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DOES THE INDONESIAN STOCK MARKET PROVIDE A GOOD HEDGE AGAINST INFLATION? EVIDENCE FROM THE PRE-1997 FINANCIAL TURMOIL

M. Shabri Abd. Majid*****

This study explores the relationship between real stock returns and inflationary trends in the Indonesian economy during the pre-1997 financial crisis period. It attempts to test the relationship between real stock returns and inflation in the light of: (i) the Fisher hypothesis that asserts the independence of real stock returns and inflation, and (ii) Fama's (1981) proxy effect framework which states that the negative real stock returns-inflation is indirectly explained by a negative real economic activity-inflation and a positive real stock returns-real economic activity relationship. A negative relationship between real stock-returns and inflationary trends is recorded. This finding is contradictory with the Fisher hypothesis which implies that the Indonesian stock market does not provide a good hedge against inflation. Fama's proxy hypothesis was found unable to explain in its entirety the negative relationship between real stock returns and inflation in the Indonesian stock market. A positive relationship between real economic activity and inflation, and a negative relationship between real stock returns and real economic activity were recorded. This result shows a consistency with the Mundell-Tobin hypothesis.

1. INTRODUCTION

There have been rigorous empirical studies on the issue of stocks being a better hedge[1] against inflation. The notion that stocks preserve real value regardless of the inflation rate fluctuations is consistent with the

* Department of Economics, Kulliyyah of Economics and Management Sciences, International Islamic University, Malaysia.

[1] A hedge investment is one that contains two or more components. As the market conditions change, the change in the value of one of these parts at least partially offsets the change in the other component; if the change in one of the two positions offsets the other exactly, it is a perfect hedge. For example buying a stock and selling short the same stock would create a perfect hedge because as the stock rises in value, the increase in the long position would exactly be offset by a fall in value of the short position (French, 1989, p. 419).

classical investment theories found in Day (1984) and Marshall (1992). However, progressive empirical studies in developed countries have documented that expected inflation, unexpected inflation and changes in expected inflation were all negatively related to stock returns which appear contrary to both economic theory and common sense.[2]

In the light of the Fisher hypothesis, real stock returns are independent of inflationary expectations. This reveals that nominal asset returns should be positively related to both expected and unexpected inflation. The Philips curve shows that a negative relationship between the unemployment rate and the rate of inflation implies a positive association between inflation and real economic activity. Therefore, stock returns that were positively correlated with real economic activity, in turn, are expected to show a positive association with inflation. The positive relation between stock returns and unexpected inflation suggests that common stocks are good hedges against unexpected inflation.

There are a number of theories to elucidate the negative real stock returns-inflation relationship. For example, Chatrath *et al.* (1997) have adopted Fama's (1981) model to explain the above relationship through a hypothesized chain of macroeconomic linkages that have their basis in the money-demand theory and the quantity theory of money. Geske and Roll (1983), Kaul (1987 and 1990), Marshall (1992), and Graham (1996) have explored the role of the monetary sector in order to explain this perplexing negative relationship between stock returns and inflation. They found that the relationship varies over time in a systematic manner depending on the influence of money demand and supply factors. Unlike Geske and Roll (1983), Kaul (1987 and 1990), Marshall (1992), and Graham (1996), Hamburger and Zwick (1981) considered both monetary and fiscal policies in describing the negative real stock returns-inflation relationship.

Generally, the previous empirical studies document a negative real stock returns-inflation relationship, implying that the stock market is not a good hedge against inflation. However, Ram and Spencer (1983)

[2] Studies on developed countries include Fama (1981; 1983; and 1990), Fama and Gibbons (1982), Geske and Roll (1983), Gultekin (1983a and 1983b), Kaul (1987 and 1990), Solnik (1973 and 1983), Boeckh and Coghlan (1982) and Malkiel (1982).

adopted the Mundell-Tobin hypothesis as an alternative to Fama's proxy hypothesis in delineating the negative relationship between real stock returns and inflation. Fama's proxy hypothesis claims that the negative real stock returns-inflation is indirectly explained by a negative real economic activity-inflation and a positive real stock returns-real economic activity relationship. In the Mundell-Tobin hypothesis, an increase in the expected rate of inflation causes a portfolio substitution from money to financial assets, which will reduce the real returns on such assets (for example, stocks). This reduction in real interest will stimulate real economic activity. Therefore, according to Mundell's hypothesis, one would expect a positive relationship between inflation and economic activity and a negative relationship between real stock returns and economic activity.[3]

Modigliani and Cohn (1982a) adopt the theory of rational valuation to explain the negative relationship between real stock returns and inflation. This theory contends that the low value of stocks during periods of high inflation is the result of a failure of investors to adjust corporate profits to the inflation premium components of interest expense (which they argue represents a return of capital rather than an expense) and of the capitalization of corporate profits at the nominal rate (rather than the theoretically correct real rate) of interest.

Wahlroos and Berglund (1986) also find a significant negative relationship when stock returns were regressed on the rate of inflation. Bulmash (1991) says that this negative stock returns-inflation relationship is indicated by the negative sloping curve where the steepness of the slope depends on the magnitude of money supply changes.

The relationship between real stock returns and inflation is further explained by Day (1984) by using a multi-period economy with production. He finds that the expected real returns-expected inflation relationship depends on the form of the economy's production function and investor preferences. When the production function exhibits stochastic constant returns to scale, the negative relation between expected real returns and expected inflation is documented. Bulmash

[3] Ram and Spencer. 1983. Stock Returns, Real Activity, Inflation, and Money: Comment. *American Economic Review.* 73: p. 463.

(1991), on the other hand, adopts the quantity of money equation, i.e. MV = PY, to explain the stock returns-inflation relationship.[4] He argues that if M (nominal money growth) does not accommodate changes in Y (output) as a proxy of real economic activity, P (price) will go up because changes in nominal money supply signal changes in inflation, then Y will have to go down, thereby negatively affecting stock prices.

Although researchers adopt different economic theories, different measures of inflation expectations[5] and different econometric models to delineate the relationship between stock returns and inflation, they generally find that stock markets in developed economies are no longer a good hedge against inflation. This phenomenon is, of course, troublesome since it consistently appears to reject both economic theories and common sense. The consistent empirical findings for developed economies motivate a similar study for a less developed economy by taking Indonesia as a case study. To the best of our knowledge, no study has been done in this area for the Indonesian stock market. As for the relationship between stock returns and inflation for developing countries, only two studies have been realised: one on the Philippines case by Gultekin (1983a) and the other on the Indian stock market by Chatrath *et al*. (1997). Unfortunately, their studies have many shortcomings. The former ignores the role of expected and unexpected inflation in the model on the Philippines economy, while the latter employs a too small sample size of data, from 1984 to 1996. Again, deficiencies in the previous studies provide additional motivation for this work which intends to cover the shortfalls mentioned earlier.

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[4] There are many explanations of this theory. For example, see Froyen, R. T. (1996). We find that under the condition assumed, the price level varies (1) directly with the quantity of money (M), (2) directly with the velocity of its circulation (V), and (3) inversely with the volume of trade done by it (T). The first of these relations is worth emphasis. It constitutes the Quantity Theory of Money.

[5] There are, at least, five major approaches that have been adopted by economists to measure inflationary trends, namely [i] contemporary inflation (Gultekin, 1983a), [ii] Auto-Regressive Integrated Moving Average (ARIMA) (Chatrath *et.al*, 1987 and Kaul, 1990), [iii] short-term interest rates on default-free discount bonds (Fama, 1981 and Solnik, 1983), [iv] money-supply and real activity-based prediction (Schwert, 1990), and [v] data from the Livingston surveys of expectations (Gultekin, 1983b and Hasbrouck, 1984).

There is, therefore, a growing need to address the question as to whether the Indonesian stock market provides an effective hedge against inflation. Does the behaviour of the Indonesian stock market coincide with the findings in developed countries? Is the Indonesian stock market in line with the Fisher hypothesis? Is the stock market of the country a good hedge against inflation? Does Fama's proxy hypothesis explain the real stock returns-inflation relationship for the Indonesian stock market?

To answer the above questions, the paper aims at:

(1) Examining the relationship between real stock returns and inflationary trends in the Indonesian stock market, thereby testing the generalized Fisher hypothesis that real stock returns are independent of inflationary expectations,

(2) Testing Fama's Proxy hypothesis which states that the negative real stock returns-inflation relationship is indirectly explained by a negative inflation-real activity relationship and a positive real activity-stock returns relationship.

(3) Exploring whether Fama's proxy effect is strong enough to explain the negative stock returns-inflation relationship.

The above questions need to be solved since the Indonesian economy has recently been subject to several measures which are increasingly opening it to foreign investment. As a result, institutional investors from developed countries such as America, Europe and Asian developed countries were attracted to this market. The spectacular performance of the Indonesian stock market before the 1997 financial crisis period may be related to inflation. Over the 1983: Q3 to 1997: Q2 period, the Jakarta Composite Index (JCI) rose sharply from approximately less than 100 to over 700, while inflation, on average, fluctuated from 4.0 to 20.1%.[6]

The findings of this paper are expected to have important consequences for policymakers, international fund managers and other institutional investors who seek to enter the Indonesian stock market for diversification purposes.

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[6] These particular economic data are retrieved from *Datastream*.

The rest of the paper is organized in the following sequence: in the next section, the hypotheses are stated. The methodology and data on which the analysis is based are presented in section 3. Section 4 discusses the results and implications of the paper. Lastly, section 6 concludes the paper.

2. STATEMENT OF THE HYPOTHESES

Since the late 1960s and early 1970s, stock markets in developed countries have been found to be no longer an effective hedge against inflation (Malkiel, 1982 and Boeckh and Coghlan, 1982). Many studies have documented that actual, expected and unexpected inflation are all negatively related to stock returns.[7] This empirical evidences appears contradicting to both economic theories and economic sense. Based on the previous empirical findings, the study expects changes in inflation rates to have a significant negative relation on stock returns, thereby contradicting the Fisher hypothesis. The negative stock returns-inflation relation is expected to be strong enough to be explained by Fama's proxy hypothesis.

3. METHODOLOGY AND DATA

3.1. Testing the Fisher Hypothesis

In this study, we divide inflation into three types: actual, expected and unexpected. Based on this, three econometric models are formulated to test the real stock returns relationship to each type of inflation. The first model is between stock returns and actual inflation as in Graham's (1996) and Chatrath *et al*'s. (1997):

$$\mathbf{SR_t - INF_t = \beta_0 + \beta_1(INF_t) + \varepsilon_t} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(3.\ 1)$$

Where $\mathbf{SR_t}$ and $\mathbf{INF_t}$ are the nominal stock returns and the actual/contemporaneous rate of inflation over period **t**, respectively. The difference of $\mathbf{SR_t - INF_t}$ represents real (or inflation adjusted) returns and $\boldsymbol{\varepsilon_t}$ is the error random term.

[7] Some of the studies which find that stock returns are negatively related to inflationary trends are: Fama (1981); Geske and Roll (1983); Huizinga and Mishkin (1984); Wahlroos and Berglund (1986); and Chatrath *et al*. (1997).

The second model is between stock returns and expected inflation as in Gultekin (1983a and 1983b), Solnik (1983), Leonard and Solt (1986), Wahlroos and Berglund (1986), and Kaul (1987), Chatrath *et al.* (1997). The model is presented as follows:

$$\mathbf{SR_t - INF_t = \beta_0 + \beta_2 E(INF_t \mid \phi_{t-1}) + \varepsilon_t} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(3.\ 2)$$

Where $\mathbf{E(INF_t)}$ denotes the expected inflation rate at the time **t** and $\boldsymbol{\phi_{t-1}}$ is the information set available to investors at the end of period **t-1.**

The third model presents tests of the relationship between stock returns and both expected and unexpected inflation as in Gultekin (1983a and 1983b), Geske and Roll (1983), Solnik (1983), Wahlroos and Berglund (1986), Leonard and Solt (1986), and Chatrath *et al.* (1997):

$$\mathbf{SR_t - INF_t = \beta_0 + \beta_2 E(INF_t \mid \phi_{t-1}) + \beta_3\{INF_t - E(INF_t \mid \phi_{t-1})\} + \varepsilon_t} \quad (3.\ 3a)$$

However, model (3.3a) may be simplified as follows:

$$\mathbf{SR_t - INF_t = \beta_0 + \beta_2 E(INF_t \mid \phi_{t-1}) + \beta_3 UE(INF_t) + \varepsilon_t} \quad \ldots\ldots\ldots\ldots(3.\ 3b)$$

where the unexpected inflation rate, which is represented by $\mathbf{UE(INF_t)}$**,** is defined as the difference between the actual and expected rates of inflation,

$$\mathbf{\{INF_t - E(INF_t \mid \phi_{t-1})\}}.$$

For the first two equations (3. 1) and (3. 2), if $\boldsymbol{\beta_1}$ and $\boldsymbol{\beta_2}$ coefficients equal to zero, the results will be consistent with the Fisher hypothesis which states that the real rate of returns on common stocks are independent of inflation rates. This implies that the stock market is a perfect hedge against actual inflation and expected inflation respectively. Meanwhile, the $\boldsymbol{\beta_2 = \beta_3 = 0}$ in the equation (3. 3a) or (3. 3b) means that the asset in question is a perfect hedge against both expected and unexpected inflation.

3.2. Testing Fama's Proxy Hypothesis

As mentioned earlier, Fama's proxy hypothesis says that the negative relationship between stock returns and inflation centres around the linkages between inflation and real activity, and between stock returns and real activity. The first proposition of the hypothesis is that there is a negative relationship between inflation and real economic activity. The second is that there is a positive association between real activity and stock returns. These can individually be tested by the following models:

$$\mathbf{INF_t} = \alpha_0 + \sum_{i=-k}^{k} \alpha_i \mathbf{REA_{t+i}} + \varepsilon_t \quad \text{(3. 4a)}$$

$$\mathbf{E(INF_t)} = \alpha_0 + \sum_{i=-k}^{k} \alpha_i \mathbf{REA_{t+i}} + \varepsilon_t \quad \text{(3. 4b)}$$

$$\mathbf{UE(INF_t)} = \alpha_0 + \sum_{i=-k}^{k} \alpha_i \mathbf{REA_{t+i}} + \varepsilon_t \quad \text{(3. 4c)}$$

$$\mathbf{SR_t - INF_t} = \delta_0 + \sum_{i=-k}^{k} \delta_i \mathbf{REA_{t+i}} + \mathbf{v_t} \quad \text{(3. 5)}$$

where $\mathbf{REA_t}$ is the real economic activity that is proxied by the real Gross Domestic Product (GDP), while $\mathbf{v_t}$ represents the error random term. Leading, contemporaneous and lagging values of the real economic activity are also incorporated in the model.

In line with Chatrath *et al.* (1997), in models (3. 4a), (3. 4b), (3. 4c) and (3. 5), we incorporate both leads and lags[8] of real economic activity due to the lack of prior evidence pertaining to the relationship between real economic activity and inflation and real returns in the Indonesian stock market. Equations (3. 4a), (3. 4b), and (3. 4c) test Fama's proposition (1). The negative relationship between inflation and real economic activity implies that some α_i's are significantly negative. Equation (3. 5) tests for Fama's proposition (2), where a positive

[8] In his studies, for instance, Ibrahim (1999a and 1999c) has also incorporated both leads-lags to capture the effect of independent variables on its dependent counterpart.

relationship between real economic activity and real stock return implies that some δ_i's are significantly positive.

Since Fama's proxy effect explanation is based on an indirect relationship between real stock returns and inflation, a single equation treatment to equations (3. 4a), (3. 4b), (3. 4c), and (3. 5) may yield inconsistent estimates (Johnston, 1984; Harvey, 1990; and Chatrath *et al.* 1997). To avoid this inconsistency in the estimates of the relationship between stock returns and the actual, expected, and unexpected inflation, the study adopts Chatrath *et al*'s (1997) two-step ordinary least squares procedure. The models are as follows:

$$\mathbf{INF_t = \mu_0 + \sum_{i=-k}^{k} \mu_i\, REA_{t+1} + \varepsilon_{It}} \quad \text{..............................(3. 6a)}$$

$$\mathbf{SR_t - INF_t = \delta_0 + \delta_1 \varepsilon_{It} + \sum_{i=-k}^{k} \delta_i\, REA_{t+1} + \nu_t} \quad \text{....................(3. 6b)}$$

$$\mathbf{E(INF_t) = \mu_0 + \sum_{i=-k}^{k} \mu_i\, REA_{t+1} + \varepsilon_{IIt}} \quad \text{..............................(3. 7a)}$$

$$\mathbf{SR_t - INF_t = \delta_0 + \delta_1 \varepsilon_{IIt} + \sum_{i=-k}^{k} \delta_i\, REA_{t+1} + \pi_t} \quad \text{.......................(3. 7b)}$$

$$\mathbf{UE(INF_t) = \mu_0 + \sum_{i=-k}^{k} \mu_i\, REA_{t+1} + \varepsilon_{IIIt}} \quad \text{..................................(3. 8a)}$$

$$\mathbf{SR_t - INF_t = \delta_0 + \delta_1 \varepsilon_{IIIt} + \sum_{i=-k}^{k} \delta_i\, REA_{t+1} + \varphi_t} \quad \text{.....................(3. 8b)}$$

For the last six equations (3. 6a), (3. 6b), (3. 7a), (3. 7b), (3. 8a) and (3. 8b), inflation and real stock returns are regressed on the lagging, contemporaneous and leading values of real economic activity. However, the differences between equations (a) and (b), for example between equations (3. 6a) and (3. 6b), are where the estimated residual from equation (3. 6a), $\varepsilon_{It,}$ is included as an independent variable in equation (3. 6b) representing the inflation variable that is purged of the relationship between inflation and real economic activity. For equations (3. 6b), (3. 7b) and (3. 8b), the δ_1 coefficients equal to zero, which will be consistent with Fama's proxy hypothesis which states that *real stock returns and inflation rates are independent once the impact of real economic activity on inflation has been controlled for*. This means that if the persistence of the negative relationship between inflation and real stock returns still exists even after controlling for the inflation-real economic activity relationship, the results are inconsistent with Fama's proxy hypothesis.

3.3. The Data

Fourteen years of quarterly changes in Consumer Price Index (CPI) are used as a proxy for inflation, and the Gross Domestic Product (GDP) is used as a proxy for real economic activity.[9] The data for Indonesian stock returns are calculated from the Jakarta Stock Exchange (JSX) Composite Index.[10] Analyses are made on the quarterly data for the period from 1983: Q3 to 1997: Q2, that is the period before the 1997 financial crisis.

Stock returns are expressed as a percentage earned on a company's common stock investment for a given period and as a profitability ratio measuring how well equity capital is employed (Fitch *et al.* 1993). The nominal stock return is computed as follows:

$$\mathbf{SR_t = Log\ \{(V_t)/(V_{t-1})\}} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(3.\ 9)$$

where $\mathbf{V_t}$ is the index value of stock at the end of quarter t and $\mathbf{V_{t-1}}$ is the index value of stock for the previous quarter-end, *t - 1*.

[9] The data for the study are compiled from *Datastream* and *Statistical Bulletin of the Central Bureau of Statistics*, the Republic of Indonesia (on various issues).

[10] The Jakarta Composite Index (JCI) is an equally weighted index that covers 254 stocks listed on the Jakarta Stock Exchange (JSX).

3.4. Expected and Unexpected Inflation Forecasts[11]

In developed countries, researchers generally use the Treasury Bill rate as a proxy for expected and unexpected inflation. This could be acceptable because inflation rates in those countries are relatively constant almost all the time. However, in emerging markets like Indonesia, inflation rates are relatively not constant. Similar to Fama and Gibbons (1982), Leonard and Solt (1986), Kaul (1990) and Chatrath *et al.* (1997), this study uses the *Auto-Regressive Integrated Moving Average* (ARIMA) model to estimate expected inflation; and the forecast errors as the unexpected component of inflation.[12] Another reason for using the ARIMA model in this study is that this particular model can detect large variabilities of inflation rates, hence achieve a greater predictability of the realized inflation rate (Solnik, 1983).

4. EMPIRICAL RESULTS

4.1. Test for Stationarity

In order to obtain credible and robust results for any conventional regression analysis, the data to be analyzed should be stationary (Pankratz, 1983; Harvey, 1990; Gujarati, 1995). Table 1 shows the Dickey-Fuller (DF) test statistics that test the presence of unit root test (non-stationarity) for all time series data, which are analyzed in this study. In the test, if the null-hypothesis is $\delta = 0$, this indicates that the unit root exists. Failure to reject the null-hypothesis indicates no statistical evidence for stationarity, while rejecting the null-hypothesis (accepting the alternative hypothesis) implies evidence for stationarity.

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[11] Interested readers may consult Fama and Gibbons (1984) and Leonard and Solt (1986) for details on different forecasting methods of inflation.

[12] Otherwise known as Box-Jenkins (B-J), the ARIMA models owe their popularity to their tremendous success in forecasting time series. For example, Gujarati (1995) and Pankratz (1983) found that, in many cases, the forecasts obtained by this model are more reliable than those obtained from the conventional econometric modeling, particularly for short-term forecasts.

Table 1: Dickey-Fuller Unit-Root Test.

Variables	Log Level		First Differences	
	Constant and No Trend	Constant and Trend	Constant and No Trend	Constant and Trend
INF	-5. 32431*	-5. 4308*	-	-
JCI	-2. 534	-2. 8700	-4. 1360*	-4. 6153*
REA	1. 3122	2. 2330	-4. 2564*	-4. 7234*

Note:
INF is the rate of inflation computed from Consumer Price Index log (CPI/CPI_{t-1}). The Jakarta Composite Index is used as a proxy for stock returns, which is calculated by log (JCI/JCI_{t-1}). Finally, the REA or log (GDP/GDP_{t-1}) is the Gross Domestic Product that is used as a proxy for the real economic activity. In a Shazam's output, the optimal lag order is automatically set (Shazam: Users' Reference Manual, 1997).
***** Represents significance at 1% level.
The Dickey-Fuller test statistics for regression models with constant and no trend and with constant and trend are as follows:

$$\Delta y_t = \delta_0 + \delta_1 y_{t-1} + \sum_{j=1}^{n} \tau_j \Delta y_{t-j} + v_t$$

$$\Delta y_t = \delta_0 + \delta_1 y_{t-1} + \delta_2 T + \sum_{j=1}^{n} \tau_j \Delta y_{t-j} + v_t$$

Table 1 above shows that the inflation rate (INF) is stationary in the log level either with constant and no trend regression or with constant and trend regression models. The stock return (JCI) and real economic activity (REA) are all non-stationary in the log level. Nevertheless, stationarity is achieved through the first difference for both models.

4.2. The ARIMA Models for Expected and Unexpected Inflation Forecasts

As for the ARIMA models, we begin with the identification stage, i.e. identify the exact order of Auto-Regressive (AR) (*p*), Integrated (I) (*d*), and order of Moving Average (MA) (*q*).

The unit-root test results (Table 1) imply that the rate of inflation is stationary at the log level. Therefore, the order of Integration is zero, I (0). As such, there is no need to differentiate it again in order to arrive at stationarity. Since the inflation series is stationary, only the Auto-

Regressive Moving Average (ARMA) (*p*, *q*) is implemented. After identifying the I (0), the order of both Auto-Regressive (AR) and Moving Average (MA) shall be determined.

Table 2: ARMA Models for Expected Inflation

Parameters	**Expected Inflation**
AR (1)	0. 5421***** (5. 472)
AR (2)	-0. 3430****** (-2. 6501)
AR (3)	-0. 1762 (-1. 0443)
MA (1)	0. 9972***** (52. 1172)
MA (2)	0. 4322***** (32. 4543)
Constant	0. 06315***** (6. 1203)
R^2	0. 4931
Skewness	0. 1561
Kurtosis	3. 4313
J-B	18. 1062
D-W	2. 0501

Note:
J-B indicates the Jarque-Bera test for normality, whereas **D-W** refers to the Durbin-Watson *d* test.
The numbers in parentheses are the t-statistics for testing the null-hypotheses that the coefficients are equal to zero.
*****, ****** Indicate significance at the 1% and 5% levels, respectively.

Model ARMA (3, 2): $\mathbf{Y_t = \mu + \alpha_1 Y_{t-1} + \alpha_2 Y_{t-2} + \alpha_3 Y_{t-3} + \beta_0 \varepsilon_t + \beta_1 \varepsilon_{t-1} + \beta_2 \varepsilon_{t-2}}$

Through a diagnostic process, an ARMA (3, 2)[13] is found to be the best model in specifying expected and unexpected inflation. The

[13] Box-Pierce chi-square statistics are also computed for ARMA (1, 1), ARMA (1, 2), ARMA (2, 1), ARMA (2, 2), ARMA (2, 3), ARMA (1, 3), ARMA (3, 1), ARMA (3,

goodness of those chosen ARMA models is shown by Modified Box-Pierce chi-square statistics where all residuals from this model are insignificant. This indicates that the residuals from the optimum number of lags chosen, AR=3 and MA=2, are white noise.

The other criteria for the fitness of a model are indicated by the computed values of Skewness and Kurtosis. The values for these should be around 0 and 3 for a normal distribution of the chosen model.[14] If we look at these criteria, our results are not much departing from the normal or ideal values of 0 and 3. The computed values of Skewness and Kurtosis are 0.1561 and 3.4313, respectively. The Durbin-Watson (D-W) *d* statistics (2.0501) indicate that in our model, there is no auto-correlation among the disturbance terms.[15] Finally, based on the normality test of Jarque-Bera (J-B), we find a J-B value of 18.1062, which asymptotically does not reject the normality assumption for our ARMA model. Having identified the appropriate *p*, *d* and *q* values, estimation and forecasting steps are performed.

4.3. Real Stock Returns and Inflationary Trends

Table 3 provides the test results for the relationship between real stock returns and inflation, thereby testing the generalized Fisher hypothesis which states that real stock returns are independent of inflationary expectations.

Model 1. $SR_t - INF_t = \beta_0 + \beta_1(INF_t) + \varepsilon_t$

Model 2. $SR_t - INF_t = \beta_0 + \beta_2 E(INF_t \mid \phi_{t-1}) + \varepsilon_t$

Model 3. $SR_t - INF_t = \beta_0 + \beta_2 E(INF_t \mid \phi_{t-1}) + \beta_3 UE(INF_t) + \varepsilon_t$

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4), ARMA (4, 4), and many others. Even though their Skewness and Kurtosis values are around 0 and 3, all these alternative models are not white noise because some of the Box-Pierce chi-square statistics are found significant.

[14] Gujarati, D.N., 1995, *Basic Econometrics,* 3rd Edition. New York: McGraw-Hill, Inc, p. 773.

[15] A simple way to test for serial correlation is by referring to the rule of thumb, where if *d* is found to be close to 2 in application, one may assume that there is no first order auto-correlation, either positive or negative. See Gujarati, D. N. 1995, p. 423. Our results are around this number.

Table 3: Real Stock Returns and Inflationary Trends

Model	Constant	INF_t	$E(INF_t)$	$UE(INF_t)$	Adj-R^2	F	D-W
1	-0.2005 (-2.142)**	-1.0017 (-2.717)*	- -	- -	0.0854	5.9301*	1.9996
2	-1.2134 (-2.2111)**	- -	0.2959 (0.1954)	- -	0.0004	3.4531	2.1984
3	-1.5921 (-2.5401)**	- -	0.6333 (0.8178)	-6.5782* (-4.1888)	0.3129	8.6150*	2.2824

Note:
The numbers in parentheses are the t-statistics for testing the null-hypothesis that the coefficients are equal to zero. D-W refers to the Durbin-Watson *d* test and Adj-R^2 indicates the Adjusted R^2.
***** and ****** represent a level of significance of 1% and 5%, respectively.
The above regression results are obtained from the models on the previous page.

Table 3 shows that the actual inflation coefficient (Model 1) is found to be negative and significant at 1%. This indicates that real stock returns are not independent of actual inflation, which is consistent with Fama's hypothesis. As for expected and unexpected inflation, only the unanticipated portion of inflation is negatively significant at the 1% level with real stock returns (Model 3). This finding, that contradicts the Fisher hypothesis, implies that the Indonesian stock market is not a good hedge against inflation. It is similar to the findings of Chatrath *et al.* (1997) and Solnik[16] (1983) for the Indian and Canadian economies in particular. It is also in line with the latest evidence for the Pacific Basin countries[17] provided by Lee (1998) and the evidence for several developed countries in general[18] (Gultekin, 1983a). However, this result

16 In providing international evidence, his study analyzes the economies of nine countries, namely USA, Japan, UK, Switzerland, France, Germany, Netherlands, Belgium, and Canada for the period from January 1971 to December 1980. Except for Canada, all other countries showed a negative relationship between real stock returns and expected and unexpected inflation.

17 In this study, Lee (1998) investigates four Pacific Basin countries, namely Hong Kong, Singapore, South Korea and Taiwan.

18 In comparing with other previous findings, we have to be alert of the different types of data used. In general, results are weaker with monthly and quarterly data than with annual data. One explanation for these weaker results is the high volatility of most variables in the short run. Most importantly, monthly and quarterly data may capture the effects of economic variables on contemporaneous rather than future inflation (Park, 1997).

does not support the finding of Kaul (1987) for the USA and Canada for the 1926-1940 period.

The Durbin-Watson (D-W) *d* statistics in Table 3 are all insignificant. Hence, we do not reject the null-hypothesis of having no auto-correlation among the disturbance terms. The Adjusted-R^2 of model (3), where real stock returns are regressed on both expected and unexpected inflation, gives the highest Adjusted-R^2 which is 0.3129, while the lowest Adjusted-R^2=(0.0004) is given by model (2) where real stock returns are regressed on expected inflation. This may indicate the importance of separating inflation into expected and unexpected inflation. It is interesting to note that real stock returns are more dependent on the actual and unexpected inflation rather than expected inflation.

It should be noted that the present study, as well as those preceding it, exhibits a rather low Adjusted-R^2 in most of the stock return-inflation models, nominal or real. Bulmash (1991) notes that even adding other economic factors such as industrial production, money supply, real economic activity and differences in interest[19] produced low Adjusted-R^2. Our finding, however, supports the finding by Boeckh and Coghlan (1982).

4.4. Tests for Fama's Proxy Hypothesis

4.4.1. Testing the First Proposition of Fama's Proxy Hypothesis: A Negative Relationship between Inflation and Real Economic Activity

Table 4 below reports the results for the first Proposition of Fama's proxy hypothesis. The finding from Table 3 indicates that the Indonesian stock market provides some support for the negative relationship between real stock returns and both actual and unexpected inflation. This finding, actually, does not support Proposition (1) of Fama's hypothesis. Based on Table 4, the FPE-based specification models, Model 1 and Model 2, show that actual and expected inflation are regressed on one leading, contemporaneous and lagging values of real economic activity incorporated into the first and second models. Then,

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[19] As proxies for unexpected inflation in the study of Fama (1981).

unexpected inflation is regressed on twelve leading, lagging and one contemporaneous values of real economic activity. The optimal lead-lag lengths that are incorporated in the model are based on the Akaike's (1969) Final Prediction Error (FPE) criterion[20] so as to avoid the inefficiency and biased parameter estimates from arbitrarily chosen lead-lag lengths.[21] However, all possible lead-lag combinations with a minimum lead-lag length were also examined,[22] but the discussion only focuses on the FPE-based specification.

Table 4: Testing the First Proposition of Fama's Proxy Hypothesis

Model	Real Economic Activity: Coefficients' Sum of Lead-Lag Specification					
	{-3. 3}	**{-5. 5}**	**{-7. 7}**	**{-9. 9}**	**{-11. 11}**	**FPE**
1	0.001011 [0. 4733]	-0. 000137 [0. 3545]	0. 003920 [1. 0017]	0.00092 [1. 2219]	-0. 00874 [1. 3432]	0. 000732***** [2.9763]**{-1.1}**
2	0.000121 [0. 5464]	0.000923 [0. 3145]	-0.00245 [0. 3675]	-0.00297 [0. 7978]	-0.026042 [1.3270]	0.000422 [1. 5139]**{-1.1}**
3	0.001033 [0. 4251]	0.002315 [0. 4492]	-0.000120 [0. 7287]	0.01453 [1. 6150]	0.046759 [1. 5098]	0.017658 [1.8873]**{-2.2}**

Note:
The numbers in **[.]** are the F-statistics used for testing the null hypothesis that the coefficients' sum of lead-lag specification is equal to zero. The numbers in **{.}** show the optimal lead-lag length based on the Akaike's (1969) Final Prediction Error criteria. These numbers of leading and lagging values of real economic activity, for example **{-3.3},** indicate that three leads and lags plus one contemporaneous value are incorporated in the model.
***** Denotes significance at the 10% level.

$$\textbf{Model 1.}\ \ \mathbf{INF_t = \alpha_0 + \sum_{i=-k}^{k} \alpha_I\, REA_{t+i} + \varepsilon_t}$$

[20] The least value of Akaike's (1969) Final Prediction Errors (FPE) is considered as the optimal lead-lag length. It is computed by the formula: $\boldsymbol{\rho^2\{N+K\}/\{N-K\}}$, where ρ^2 denotes variance, N is the number of observations, and K is the number of explanatory variables excluding the constant term.

[21] In case a too large lag length is chosen, the estimated parameters are inefficient due to the inclusion of irrelevant variables, while with the incorporation of a too small lag length, the estimated coefficients will be biased due to the omission of important variables (Ibrahim, 1999c, p. 6). Another weakness of including arbitrary lead-lag lengths is that it generally yields insignificant F-statistics (Ibrahim, 1999a, p. 11).

[22] In examining all possible lead-lag combinations, the study only reports a combination of lead-lags of (-3. 3), (-5. 5), (-7. 7), (-9. 9) and (-11. 11). However, the maximum lead-lag length included in the models is only considered until (-12. 12). See, Ibrahim (1999c).

$$\textbf{Model 2. } E(INF_t) = \alpha_0 + \sum_{i=-k}^{k} \alpha_I \, REA_{t+i} + \varepsilon_t$$

$$\textbf{Model 3. } UE(INF_t) = \alpha_0 + \sum_{i=-k}^{k} \alpha_I \, REA_{t+i} + \varepsilon_t$$

Table 4 shows that in a long-term period, there is a positive relationship between actual inflation and real economic activity. It is shown by the positive sum of lead-lag coefficients at the 5% level of significance of F-statistics. In general, the FPE-based model, compared to the other arbitrarily chosen lead-lag combination models, shows the highest F-Statistics.[23] These significant positive relationships are also supported by regressing unexpected inflation on real economic activity.

It is found that only actual inflation plays a significant positive role in determining the real economic activity. This long-run finding indicates that the positive relationship between actual inflation and real activity is in contradiction with Fama's proxy effect. However, this fact may be consistent with either the Mundell-Tobin hypothesis or the Philips' curve model.

4.4.2. Testing the Second Proposition of Fama's Proxy Hypothesis: A Positive Relationship between Stock Returns and Real Economic Activity

Table 5 below reports the results of the regression between real stock returns and real economic activity. Based on the FPE-based specification model {-2. 2} in Table 5, a significant negative relationship between real stock returns and real economic activity is depicted as shown by the significant F-statistics at the 5% level. This is inconsistent with the second proposition of Fama's proxy hypothesis.

Overall, the study finds that there is a positive relationship between inflation and real economic activity and a negative relationship between real stock returns and real economic activity. These results are inconsistent with Fama's proxy hypothesis. Nevertheless, this result seems to be in line with the Mundell-Tobin hypothesis, which says that the negative relationship between real stock returns and inflation is

[23] Ibrahim (1999a) finds similar results.

directly explained by the positive inflation-real activity and the negative real stock returns-real activity relationships. This result thus supports Ram and Spencer's (1983) work that criticize Fama's proxy hypothesis.[24]

Table 5: Testing the Second Proposition of Fama's Proxy Hypothesis

Real Economic Activity: Coefficients' Sum of Lead-Lag Specification						
Model	**{-3. 3}**	**{-5. 5}**	**{-7. 7}**	**{-9. 9}**	**{-11. 11}**	**FPE**
1	-0. 097667 [1. 2687]	-0. 214133 [1. 3663]	-0. 212701 [0. 9943]	-0.303506 [1. 7161]	-0. 332490 [1. 372]	-0. 265041** [2.8750]**{-2. 2}**

Note:
The numbers in **[.]** are the F-statistics used for testing the null hypothesis that the coefficients' sum of lead-lag specification is equal to zero. The numbers in **{.}** show the optimal lead-lag length based on the Akaike's (1969) Final Prediction Error criteria. These numbers of leading and lagging values of real economic activity, for example **{-3.3},** indicate that three leads and lags plus one contemporaneous value are incorporated in the model.
** denotes significance at the 5% level.

$$\textbf{Model 1. } SR_t - INF_t = \alpha_0 + \sum_{i=-k}^{k} \alpha_I \, REA_{t+i} + \varepsilon_t$$

4.5. Real Stock Returns, Inflationary Trends, and Real Economic Activity

Even though the findings show a negative relationship between inflation and real stock returns, so far none of them support Fama's proxy hypothesis when both propositions of this hypothesis are regressed in isolation. Since the framework of Fama's proxy effect is based on an indirect relationship between stock returns and inflation, this study tries to examine the extent to which Fama's proxy effect is consistent and valid to explain the negative stock returns-inflation relationship (Table 3). Table 6 below reports the results from three regressions of the real stock returns or purged actual, expected and unexpected inflation.

[24] It is important to know that in their study, Ram and Spencer (1983) employ a different inflation equation, derived from a Fisher-Philips relationship, different but equally plausible variables to represent real activity, and stock returns equations of much the same character as Fama's 1981) study (see Ram and Spencer, 1983, p. 463).

Table 6: Real Stock Returns, Inflationary Trends and Real Economic Activity

Lead-Lag Specification	Real Economic Activity: Estimated & Sum of Coefficients
Model 1.	
{-3.3}	-0.0732 {1.3343]
{-5.5}	-0.3284 [1.5242]
{-7.7}	-0.2617 [1.0346]
{-9.9}	-0.3574** [2.6808]
{-11.11}	-0.3035 [1.5982]
ε_{It}	-2.4232** (-2.1451)
FPE	-0.3112* [3.0119] **{-1.1}**
	R^2 = 0.7543
	Adjusted- R^2 = 0.4342
	D-W = 1.9432
	J-B = 13.7980
Model 2.	
{-3.3}	-0.1340 {1.2186]
{-5.5}	-0.3201 [1.1023]
{-7.7}	-0.0645 [0.9978]
{-9.9}	-0.2007 [1.5899]
{-11.11}	-0.6003* [3.9873]

Table 6: (Continued)

Lead-Lag Specification	**Real Economic Activity: Estimated & Sum of Coefficients**
$\varepsilon_{\mathbf{Iit}}$ **FPE**	3.7888 (0.9008) -0.5067* [5.4178] **{-2.2}** $\mathbf{R^2}$ = 0.8975 **Adjusted-** $\mathbf{R^2}$ = 0.6321 **D-W** = 1.7879 **J-B** = 27.8131
Model 3.	
{-3.3}	-0.0921** {2.449]
{-5.5}	-0.6934** [2.3868]
{-7.7}	-0.1677 [1.599]
{-9.9}	-0.2897** [2.1023]
{-11.11}	-0.2758 [1.5756]
$\varepsilon_{\mathbf{IIIt}}$ **FPE**	-2.5424*** (-1.6001) -0.28762** [2.9977] **{-1.1}** $\mathbf{R^2}$ = 0.8998 **Adjusted-** $\mathbf{R^2}$ = 0.67543 **D-W** = 1.8632 **J-B** = 43.1750

Note:

The numbers in **(.)** and **[.]** are the t-statistics and F-statistics, respectively, used for testing the null hypothesis that estimated and coefficients' sum are equal to zero. The **{.}** is the optimal lag length based on Akaike's (1969) Final Prediction Error (FPE) criteria.

J-B and **D-W** represent the Jarque-Bera test for normality and Durbin-watson *d* test, respectively.

*****, ******, ******* denote the levels of significance of 1, 5, and 10%.

$$\underline{\textbf{Model 1.}}\quad SR_t - INF_t = \delta_0 + \delta_1 \varepsilon_{It} + \sum_{i=-k}^{k} \delta_i REA_{t+1} + \nu_t$$

$$INF_t = \mu_0 + \sum_{i=-k}^{k} \mu_i REA_{t+1} + \varepsilon_{It}$$

$$\underline{\textbf{Model 2.}}\quad SR_t - INF_t = \delta_0 + \delta_1 \varepsilon_{IIt} + \sum_{i=-k}^{k} \delta_i REA_{t+1} + \pi_t$$

$$E(INF_t) = \mu_0 + \sum_{i=-k}^{k} \mu_i REA_{t+1} + \varepsilon_{IIt}$$

$$\underline{\textbf{Model 3.}}\quad SR_t - INF_t = \delta_0 + \delta_1 \varepsilon_{IIIt} + \sum_{i=-k}^{k} \delta_i REA_{t+1} + \varphi_t$$

$$UE(INF_t) = \mu_0 + \sum_{i=-k}^{k} \mu_i REA_{t+1} + \varepsilon_{IIIt}$$

Table 6 presents the regression results of real stocks on the purged actual, expected and unexpected inflation as well as lagging, contemporaneous and leading values of real economic activity. One lagging, one contemporaneous and one leading value of real economic activity are identified as the FPE-based specification for Models 1 and 3, while two lagging, one contemporaneous and two leading values of real economic activity are identified as the FPE-based specification for Model 2.

Based on Table 6, the results from Models 1 and 3 are found to be inconsistent with Fama's proxy hypothesis where a negative relationship between real stock returns and both actual and unexpected inflation (Table 3) still persists and remains significant (Table 6) even after controlling for the inflation-real economic activity relationship[25]. The

[25] Once the effect of real economic activity on inflation has been controlled for, all the inflation rate coefficients that were significant should not be. For this purpose, Wahlross and Berglund (1986) simply test this model by including the real economic

findings also show that the independence of real stock returns on the expected inflation component is consistent with the evidence from Table 3 (Model 2). The results in Table 6 indicate a negative relationship between real stock returns and inflationary trends, which is explained by the relationship between real stock returns and both actual and unexpected inflation as evidenced by the negative significance of ε_{It} and ε_{IIIt} at the 5 and 10% levels, respectively. In general, the results from Table 3 and Table 6 are not much different. Both actual and unexpected inflation is significantly negative in affecting real stock returns even though at a lesser level of significance. These results show that Fama's proxy effect framework cannot totally explain the strong negative relationship between real stock returns and inflation for the Indonesian economy.

5. CONCLUSION

The well-documented negative relationship between real stock returns and inflationary trends in developed countries is supported by the findings regarding the Indonesian economy. A negative relationship between real stock returns and both actual and unexpected inflation has been found. This implies that the Indonesian stock market does not provide a good hedge against inflation. The changes in the inflation rate do affect real stock returns.

In an effort to explain the negative relationship between real stock returns and inflation, the study examines both propositions of Fama's proxy effect framework which centers on a negative relationship between inflationary trends and real economic activity, and a positive relationship between real stock returns and real economic activity. Fama's proxy effect fails to explain the negative relationship between real stock returns and inflation. A positive relationship between inflationary trends and real economic activity and a negative relationship between real stock returns and real economic activity that are opposite of both Fama’s propositions are found. These results are, however, in accordance with the Mundell-Tobin hypothesis which says that the negative real stock returns-inflation relationship is directly explained by a positive relationship between inflation and real economic activity and

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activity as an independent variable into the real stock returns-expected and unexpected relationship's model. Their results are not much different from those of our study.

a negative relationship between real stock returns and real economic activity. The consistency of Fama's proxy hypothesis is then tested by introducing a two-step estimation that control for the inflation-real economic activity relationship. The study finds the persistence of the negative real stock returns-inflation relationship, particularly between real stock returns and actual and unexpected inflation, even though at a lesser level of significance.

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