

The Long-Run Relationship between Nominal Interest Rates and Inflation of the Asian Developing Countries

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ABSTRACT

The relationship between nominal interest rates and inflation in developed countries and the G7 countries have been well documented. However, such relationship in relatively less developed Asian countries is less clear and similar studies that consider a different financial markets may have different results. Therefore, this paper uses data for five Asian developing countries namely Malaysia, Thailand, Indonesia, South Korea and Philippines to examine the Fisherian link between inflation and long-term nominal interest rates. In doing so, the Augmented-Dickey Fuller Test and Engle-Granger are applied to investigate the stationary and cointegration properties of the variables. The results indicate unit root properties for the level of interest rates and inflation for all five countries, however there is no cointegration between both variables for all the countries except for Indonesia. The findings for these four countries are consistent with other findings who argue that the Fisher effect does not hold for countries other than the United States.

INTRODUCTION

Irving Fisher pointed out that the nominal rate of interest could be defined as a sum of two major variables, namely the expected real rate of interest and the expected rate of inflation. This relationship implies that if expected inflation rises by one percent, the nominal interest rate will rise by one percent as well. In other words, there is a one-to-one effect between these two variables. Implicitly, this model assumes that the real rate of interest should remain fairly steady for extended period of time, and that most or all of the variation in nominal rates should be a result of changing inflationary expectations. Expressed differently, the above relation implies

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INTRODUCTION

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that the real rate of interest and inflation are largely independent of one another.

The question of whether the relationship between nominal interest rates and inflation is one-to-one, and whether the real interest rates remain constant over time, are subjects of considerable controversy, both theoretically and empirically. Thus, several studies on the Fisher effect had been done and interesting conclusions have been made. Sargent (1972) had made a thorough analysis and concluded that there exists a one-to-one relationship between nominal interest rate and expected inflation. Fama (1975) investigated the efficiency of the US T-Bills market over the period of 1953-1971 and finds that the one month nominal rate increases proportionately with the increase in the expected changes in purchasing power. Mandelker and Tandom (1981) extended Fama's approach using data over the period of 1966-1979, and had found the same conclusion as Fama. This indicates that the real rate of interest is independence of the changes in the price level. However, several studies later argue that the Fisherian hypothesis does not hold for certain period of time or when analysis is performed on countries other than the United States (see Gultekin (1983), Sheehan (1996), Nilss (1996), Lee, Clark and Suhm (1998) and Koustas and Serktis (1999)).

Several recent empirical studies recognize that valid tests of the Fisher relation may require consideration of the stationarities of the time series data. These include papers by Rose (1988), Mishkin (1992), Evans and Lewis (1995), Crowder and Hoffman (1996), Ghafar and Sekharan (1997) and the most recent is the work of Malliaropulos (2000). Rose (1988) concludes that interest rates possess a unit root in their autoregressive representation, but inflation does not. Therefore, a regression of interest rates on inflation is spurious because an attempt is made to link variables that maintain different orders of integration. Thus, from Rose findings, the real rate of interest is a nonstationary series which imply that the Fisher relation is rejected.

Mishkin (1992) focused on nonstationarities of inflation and nominal interest rates and tested the Fisher effect as a long run equilibrium relationship using cointegrations technique, namely the Engle-Granger Cointegration Test. He finds that inflation and nominal interest rates are unit root processes and they are both integrated of order 1 (denoted by saying that they are $I(1)$). Therefore, following Engle and Granger (1987), these two variables are cointegrated and this provides support for the Fisher effect in the long run.

Evans and Lewis (1995) also observe cointegration between nominal interest rates and inflation in a sample of post war data. They, however, apply the DOLS estimator (a least squares projection of nominal interest rates on inflation in a model augmented with lead and lag changes in inflation) to estimate the long-run response of nominal interest rates with respect to inflation. They conclude that the Fisher relation is generally consistent with post war data.

Crowder and Hoffman (1996) use quarterly data over the period 1952:1 to 1991:4. They find that both nominal interest rates and inflation are nonstationary. They further test the data for cointegration using the maximum likelihood procedure proposed by Johansen (1988), and conclude that there exists a long-run relationship between nominal interest rates and inflation.

Performing the error correction model on Malaysia's data, Ghafar and Sekharan (1996) find that the Fisher effect does not hold for that data. They, therefore, reformulated the Fisher's model with the inflation rate as a function of the nominal interest rates.

Malliaropoulos (2000) proposes an alternative test of the Fisher effect, based on a VAR representation in appropriately detrended variable. He finds strong support for the Fisher effect both in the medium term and in the long-term.

Following the lead of Mishkin (1992), it has been recognized that the persistence in nominal interest rates and inflation can be modeled under the unit root hypothesis. Using this hypothesis, Mishkin and Simon (1995) test the Fisher effect on Australian data. Initial testing indicates that both interest rates and inflation contain unit roots. They then apply Monte Carlo simulations and the results indicate that long run Fisher effect seems to exist. This tells us that when the interest rate is higher for a long period of time, then the expected inflation rate will also tend to be high. Hassler and Wolters (1995) extended Mishkin's approach on five industrial countries, and their results also find support for the long run Fisher effect.

In this paper, in line with Mishkin (1992), the validity of the Fisher effect will be reexamined. Most of the previous studies focus only on developed nations or the G7 countries and have produced different conclusions, however the validity of the Fisher effect in other financial markets especially in less developed Asian countries for example Malaysia, Korea, Philippines, Thailand and Indonesia is less clear and may have different results. Specifically how is the relationship between inflation rate and nominal interest rates in these less developed markets when compared to the well developed, well organized and more efficient markets like

the US and the UK? Therefore, data from these countries are used in this paper. The purpose of this paper is two fold. First, is to test the stationarity of the time series variables, namely interest rates and inflation. Second, is to examine if these two variables are cointegrated. If cointegration is detected, then causality test is conducted to avoid problem of misspecification (see Granger 1988). Knowing the interactions of nominal interest rates and inflation will assist investors in various economic decisions such as portfolio adjustment, setting charges on loans, balancing money and real investment.

DATA

The empirical analysis is based on monthly data for Malaysia, Thailand, Indonesia, South Korea and Philippines from 1986 to 1996 as there was no shock to the sample countries' economy during that period. Nominal interest rates are the three-month T-Bill rates. The Consumer Price Index (CPI) is used as the measure of inflation. The Malaysian data are taken from the Monthly Statistical Bulletin issued by the Bank Negara Malaysia. Data on other countries are downloaded from the CD-Rom version of International Financial Statistics of the International Monetary Fund. In what follows, unit roots in the inflation and interest rates are tested. Then, cointegration are tested as the test on Fisher effect critically depends on the integration and cointegration properties of the variables. The Augmented Dickey-Fuller (ADF) test for unit root and Engle-Granger Cointegration Test are applied in this study.

According to Fisher effect, nominal rate of interest (i) is equal to expected real rate (r) plus expected inflation rate (π^e). Therefore, subtracting the expected inflation rate from the nominal interest rate will generate the expected real rate,

$$r = i - \pi^e$$

The null hypotheses to test the Fisher effect can be stated as follow:

H₀: There is no relationship between the expected real rate and the expected inflation.

Rejection of this hypothesis implies that the expected real rate is not constant and therefore the Fisher model is not valid.

METHODOLOGY

UNIT ROOT PROCESS AND AUGMENTED DICKEY-FULLER TEST

A series y_t is said to possess a unit root if $\Delta y_t = y_t - y_{t-1}$ is stationary. A stationary series tends to run to its mean and fluctuate around it. Such a series is then said to be mean reverting. On the contrary, a series which nonstationary would have a different mean at different points in time. The Dickey-Fuller test for nonstationarity of a series y_t consists of running the regression of Δy_t on the constant intercept and y_{t-1} using ordinary least squares (OLS). The OLS t-ratio of the regression parameter of y_{t-1} will be examined. This t-ratio is not asymptotically normal under the null. The test, however, assumes that the residuals are serially uncorrelated. To cater for autocorrelated errors, lagged values of Δy_t may be included in the regression. Again the t-ratio of the regression parameter of y_{t-1} is examined for significance. This is known as the ADF test.

ENGLE-GRANGER COINTEGRATION TEST

According to Engle and Granger (1987), a unique long run equation between two time series x_t and y_t can be said to exist if both x_t and y_t are integrated of order 1, written as $I(1)$. It is shown that if x_t and y_t are both $I(1)$, then it is possible that their linear combination to be $I(0)$. If this is the case, then x_t and y_t are said to be cointegrated, and we can be certain that any correlation over time between x_t and y_t is not spurious. Consider the following cointegration regression:

$$y_t = \beta_0 + \beta_1 x_t$$

The disequilibrium error is

$$\mu_t = y_t - \beta_0 - \beta_1 x_t$$

where μ_t is a linear combination of x_t and y_t . Engle and Granger pointed out that if the long run relationship actually exists, then overtime the disequilibrium error should rarely drift from zero and often across the zero line. Thus, the disequilibrium error should form a stationary time series and have a zero mean, that is μ_t should be $I(0)$ with $E(\mu_t) = 0$. We would expect μ_t to be $I(0)$ if x_t and y_t are $I(1)$.

This test is appealing in examining the validity of the Fisher effect. Cointegration between nominal interest rate and inflation indicates that over the long run, inflation moves in tandem with the nominal interest rate.

RESULTS AND DISCUSSION

Before the cointegration analysis is conducted, the unit root property of the time series data is checked by running the Augmented Dickey Fuller test. All series have been log-transformed before the analysis to avoid problems of heteroscedasticity. The test results reported in Table 1 indicate that the null hypothesis of a unit root could not be rejected for all five countries in their level form. However, this hypothesis is rejected for their first differences, meaning that the series are integrated of order one, or $I(1)$.

TABLE 1. Unit root results

Country	Levels		First Differences	
	Interest rates	Inflation	Interest rates	Inflation
Malaysia	-0.043826 (0.018638)	-0.038935 (0.025051)	-0.615305* (0.092272)	-1.076766* (0.129297)
Philippines	-0.084872 (0.034581)	-0.061925 (0.029042)	-0.905426* (0.122031)	-1.025140* (0.126701)
Indonesia	-0.158823 (0.048271)	-0.085581 (0.036482)	-1.197018* (0.127961)	-1.028581* (0.127580)
Thailand	-0.192534 (0.055564)	-0.109923 (0.042277)	-1.308624* (0.131926)	-1.135281* (0.128298)
South Korea	-0.119799 (0.044631)	-0.095408 (0.038292)	-1.207656* (0.134366)	-1.048970* (0.127461)

Note: The null hypothesis is that the series contain a unit root. The (*) indicates the rejection of this hypothesis at the 5% level of significance. The figures in the parentheses are the standard errors.

Since the series are $I(1)$, it is meaningful to proceed with the Engle-Granger cointegration test on these series to determine their long run relationships. The results are presented in Table 2.

From the above table, the unit root hypothesis is not rejected at 5% level of significance for all countries except Indonesia. This indicates that, for Indonesia, while interest rates and inflation are $I(1)$, their linear combinations are $I(0)$. Therefore, following Engle-Granger (1987), inflation and interest rates are cointegrated only for Indonesia, which imply that in the

TABLE 2. Engle-Granger cointegration test

Country	Coefficient	R ²	Dw	Adf
Malaysia	-0.054469*	0.216138	1.971969	-2.589387
Philippines	-0.095695*	0.055143	2.020551	-2.617015
Indonesia	-1.160595	0.080527	1.995565	-2.625
Thailand	-0.225801*	0.116200	1.996565	-3.739958
South Korea	-0.134834*	0.083464	1.992966	-2.797284

Note: The (*) denotes the rejection of cointegration at 5% level of significance.

long-run, inflation and nominal interest rates move in tandem to each other parallel to the Fisher hypothesis.

Since cointegration is detected for Indonesia, test of causality between interest rates and inflation is conducted for this country using Granger-Causality test. To implement this test, the following regression is estimated:

$$i = \sum \alpha_j \pi^c + \sum \beta_j i + \mu_{1t}$$

$$\pi^c = \sum \lambda_j \pi^c + \sum \delta_j i + \mu_{2t}$$

The error term μ_{1t} and μ_{2t} are assumed to be uncorrelated. Table 3 gives a summary of the results of the causality test.

The result suggests that the direction of causality is from interest rates to inflation and from inflation to interest rates since the F-values are significant at 5% level of significance. Therefore, there is a bilateral causality between the two variables. This finding is interesting as it suggests that in the interest rates determination process, one cannot ignore information on inflation trends and vice versa.

TABLE 3. Granger test of causality

Direction of causality	F value	Decision
$i \rightarrow \pi^c$	0.31674	Do not reject
$\pi^c \rightarrow i$	0.44188	Do not reject

CONCLUSION

The well known Fisher hypothesis that proposes a positive relationship between interest rates and inflation has produced numerous empirical studies for the past several decades. This hypothesis requires that interest rates to be adjusted to the inflation rate. In this paper, the Fisher effect is being examined in 5 Asian developing countries (Malaysia, Philippines, Indonesia, Thailand and South Korea) using Engle-Granger Cointegration Test. The results indicate unit root properties for the level of interest rates and inflation for all five countries. However, when cointegration test is performed, the cointegration between these two series is not supported for Malaysia, Philippines, Thailand and South Korea. This suggests that the long run equilibrium relationship between interest rates and inflation is not real in these four countries. This finding is consistent with Crowder and Hoffman (1996) who conclude that interest rates may not be a good predictor of future inflation. Since the findings of this study show that there is no cointegration between inflation and interest rates for four out of five sample countries, it therefore supports the findings of Gultekin (1983), Sheehan (1996), Nilss (1996), Lee, Clark and Suhn (1998) and Koustas and Serktis (1999) who argue that the Fisher effect does not hold for countries other than the United States.

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