AN EMPIRICAL ANALYSIS OF THE FISHERIAN HYPOTHESIS ON THE MALAYSIAN EQUITY MARKET

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ABSTRACT

The negative effect of inflation on risk free debt contracts offering nominal payoffs in future time period is commonly acknowledged by financial researchers. The relationship known as the Fisher effect claims that nominal interest rates proportionately adjust to changes in the expected price level. Higher expected price level reduces the real value of future promised nominal cash flows, thus, reducing the value of debt. Extension of Fisherian hypothesis on risky assets such as common stock mostly reject its validity. Contrary to economic theory, existing evidence indicates that common stock fails to perform as an effective hedge against inflation despite being a claim on real assets. This study investigates the validity of Fisherian hypothesis in the Malaysian equity market. In contrast to the previous study, we examine the Fisher effect based on the stochastic process of common stock and price indices. It is shown that both, common stock and price indices, are nonstationary rendering traditional least square analysis using level series invalid. However, our analysis indicates that both series are cointegrated, i.e. they obeying a long-run equilibrium path consistent with the Fisher effect. Over the long run, stock and price indices move together. Further, the results also support stationarity of ex-ante real common stock returns. Mean reversion of ex-ante real returns strengthens the case for Fisher effect in the Malaysian equity market. Thus, for the case of Malaysia common stock is an effective hedge against erosion of purchasing power due to increase in the price level.

INTRODUCTION

The relationship between nominal interest rates and inflation as postulated by Fisher (1930) has been investigated extensively by financial researchers.[1] According to the Fisherian hypothesis, increase in the expected inflation rate requires proportionate adjustment in the nominal interest rates.[2] This proportionate adjustment is well understood for risk free debt contracts offering nominal payoffs in

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[1] *See for example Fama (1975), Nelson and Schwert (1977), Mishkin (1981, 1984, 1992), Fama and Gibbons (1982), Summers (1983), and Barsky (1987).*

future time period. Higher expected future price level erodes the purchasing power of promised nominal payments and therefore reduces current value of debt. However, there is overwhelming evidence suggesting that this hypothesis does not hold for risky assets such as common stock.[3] Extension of Fisherian hypothesis on common stock generally concludes with a rejection of the positive relationship but instead common stock returns are shown to be negatively related to the inflation rate. These negative findings contradict the traditional view that common stock represents a claim on real assets and therefore should be an effective hedge against inflationary pressures.

In this paper, the hypothesis is examined for major indices of the Kuala Lumpur Stock Exchange (KLSE) by studying the stochastic process of each series. Nelson and Plosser (1982) indicate that many macro economic time series including consumer prices and common stock prices, display random behaviour that is non-mean reverting. Regressing one random walk series against the other can lead to spurious results in which conventional significance test could be misleading. This phenomenon of spurious regression is documented by the work of Granger and Newbold (1974), and Phillips (1986). Further, as shown by Engle and Granger (1987), two series that are non-stationary could obey a long-run equilibrium relationship through a cointegration process. Exploiting this methodological development, we examine the validity of Fisherian hypothesis on the Malaysian stock market. Our results indicate the presence of stochastic trends in both, stock indices and prices (actual and expected). The long-run relationships between stock indices and prices are supported by the cointegration test. In addition, we also find that the ex-ante real stock returns are stationary, supporting mean reversion for ex-ante real returns as suggested by Fisherian hypothesis. The paper is presented as follows; Section II briefly reviews existing empirical findings on the issue and possible explanations that have been proposed to explain the relationship between common stock and inflation. In section III, we discuss the methodological issues related to our studies. These include Augmented Dickey-Fuller (ADF) unit root test, Engle-Granger two-step cointegration test, derivation of expected inflation, and calculation of ex-ante real common stock returns. The results of the tests are presented and discussed in Section IV. The paper ends with a brief summary in Section V.

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[2] *The initial hypothesis proposed by Fisher (1936) does not state the exact magnitude of the response. Three variations of magnitudes of adjustment have then been proposed by subsequent works; 1-to-1 (labelled as traditional Fisher hypothesis), greater than 1-to-1 (Darby (1975) and Feldstein (1976)), and less than 1-to-1 (Mundell (1963) and Tobin (1965)). Despite these magnitudes of adjustment, all of them are consistent with Fisherian hypothesis.*

[3] *Studies that reject Fisherian hypothesis for common stock include Lintner (1975), Bodie (1976), Nelson (1976), Jaffe and Mandelker (1976), Fama and Schwert (1977), Fama (1981), Geske and Roll (1983), Asprem (1989), and Graham (1996).*

COMMON STOCK AND INFLATION

The availability of effective hedging mechanisms for financial returns against erosion of purchasing power is of great importance for investors. Increase in general price level erodes the purchasing power of promised nominal cash flows unless these cash flows can be adjusted to the expected changes in price level. According to Fisher (1930), this requires nominal returns to be adjusted parallel to the expected increase in price level. From this perspective, common stock which reflects a claim on real assets could be an effective hedge against inflation. However, various studies on the relationships between common stock and inflation reject this role of common stock as an inflation hedging mechanism. Many have shown that the relationship between the two is negative.

Several explanations have been proposed to justify these puzzling findings. Fama (1981) argues that the negative relationship is spurious, resulting from a negative relationship between inflation and real activity that arise from the adjustment of monetary sector toward expected changes in real output. In multiple regression settings, Fama shows that the negative relationship disappears when real variables are included as independent variables. This is true for both the expected and unexpected changes in price level. Based on Fama's explanations, Graham (1996) and Kaul (1987,1990) show that the negative relationship is more profound when monetary policy is neutral or counter-cyclical and tended to be positive when policies are pro-cyclical. Graham indicates that when monetary policy is pro-cyclical such as in the 1976:1-1981:2, inflation has a positive effect on stock returns.[4]

Geske and Roll (1983) reject the causality of inflation on common stock returns inferred by Fama and Schwert (1977). It is argued that the negative relationship reflects a reverse causality arising from a chain of events which causes higher increase in monetary growth. Monetization of debt to finance the budget deficit requires higher monetary growth which in turn fuels inflation. Thus, the negative reaction of stock returns form as a signal toward the expected decline in government revenue due to the anticipated decline in personal and corporate taxes.[5]

[4] *Recent theoretical models by Marshall (1992), Lee (1989) and Stiltz (1986) provide a general equilibrium model that yields a negative relationship between common stock returns and expected inflation, which is consistent with empirical findings.*

[5] *Several other earlier explanations of the puzzling relationship have been proposed by other researchers. Kessell (1956) argues that due to nominal contracting unanticipated inflation effects firms who are net creditors. Lintner (1975) claims that in an inflationary economy, firms have to resort to non-internally generated funds that receive zero interest, thus, diluting the return to equity. Modigliani and Cohn (1979) propose the 'money illusion' explanation in which investors fail to incorporate the effect of inflation in their evaluation of shares. Summers (1981) argues the inability to identify the true real profit as a major cause of this negative relationship. 'Inflation illusion' occurs due to investors' reliance on nominal accounting statements reported by firms.*

Most of the empirical evidence cited above relies on linear regression techniques between measures of common stock returns, inflation and other explanatory variables. As highlighted by Nelson and Ploser (1982), many of these economic time series including consumer prices and common stock prices can be characterised by a unit root process. Regression between these series could mean to spurious regression as shown by Granger and Newbold (1974) and Phillips (1986).[6] In light of this methodological development, we examine the existence of the Fisher effect in the context of Malaysian stock market.

DESCRIPTION OF METHODOLOGY

A. UNIT ROOT PROCESS AND AUGMENTED DICKEY-FULLER UNIT ROOT TEST

The presence of unit root in economic time series would make the ordinary least squares (OLS) estimator a biased estimator. The Gauss-Markov theorem would not hold since unit root series do not have a finite variance. Consider the following first order process :

$$\chi_t = \alpha_1 \chi_{t-1} + \varepsilon_t \qquad (1)$$

where ε_t is white noise. If χ_t is generated by a unit root process (i.e., $\chi_t = \sum_{i=1}^{t} \varepsilon_i$), testing the null hypothesis of $\alpha_1 = 1$ using the conventional significance test is inappropriate since the variance becomes infinitely large as t increases. Nonstationarity of χ_t causes the OLS estimator of α_1 to be biased. Dickey and Fuller (1979, 1981) provide the test for unit root process based on the following regression equation:

$$\Delta\chi_t = \eta + \beta T + \alpha\chi_t{-1} + \sum_{i=1}^{k} \omega i \, \Delta\chi_{t-1} + \lambda t \qquad (2)$$

where Δ is the first-difference operator; χ_t is the series tested; T is a linear time trend; and λt is a covariance stationary random error .The appropriate number of lagged difference (k) is determined by Akaike's Information Criteria (AIC). Optimal choice of lag length removes autocorrelations in error term. The null hypothesis of unit root, ☒ α ☒ $=1$, is tested against alternative of stationarity, ☒ α ☒ < 1. The critical values for the test are developed by MacKinnon (1991). We test the presence of unit root for the level and the first differences of each of the series analyzed in this study.

[6] *Mishkin (1992) employs this approach in his re-examination of the Fisher effect. He concludes that there is a cointegration relationship between expected inflation and nominal interest rates. However, he does not extend the analysis to risky assets.*

ENGLE-GRANGER TWO-STEP COINTEGRATION TEST

Engle and Granger (1987) propose a two-step cointegration test that identifies the long-run relationship between two non-stationary variables (i.e. integrated of order 1 or *I (1)*). It is shown that if two series say, *x* and *y*, are both *I(1)*, then it is possible for their linear combination to be *I(0)*. If that is the case, *x* and *y* are said to be cointegrated. Two variables that are cointegrated obey an equilibrium relationship in the long run, although they may diverge from the equilibrium path in the short run. The proposed cointegration test calls for testing the stationarity of the error term from the following cointegration regression:[7]

$$y_t = \alpha_0 + \alpha_1 x_t + \varepsilon_t \qquad (3)$$

The ADF test described above is used to test for unit root on the residuals ε_t.[8]

Cointegration between *x* and *y* is supported if ε_t is stationary (i.e. *I(0)*).[9] This test is appealing in examining the validity of the Fisher effect. Cointegration between stock and price indices indicates that in the long run, stock prices move in tandem with the price level obeying a long-run equilibrium path. If this is the case, then common stock can be used as a hedge against inflation.

EXPECTED INFLATION AND EX-ANTE REAL COMMON STOCK RETURNS

Empirical test of the Fisher effect requires derivation of two variables which are not directly observable, i.e., the expected inflation rates and the ex-ante real returns. Several approaches have been adopted by researchers in estimating these unobserved variables. For our empirical test, we adopt three different measures of expected inflation as follows:

$$INF^e_t = INF_t + v_t \qquad (4a)$$

$$INF^e_t = \alpha_{t-1} + \beta_1 RTB_{t-1} + v_t \qquad (4b)$$

$$INF^e_t = \beta_0 + \beta_1 MG_t + \beta_2 Y_t + v_t \qquad (4c)$$

[7] *Stock (1987) shows that the test yields 'superconsistent' estimators as it converges to the true value at a rate T^{-1} rather than the usual $T^{-1/2}$. Theoretically, the choice of dependent and independent variables for the cointegration regression is irrelevant since the coefficient of determination (R2) of the regressions goes to one asymptotically leading to perfect fitting regardless which way the regression is run.*

[8] *The OLS equation used to test for stationarity of the error series is similar to Equation (2) but without time trend (T).*

[9] *The proposed two-step cointegration test considers estimating and testing for bivariate process which can have only zero or one cointegrating vector. Engle and Yoo (1987), Stock and Watson (1987) and Johansen (1991) provide the test for multiple cointegrating vectors.*

where *INF* is expected inflation rate, *RTB* is Treasury bills discount rates, *MG* is growth rate of monetary aggregate, *Y* is output growth, and v_t are random error terms.

Superscript *e* denotes expectation and subscript t denotes time period. Equation (4a) is based on the rational expectation assumption that realized inflation rate represents the unbiased expectation of inflation. Thus, the actual inflation rate is used as proxy for expected inflation. The next two measures of expected inflation follow Fama (1981). Equation (4b) is the traditional Fisherian hypothesis that breaks the observed nominal interest rate into two components, expected real rate and expected inflation. As shown by Fama (1975) in an efficient market the observed T bills rate forms an unbiased estimator of expected inflation rate. Equation (4c) is based on the quantity theory of money. Here, expected inflation is a function of growth of monetary aggregate and output in the economy. Based on these measures of expected inflation, the ex-ante real return on the common stock is defined as follows:

$$RR_t = NR_t - INF^e_t \qquad (5)$$

where *RR* denotes ex-ante real rate of returns for common stock and *NR* is the nominal rate of return for common stocks. The ADF unit root test described earlier is performed on ex-ante real returns. Evidence of stationarity in the ex-ante real returns supports the Fisherian hypothesis and vice versa. Stationarity implies that over the long run, ex- ante real returns are mean reverting and any shock will only exert a transitory effect on movement of real returns. Thus, parallel with the Fisherian hypothesis, this indicates the mean reversion of real common stock returns qualifying common stock as an inflation hedging mechanism.

We performed the preceeding analysis on four major indices of the KLSE, i.e. Composite Index (COMP), Industrial Index (IND), Finance Index (FIN) and the Property Index (PROP) for a period of 16 years (1980:1-1996:6). The inflation rate is measured by changes in Consumer Price Index (CPI). To derive the expected inflation in Equation (4b) and (4c), the narrow money (M1 money), Industrial Productions Index (IP) and three-month T bills' rates are used. Data for the stock indices are taken from KLSE publications. The T bills' rates are gathered from the Monthly Statistical Bulletin of Bank Negara (Central Bank of Malaysia) and the CPI, M1 and IP are downloaded from the International Financial Statistics CD ROM. All variables are specified in log except the T bills rates.

RESULTS AND DISCUSSION

The results of ADF unit root test on the level and first differences of common stock and price indices are reported in Table 1. The level of each of the series tested can be characterized as a unit root process that is non-mean reverting. The unit root hypothesis cannot be rejected for the level measurement. However, their first differences are stationary. The null hypothesis of unit root is rejected at a 5 percent significance level when the data are specified in their first differences. These indicate that regression estimations using level measurement are spurious and invalid. We then proceed with the cointegration test as suggested by Engle and Granger (1987). The cointegration regression using stock indices as the dependent variable and CPI as an independent variable is performed. In total we have twelve cointegration regressions since each index is regressed with three different measurements of prices derived from Equations 4a-c. The ADF test is then performed on the error series derived from each of the regression. The results are presented in Table 2. The unit root hypothesis can be rejected for all of the error series at 5 percent significance level. These findings indicate that while the level of stock indices and prices are *I(1)*, their linear combinations are *I(0)*. As shown by Engle and Granger, this implies that in the long-run common stock indices and prices move in tandem with each other as suggested by the Fisherian hypothesis. Stock indices and prices are cointegrated. This implies that they obey a long-run equilibrium path. Cointegration between stock indices and prices allows them to deviate from the long run equilibrium path momentarily but over the long run, they are subject to a common equilibrium force . The findings support the effectiveness of common stock as a hedge against inflation.

An alternative approach to test the Fisherian hypothesis is to examine the stochastic properties of the ex-ante real equity returns. According to the Fisherian hypothesis, expected real returns are invariant with respect to changes in prices and therefore should possess a stationary property. We estimated twelve different measurements of ex-ante real returns using Equation (5) (three for each common stock index). The ADF unit root test is performed on these estimated series of ex-ante real returns. As shown in Table 3, the results are consistent with the Fisher hypothesis. All of the twelve ex-ante real common stock returns are stationary, i.e. mean reverting and therefore supports the Fisherian effect. The random walk hypothesis is rejected for all measurements of expected real returns at 5 percent significance level. Overall, the findings indicate that real common stock returns are invariant with respect to changes in the price level, suggesting the ability of common stock to be an effective hedge against inflation.

Johansen (1991) provide the test for multiple cointegrating vectors.

CONCLUSIONS

The availability of inflation hedging mechanism is of critical importance to investors. According to the Fisherian hypothesis, nominal rates of returns should adjust to expected changes in prices in order to compensate investors for the loss of purchasing power derived from future payments. In this paper, we investigate the validity of this hypothesis in the Malaysian equity market. We examine the stochastic properties of the KLSE indices and also the price indices. At the level form unit root hypothesis cannot be rejected for all of the series tested. However, it is shown that stock indices and prices are cointegrated in the long run, which is parallel to the Fisher effect. Further we also show that the ex-ante real returns for all of the common stock indices are stationary. Ex-ante real returns are mean reverting and invariant with respect to changes in price level. Contrary to some of the earlier findings, our results support the Fisherian hypothesis for the Malaysian stock market. In Malaysia, common stock is an effective hedge against inflationary pressures.

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TABLE 1

AUGMENTED DICKEY-FULLER UNIT ROOT TEST FOR COMMON STOCK AND PRICE INDICES

	Level	First Difference
COMP	-2.313	-6.578**
IND	-2.276	-6.950**
FIN	-1.072	-6.734**
PROP	-2.493	-6.553**
CPI	-0.117	-6.096**
CPITB	0.109	-5.480**
CPIM	0.281	-6.828**

Notes:

1. COMP, IND, FIN, PROP signify the Composite Index, Industrial Index, Finance Index, and Property Index respectively. CPI, CPITB, and CPIM are price index based on the actual CPI and derivation based on Equation (4b) and (4c) respectively.

2. (**) indicate significance at 5 percent.

TABLE 2

ENGLE-GRANGER TWO-STEP COINTEGRATION TEST BETWEEN COMMON STOCK AND PRICE INDICES

Dependent	Independent	ADF
COMP	CPI	-3.337**
	CPITB	-3.185**
	CPIM	-3.244**
IND	CPI	-2.884**
	CPITB	-2.768**
	CPIM	-2.867**
FIN	CPI	-2.800**
	CPITB	-2.673**
	CPIM	-2.853**
PROP	CPI	-2.901**
	CPITB	-2.819**
	CPIM	-2.957**

Notes:

1. The ADF test is performed on the error term of the cointegration regression.

2. See notes for Table 1 AND footnotes 8 for estimation procedure.

TABLE 3
AUGMENTED DICKEY-FULLER UNIT ROOT TEST FOR EX-ANTE REAL COMMON STOCK RETURNS

	Level	First Difference
RRCOMPCPI	-5.927**	-7.816**
RRCOMPTB	-5.938**	-7.798**
RRCOMPM	-5.932**	-7.826**
RRINDCPI	-6.021**	-7.877**
RRINDTB	-6.032**	-7.894**
RRINDM	-6.011**	-7.915**
RRFINCPI	-5.638**	-8.002**
RRFINTB	-5.653**	-8.028**
RRFINM	-5.677**	-8.056**
RRPROPCPI	-5.690**	-8.287**
RRPROPTB	-5.678**	-8.267**
RRPROPM	-6.553**	-8.991**

Notes:

1. RR denotes ex-ante real returns. COMP, IND, FIN, PROP signify the Composite Index, Industrial Index, Finance Index, and Property Index respectively. CPI, TB, and M are price index based on the actual CPI and derivation based on Equation (4b) and (4c) respectively. As an example, RRCOMPTB indicates ex-ante real common stock return as measured by the difference between nominal common stock return (measured by Composite Index) and expected inflation (measured by Equation (4b)). Estimation is based on Equation 2.

2. See note for Table 1.