta_{n2}(L)\cdots\beta_{nn}(L) \end{pmatrix} \begin{pmatrix} \Delta x_{1t} \\ \Delta x_{2t} \\ \vdots \\ \Delta x_{nt} \end{pmatrix} + \begin{pmatrix} \gamma_1 z_{1,t-1} \\ \gamma_2 z_{2,t-1} \\ \vdots \\ \gamma_n z_{n,t-1} \end{pmatrix}$$

$$+ \begin{pmatrix} \phi(L)0\cdots0 \\ 0\phi(L)0\cdots0 \\ \vdots \\ 0\cdots0\phi(L) \end{pmatrix} \begin{pmatrix} \varepsilon_{1,t} \\ \varepsilon_{2,t} \\ \vdots \\ \varepsilon_{n,t} \end{pmatrix}$$

where X_t is an (n x 1) vector of variables in the system, α's represent a vector of constant terms, β's are estimable parameters, Δ is a difference operator, L is a lag operator, $\beta(L)$ and $\Phi(L)$ are finite polynomials in the lag operator, z_{t-1}'s are error-correction terms, and ε_t's are joint white-noise processes.

The Granger-causality can be detected through the statistical significance of the t-statistic for the lagged error-correction term and /or the F-statistic applied to the joint significance of the sum of lags of each explanatory variable. The non-significance of both the t-statistic and F-statistic in the system indicates econometric exogeneity of the dependent variable. In addition to indicating the direction of causality amongst variables, VECM also allows us to discriminate between the short-and long-run Granger-causality. The F-test of the explanatory variables (in their first differences) indicates the "short-run" causal effects, whereas the "long-run" adjustment of the dependent variable with respect to deviation from equilibrium is implied through the significance of the t-statistic of the error-correction term.

THE FISHER EQUATION

Fisher (1930) argued that within a country, the nominal interest rate consists of two components, a real rate and a premium for expected inflation. The well known Fisher effect states that changes in the expected inflation rate will be reflected in the nominal interest rate one-for-one, ceteris paribus, and hence keeping the real interest rate constant over time. The Fisher equation can be estimated by using the following model:

$$i_t = \alpha + \beta \pi^e_t + \varepsilon_t \qquad (6)$$

where i_t is the changes in nominal interest rates in period t, π^e_t is the changes in expected inflation in a given time period t, stated in logarithm terms; and ε_t is the residual, assumed to have a zero mean and finite variance. If i_t and π^e_t are both integrated of order one, and they are cointegrated then Equation 6 can be said to depict the whole form of Fisher effect. The absence of cointegration relationship when both variables are I(1) would imply the absence of long-run Fisher effect.

The Johansen procedure allows us to do hypotheses tests on the parameters from Equation 6. The one-for-one movement of nominal interest rate and expected inflation, is tested by imposing the restriction $\beta = 1$ on the cointegrating regression. The test on the null hypothesis H_0: $\beta = 1$ is considered as the strong form of Fisher hypothesis. The hypothesis can be conducted using standard asymptotic chi-square tests under the Johansen maximum likelihood approach. It is in this special case that the nominal interest moves one-for-one with the rate of inflation and that the full Fisher effect is said to hold.

The adequacy of the regression model is checked by employing a series of diagnostic tests to ensure the validity of the results for statistical influence. They are the Norm tests for normality of the residuals, the ARCH test for Autoregressive Conditional Heteroscedasticity effects in residuals, HET test for residuals heteroscedasticity tests and the Box-Pierce Q-Statistic test for autocorrelation.

SOURCE OF DATA

In this study, the three-month Treasury bill is used as the nominal interest rates for Malaysia, Singapore and the Philippines. Due to the deficiency of data, the nominal interest rates for Indonesia and Thailand are proxies by the three months SBI (Bank Indonesia Certificate) rate and the money market rate, respectively. All the interest rates are market determinant rates, which are free from monetary authorities' intervention. The consumer price index (CPI) is used as a measure of inflation for each of these countries.

Several studies have focus on the behavior of interest rates and inflation during different periods (e.g. Mishkin 1992). These analysis suggest that the interest rates and inflation have not been invariant over these sub-periods due to institutional factors and the forecastability of inflation. To overcome this problem our study is based mainly on the experiences of 1990s. Monthly data spanning from January 1990 to March 1997 (87 observations) are used in the analysis for Malaysia, Singapore and Indonesia. Due to some problems in data collection, the sample period for Philippines only covers from January 1990 to December 1996 (84 observations). Since monthly data are not available for Thailand, the analysis is conducted using quarterly frequency data that cover from 1982:1 to 1996:4 (60 observations).

The data of treasury bill and CPI for Malaysia, Singapore and Indonesia are collected, respectively, from Monthly Bulletin of Bank Negara Malaysia, Monthly Statistical Bulletin of Monetary Authority of Singapore, and Indonesia Financial Statistics, published by the Bank of Indonesia. The Treasury bill and CPI for Thailand and the Philippines are both collected from the International Financial Statistics, published by IMF. The expected inflation rate for each countries is computed, using the rational expectation approach, as a function of the distribution lags of the past rate of inflation (see Fisher 1930; Fama 1975; and Amsler 1986). The results are presented in Table 1.

TABLE 1. Estimation of the expected inflation
(The Model: $\pi = a_0 + a_1\pi_{t-1} + \dots a_k\pi_{t-k} + e_t$)

Country	Regression equation	R^2	DW	Lag
Malaysia	$\pi = 0.9999 + 0.7550\pi_{t-1}$ (13.140) (4.270)	0.6702	1.8679	1
Singapore	$\pi = 0.5942 + 0.7728\pi_{t-1}$ (12.550) (3.598)	0.6496	1.6333	1
Indonesia	$\pi = 2.4020 + 0.9261\pi_{t-1} - 0.2068_{t-2}$ (8.816) (-2.177) (5.134)	0.6913	1.4401	2
Thailand	$\pi = 2.0454 + 0.5940\pi_{t-1}$ (5.899) (3.870)	0.3750	1.6034	1
Philippines	$\pi = 1.6891 + 0.9874\pi_{t-1} + 0.0539\pi_{t-2} - 0.2008\pi_{t-3}$ (9.070) (0.3484) (-1.898) (3.255)	0.8204	1.2701	3

Note: The values in parentheses represent the t-statistics.

ESTIMATION RESULTS

As a preliminary step towards testing the Fisher relation, we investigate the time-series properties of the data used in the analysis. To determine the order of integration of each series under study, the Augmented Dickey-Fuller (ADF) and the Phillips-Perron (PP) unit root tests are conducted first on the levels and then on the first differences of the logarithms of nominal interest rate and expected inflation. Test results for levels are reported in Table 1 panel A, and those for the first differences are summarized in panel B of the same table. As shown in panel A of Table 1, the unit root hypothesis cannot be rejected for any statistic test, indicating that the series are non-stationary in their levels. However, the series attain their stationary after the first differencing in all cases. Results presented indicate that the null hypothesis of a unit root is rejected for all the cases at the 5% significance level or better. In addition, the hypothesis of a deterministic (linear) trend in the data is tested and rejected. Thus, confirming the presence of one unit root in our data series. The results are not surprising given the evidence in Dutt and Ghosh (1995) and Payne and Ewing (1997), among others.

We conclude that both the nominal interest rates and inflation rates for the ASEAN economies are integrated of order one, that is, they are all ~ I(1). The results from univariate unit root tests suggest that interest rates and inflation are driven by nonstationarities and justify their inclusion in the VAR system in order to investigate the existence of long-run comovements in interest rates and inflation. If the textbook Fisher relation holds, it implies that they should share a common stochastic trend.

The presence (or absence) of a long-run equilibrium relationship between the nominal interest rates and expected inflation can be confirmed by conducting the Johansen (1988) maximum likelihood procedure. In the preliminary analysis, we first run the Fisher equation using before-tax nominal interest rates. The evidence obtained are in general not in favor of the Fisher effect for all countries examined in the sample period, except for Singapore. The model also suffers from misspecification so, only the post-tax results are reported and discussed in this paper. In most case, normality test reject the hypothesis of normality in the error terms. The equations also exhibit significant ARCH effect.

The Fisher hypothesis was re-examined using after-tax nominal interest rates as dependent variables. Table 2 presents both the results of the trace and maximum eigenvalue tests for the tax adjusted Fisher equation. The model was estimated using lag length based on Akaike Final Prediction Error (FPE) criteria. Both the computed trace and maximum eigenvalue (λ-max) statistics consistently arrive at the same conclusion. There is one cointegrating vector in the bivariate system for the case of Malaysia, Singapore, and Thailand. Columns 2 and 4 suggest that while the null hypothesis of $r = 1$ (against the alternative $r = 2$) cannot be rejected for Singapore, Malaysia, and Thailand. However, it can be easily rejected for the case of the Philippines and Indonesia. Johansen (1988) demonstrates that in a special case when the member of cointegration vectors is equal to number of variables these is no common trend between the variables, and that each variable is stationary. For this reason, further analysis relating to the Fisher relation cannot be performed for Indonesia and the Philippines.

These test results are insensitive to the chosen lag length in the autoregressive specification. Experimentation with high lag length did not produce any significant different results especially with respect to the number of cointegrating vectors in the system. This implies that after-tax effects on changes in inflation in the autoregressive specifica-

TABLE 2. Unit root results

Variable	ADF Test		PP Test	
	Constant without trend	Constant with trend	Constant without trend	Constant with trend.
		A. Levels		
Interest Rate				
Malaysia	-1.6856(1)	-1.9146(1)	-1.9158(1)	-2.1202(1)
Singapore	-2.5892(2)	-3.1533(2)	-2.7616(1)	-3.2518(1)
Indonesia	-1.1077(0)	-1.5192(0)	-1.1733(1)	-1.5780(1)
Thailand	-2.8098(0)	-2.8666(0)	-2.8013(1)	-2.8872(1)
Philippines	-1.5047(4)	-2.7224(4)	-1.5506(1)	-2.6956(1)
Expected Inflation				
Malaysia	-2.5505(6)	-2.7913(6)	-2.4354(1)	-3.3859(1)
Singapore	-2.1702(0)	-2.6303(0)	-2.0913(1)	-2.5595(1)
Indonesia	-2.6430(0)	-2.4620(0)	-2.8247(1)	-2.6482(1)
Thailand	-2.5941(0)	-3.2523(0)	-2.4505(1)	-3.3516(1)
Philippines	-1.4175(0)	-2.1292(0)	-1.5862(1)	-2.3143(1)
		B. First Differences		
Interest Rate				
Malaysia	-3.4764(6)*	-3.4844(6)*	-11.535(1)*	-11.479(1)*
Singapore	-3.9338(7)*	-4.0733(7)*	-11.076(1)*	-11.017(1)*
Indonesia	-3.0919(4)*	-3.5576(4)*	-8.2683(1)*	-8.3482(1)*
Thailand	-3.6864(3)*	-3.6642(3)*	-8.2571(1)*	-8.2599(1)*
Philippines	-4.9963(2)*	-4.9828(2)*	-7.9870(1)*	-7.7570(1)*
Expected Inflation				
Malaysia	-4.0640(3)*	-4.0718(3)*	-10.272(1)*	-10.317(1)*
Singapore	-3.5535(5)*	-3.5219(5)*	-10.484(1)*	-10.432(1)*
Indonesia	-3.6403(7)*	-3.9702(7)*	-8.2683(1)*	-8.3482(1)*
Thailand	-3.9033(4)*	-3.9054(4)*	-8.4025(1)*	-8.2599(1)*
Philippines	-3.3130(3)*	-3.3186(3)*	-7.9870(1)*	-7.7570(1)*

Notes: The null hypothesis is that the series is I(1). The critical values for rejection are –2.86 at a significant level of 5% for models without trend and –3.41 for models with trend. These values are provided by the SHAZAM output based on MacKinnon (1991).

tion are reflected in nominal interest rates in the three economies. The adequacy of the specification of these models is checked by the diagnostic tests (residual normality, autoregressive, heteroscedasticity and ARCH effect) and is summarized in the last three columns of Table 2. In general, the result of the diagnostic tests revealed that the VAR models are well specified.

Cointegration is only a necessary but not a sufficient to establish nominal interest rates adjust one-for-one to inflation innovations. The market is said to be efficient, in the sense of interest rates, if nominal interest rates fully summarize the information on future inflation rates if the strong form of the Fisher hypothesis holds. The test results of the hypothesis that $\beta = [1 \ -1]$ are also summarized in Table 2. The strong form of the hypothesis is tested under the cointegration regression for Malaysia, Singapore, and Thailand. The results presented in Table 2 show that the null hypothesis of Fisher effect in the strong form cannot be rejected for these three economics. Based on the likelihood ratio test statistic we conclude that the evidence support the existence of the full Fisher effect in three out of five ASEAN countries. This accords with intuition: we would expect agents to act on after-tax basis and investors to protect their real returns, net of tax and inflation.

To gain some further insight about the dynamics of the system, we estimate the vector error correction model (VECM) that is the dual to the cointegration model above. Table 3 presents a summary of the results for the three ASEAN countries. The error-correction coefficient (ECT), measures the one-period response of each of the endogenous variables to a deviation from the equilibrium is corrected. The coefficient of ECT displays the expected negative sign implying that interest rates adjust in the opposite direction of last period's deviation form the equilibrium relationship. These terms are statistically significant when the independent variable is interest rate, implying that inflation adjusts to short-run deviations from long-run equilibrium (ex-post real interest rates). This estimates seems to suggest a high speed, with around 57 percent for Malaysia and 55 percent for Singapore, of any deviation from the long-run ex post real interest rates in the current month. It is worth noting here that single period response is smallest in Thailand, about 40 percent in a quarter. However, these results must be interpreted with caution since the analysis is based on different data frequency.

The F-tests reveal that the lagged interest changes have no significant effect on inflation growth at a significance level of 5 percent in all cases. For example, in the equation for Malaysia the estimated coeffi-

TABLE 3. Johansen cointegration results

Country	λ-max	Critical Value	Trace Test	Critical Value	Lag	Norm	Arch	Hetro	Q(8)
Malaysia (1990:01 – 1997:03)									
P=0	17.43*	14.1	20.87	15.4	10	5.92	10.08	52.55	3.44
P≤1	3.44	3.8	3.44	3.8					
$[H_0: \beta=1] = 1.26(0.26)$									
Singapore (1990:01 – 1997:03)									
P=0	16.39*	14.1	19.25*	15.4	8	1.84	3.73	24.65	0.81
P≤1	2.86	3.8	2.86	3.8					
$[H_0: \beta=1] = 2.19(0.14)$									
Thailand (1982:1 – 1996:4)									
P=0	15.51*	14.1	17.34*	15.4	5	0.82	1.56	–	3.39
P≤1	1.83	3.8	1.83	3.8					
$[H_0: \beta=1] = 3.36(0.06)$									
Indonesia (1990:01 – 1997:03)									
P=0	14.08*	14.1	16.6*	15.4	6	2.89	4.31	26.05	3.36
P≤1	3.52*	3.8	3.52*	3.8					
Philippines (1990:01 – 1997:03)									
P=0	20.85*	14.1	26.29**	15.4	8	15.12	6.80	42.43	3.21
P≤1	5.45*	3.8	5.45*	3.8					

Notes: P indicates the number of cointegrating vectors. The optimal lag-structure for each model is determined through the likelihood-ratio test. Monthly frequency data are utilized for all the sample countries, except for Thailand.

cients of the lagged first-difference INF are jointly insignificant (F=0.989; p-value=0.404). Thus, inflation does not Granger-cause interest rates in the short run. This result holds for the other two equations and so we can conclude that inflation is also strongly exogenous to the parameters of the cointegarting system.

TABLE 4. Vector error correction models

Dependent Variable	Independent Variable F – statistics ΔINT	ΔINF	Coefficient (std. error) $ECT_{[t-1]}$
Malaysia			
ΔINT	0.214	0.989	-0.573
	(0.886)	(0.404)	(0.233)*
ΔINF	0.293	1.220	-0.237
	(0.880)	(0.310)	(0.264)
Singapore			
ΔINT	1.460	1.445	-0.553
	(0.223)	(0.228)	(0.247)*
ΔINF	0.390	0.426	-0.338
	(0.815)	(0.789)	(0.304)
Thailand			
ΔINT	0.655	1.044	-0.471
	(0.590)	(0.397)	(0.183)*
ΔINF	0.575	1.173	-0.119
	(0.639)	(0.348)	(0.254)

Notes: Standard errors in parentheses and p-value for the F-tests are given in brackets.
* Indicates significance at 5 percent.

CONCLUSIONS AND IMPLICATIONS

This study examines the long-run relationship between nominal interest rates and inflation for five ASEAN economies in the 1990s using monthly data (except for Thailand). Both nominal interest rates and inflation were found to be nonstatioary in levels but stationary in first difference. We also found that inclusion of taxes affect the inflation-interest rates relation. Results based on the Johansen multivariate cointegration approach failed to reject the null hypothesis of non-cointegration in three out of five of the ASEAN countries – Singapore, Malaysia and Thailand. Thus, providing empirical support for stable long-run co-movements between after-tax nominal interest rates and inflation. What is suprising is that cointegration can be found in less than ten years of data for these economies. The weak form of the Fisher hypothesis appears not hold for the case of Indonesia and the Philippines.

The strong form of the hypothesis was tested and was found to hold for countries with more efficient capital markets like Singapore and Malaysia. In addition, our results show that the Fisher effect holds for Thailand, which delayed their financial reforms till 1990. It is worth pointing out here that for Thailand, our analysis is based on quarterly data and the data begins from 1982:1 and the results may not be compared to the remaining ASEAN economies where the starting date begin in January 1990. While it may be impossible to draw strong conclusions, these results are at least suggestive that deregulation of the financial sectors in the recent year has impact on the behavior of the financial variables. As expected in a deregulation environment real interest rate is insulated from nominal shocks and money is superneutral.

The Fisher effect is easily rejected for the case of the less liberalized financial systems of Indonesia and the Philippines. These two countries experience high and volatile rates of inflation and interest rates during the episodes of currency and financial instability. In fact, the evidence showed that cointegration was weak for countries with managed exchange rate and capital controls like the Philippines. While most of the ASEAN countires have relatively open accounts in the 1990s, capital control stills remain in the Philippines. Partial adjustment to anticipated inflation meant that real rates was systematically affected by shocks to nominal money supply. Thus, in these two countries the monetary authority can affect real activities since money is not neutral.

Lastly, we limit our analysis to the period before the 1997 Asian financial crisis. The crisis was proceeded by high interest rates, bad bank loans and slow economic growth. During the crisis most of the sample countries (perhaps except for Singapore) have suffered major policy reversals and some political instability which may cause too much noise for cointegration method to detect the stable long-run relationship as suggested by the Fisher equation. The recent capital controls in Malaysia may adversely affect the inflation-interest rate relation. Of course all the issues merit further research.

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