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Predictability Power of Interest Rate and Exchange Rate Volatility on Stock Market Return and Volatility: Evidence from Bursa Malaysia

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Abstract — **The aim of this paper is to examine the predictability power of exchange rates and interest rates' respective volatilities on stock market volatility and return using monthly Kuala Lumpur Composite Index (KLCI) returns, 3 months Malaysia Treasury bond and monthly exchange rate of Ringgit per US Dollar from 1997 January to 2009 November. The study adopts two models based on GARCH (1,1), model 1 (model 2) without (with) interest rate and exchange rate. The relationship between interest rate and exchange rate and KLCI returns are found to be negative, but significant for exchange rate and insignificant for interest rate. Insignificant relationship exists between return variance and the variables though positive for exchange rate and negative for interest rate. This means the variables have a certain degree of predictive powers for KLCI returns but weak volatility prediction.**

Keywords-GARCH; Exchange rate; Volatility; Interest rate;

I. INTRODUCTION

The study investigates the predictive powers of interest rate and exchange rate volatilities on Malaysian stock market; an assessment of KLCI. Changes in the two variables affect the value of companies stocks and hence the stock returns indirectly. The relationship has been studied significantly but most of the research where focused in the USA and well developed markets. Some empirical evidence states that there is a negative relation between interest rate and stock return and the level of interest rates and their volatilities affects the return distribution of the financial sector. Some say the relationship is not exact while others suggest that there is no equilibrium relationship between stock return and interest rate in the long run.

The role of exchange rate risk has been investigated by authors such as [3], [5] and others. Some studies have found positive relation while others found negative relationship. But it can also be argued that when exchange rate fluctuates, the value of assets and liabilities denominated in foreign currency can be greatly affected, either gain in value or drop in value. Which in turn can affect firms profitability and eventually affects the value of its stocks

In a nut shell, empirical studies that attempted to test the relation between interest rate, exchange rate and stock returns, yield mixed results and because of the mixed result we saw it fit to conduct this study. Which we hope will enrich existing literature by analysing the KLCI subjected to different interest rate and exchange rates using GARCH over the period of 1997 to 2009 which will enable us to model jointly the interest rate, exchange rate and stock return.

The purpose of this study is to examine the effects of interest rates and exchange rates volatility on the underlying stock return in the Malaysian Stock market. Specifically, we will investigate to what extent the knowledge of interest rate and exchange rate volatility both present and historical can help investors predict volatility and conditional market return and hence derive above average risk adjusted return.

II. LITERATURE REVIEW

Past literature states that there is a negative relationship between stock return and interest rate, even though the relationship is not exact. [10] investigated this relationship using the Korean Stock Price Index 200 (KOSPI 200) and weekly negotiable deposit. Results of [10] indicated that interest rates have a strong and weak predictive power for stock return and volatility respectively. These results are supported by [14] who did a similar research based on Karachi Stock Exchange monthly returns and concluded that there exist significant and negative relationship between interest rate and market return and negative but insignificant relationship between intrest rate and variance. Other past literature on these relations includes that of [12] and [4] who found that interest rate volatility is positively related to market variance but negatively related to subsequent stock returns.

[2] carried out a research on the Ghana Stock Exchange. The results indicated a negative relationship between exchange rate volatility and conditional stock returns. In another study carried by [13] in the Nigerian Stock Market, they found a negative relation between exchange rate fluctuations and the Nigerian stock market returns.

From the past literature, authors aimed to either find the effect of interest rate volatility on stock market returns or exchange rate volatility on stock market returns in Malaysia. Thus, it is hoped that this study will fill the gap in the literature, which has, so far, focused mainly on advanced economies and hence set the stage for more research in this area.

Our study differs from that of the reviewed papers because we investigate the joint effects of exchange rate volatility and interest rate volatility on market volatility and

returns.From the previous study we proposed the following hypothesis to reflect the research model:

H0: Interest and exchange rate volatility has no impact on conditional mean returns ($\gamma_2=\gamma_3=0$)

H1: Interest and exchange rate volatility has impact on conditional mean returns.

III. DATA AND METHODOLOGY

The study period ranges from January 1997 to November 2009. The data frequency selected was monthly so as to ensure an adequate number of observations. An observation lower than this (yearly) will not provide enough observation of which a reliable conclusion can be drawn from as the data will not be an adequate representation of volatility while a higher frequency will be affected by effects of settlements and clearing delays which affect returns over a shorter sampling intervals. Monthly close of Kuala Lumpur Composite Index obtained from Yahoo Finance, end of month exchange rates and 3 months Treasury bill used in this study were both obtained from International Financial Statics published by IMF. US Dollar has been used in view of the dominance of the dollar in international transaction as well as close links between the Malaysian and US economies.

Market returns (Rt) are calculated from the monthly index price as follows:

$$Rt = Ln\,(P_t/P_{t-1}) \times 100 \quad (1)$$

Where, R_t= market return at period t; Pt = Index Price at period t; Pt-1= Index Price at period t-1; Ln = natural log.

Changes in Exchange rate were obtained by:

$$\Delta s_t = \frac{s_t - s_{t-1}}{s_{t-1}} \quad (2)$$

Where S_t is the current exchange rate and S_{t-1} is the previous months' exchange rate. We use GARCH model, to model volatility in the stock markets.

Our study adopted a model used by [7] to model stock return volatility which is as follows:

$$Y_t = \gamma_0 + \gamma_1 Y_{t-1} + \varepsilon_t \quad (3)$$

$$\sigma_t^2 = \omega + \sum_{i=1}^{q} \alpha_i \varepsilon_{t-i}^2 + \sum_{j=1}^{p} \beta_j \sigma_{t-j}^2 \quad (4)$$

$$\sum_{i=1}^{q} \alpha_i + \sum_{j=1}^{p} \beta_j < 1 \quad (5)$$

Where, it is assumed that index returns have a linear relationship with its own conditional volatility and an autoregressive component respectively. Constant parameters are $\gamma_0, \gamma_1, \varpi$, α and β. Y_{t-1}, ε_{t-j}, σ^2_{t-j} are the lagged returns, innovations and variance respectively. The lag length for the equations was selected using Schwartz (1978) test results. It is assumed that p=q=1, and that error terms follow normal distribution.

To analyse the effects of interest rate and exchange rate volatilities on the monthly market returns and variance, two different models were employed. Model 1 without exchange rate and interest rate changes and model 2 with both interest rate and exchange rate. These models are mentioned as below.

MODEL 1:

$$Y_t = \gamma_0 + \gamma_1 Y_{t-1} + \varepsilon_{t-1} \quad (6)$$

$$\sigma^2_t = \omega + \alpha \varepsilon^2_{t-1} + \beta \sigma^2_{t-1} \quad (7)$$

MODEL 2:

$$Y_t = \gamma_0 + \gamma_1 Y_{t-1} + \gamma_2 E_t + \gamma_3 I_t + \varepsilon_{t-1} \quad (8)$$

$$\sigma^2_t = \omega + \alpha \varepsilon^2_{t-1} + \beta \sigma^2_{t-1} + \lambda_2 E_t + \lambda_1 I_t \quad (9)$$

Where I_t and E_t are interest rate and exchange rate at time t respectively.

IV. DESCRIPTIVE STATISTICS

Table I shows the descriptive statistics for the sample period. Stock return data series has a positive skewness and the distribution is not normal as shown by the kurtosis. The nonzero skewness and the kurtosis of the above variables suggest that the two data series are not normally distributed. The Jarque-Bera further confirms the results.

TABLE I. DESCRIPTIVE STATISTICS

Var.	Mean	Std. Dev.	Skewness	Kurtosis	Jarque-Bera
R_t	0.0222	8.0752	0.0014	5.5292	41.0446
I_t	-0.7423	8.9207	-0.6295	10.8551	406.0930
E_t	0.0025	0.0303	0.1339	23.2788	2639.173

V. DATA ANALYSIS

A. Stationarity Test

The Augmented Dickey – Fuller (ADF) test was used for stationary to the variables Et, It and Rt. The variables were found to be stationary at all levels as shown in Table II below.

TABLE II. ADF UNIT ROOT TEST

Variables	Critical Value		ADF Test Statistic
	1 %	*5%*	
R_t	-3.473382	-2.880336	-10.09088
I_t	-3.473382	-2.880336	-12.10596
E_t	-3.475500	-2.577365	-4.452398

B. Relationship Between Variables

1) Multicollinearity

As shown in Table III, no high pair-wise correlation between the independent variables have been detected, chances of multicollinearity have been reduced as all correlation between the independent variables are less than 0.8. This follows a rule of thumb suggested by [10], which says that if the zero-order correlation coefficient between two regressors is in excess of 0.8, multicollinearity should be considered a serious problem.

TABLE III. CORRELATION BETWEEN VARIABLES

Variables	R_t	I_t	E_t
R_t	1.000000	-0.192206	-0.452530
I_t	-0.192206	1.000000	0.020014
E_t	-0.452530	0.020014	1.000000

2) Auxiliary Variables and VIF

To further test for multicollinearity, auxiliary variables and VIF models where used. This is done to ensure that there is no linear relationship between the independent variables. Table IV shows the R^2 from the auxiliary regression and VIF, which is computed using R^2.

TABLE IV. AUXILIARY VARIABLES AND VIF

R^2	$VIF=1/(1-R^2)$
0.006439	1.006481

According to [10] VIF above 10 indicates that there is imperfect multicollinearity. Therefore in our case there are no signs of imperfect multicollinearity.

C. Empirical Results

Table V shows estimates of both models for the sample period. Model 1 shows estimates without the variables while model 2 shows estimates taking into account both variables.

Point estimates of conditional variance parameters are almost the same for both models, with the sum of α and β for both models less than 1. This suggests that the conditional volatility of return is quite persistent in both models. [14] stated that, "… these values also show that return volatility is mean reverting i.e no matter how much time it takes, but volatility process does return to its mean."

Mean equations of model 1 and model 2 suggest that lagged KLCI returns have insignificant impact on contemporaneous KLCI returns. Variance equation for model 1 suggests that past square KLCI residuals significantly and positively relate to volatility in stock return. Model 2 suggest that past square residuals do not significantly impact volatility in stock return.

Estimate of the λ_1 and λ_2 in the variance equation is negative for interest rates and positive for exchange rate. Both interest rate and exchange rate are insignificant.

This suggests that historical interest rate volatility has an inverse relationship with KLCI volatility. The inclusion of interest rate in model 2 for conditional variance marginally alters the estimates of ω,β and α.

These results depicts that interest rate volatility has insignificant effect on KLCI volatility, therefore does not have predictive power over volatility in Bursa Malaysia. These results are in line with [14], and opposing that of [10], [4] and [12] who found positive but insignificant value of λ.

With respect to exchange rate, the results imply that exchange rate volatility is positively related to KLCI volatility, though the relation is not significant. This is contrary to [1] who found that exchange rate volatility is negatively related to stock market return.

Including exchange rate in the conditional variance insignificantly distorts ω,β and α estimates.

TABLE V. MODEL ANALYSIS

Model	1	2
γ_0	0.6278 0.4264* (0.1409)	0.4632 0.4188* (0.2793)
γ_1	0.1508 0.0963* (0.1172)	0.0865 0.0875* (0.2921)
γ_2	-	-0.0077 0.0355* (0.7119)
γ_3	-	-29.9183 23.6036* (0.0000)**
ω	0.8588 0.5800 (0.1387)	2.7885 1.0549* (0.0183)**
α	0.1042 0.0424* (0.0139)**	0.1006 0.0645* (0.1258)
β	0.8653 0.0492* (0.000)**	0.8019 0.0749* (0.0000)**
λ_1	-	-0.6812 0.1894* (0.0564)
λ_2	-	178.7170 104.3106* (0.0942)
Adj. R^2	0.0300	0.1841

P-value in paranthesis
*Standard Error
** Significant at 5%

These results depicts that exchange rates have no predictive power over volatility of Bursa Malaysia.

D. Checking the Model

1) Diagnostic Check

Table VI shows the skewness and kurtosis for both models, which shows an improvement to the original data series. The results indicate that all models designed are fairly specified.

TABLE VI. DIAGNOSTIC CHECK

Model	*Skewness*	Kurtosis
1	-0.048003	3.498635
2	0.051636	3.173255

2) Normality Test

Table VII shows result of the normality test. The error term for both models is normally distributed.

TABLE VII. NORMALITY TEST

Model	P-val.	α	Normality
1	0.4396	0.05	Normal
2	0.8683	0.05	Normal

3) Significance Test

At 5% significance level Model 1 is not significant while model 2 is significant and the error term is normally distributed, therefore it is the best model. The low Adjusted R-square of 18.41% shows that that the variables under study account for less than half of the volatility and return of the stock markets. Table VIII shows the results of the significance level.

TABLE VIII. SIGNIFICANCE TEST

M	F-stat.	P-val.	Conclusion	Adj. R^2
1	1.1455	0.3375	Not sig.	0.0300
2	5.2880	0.0000	Sig.	0.1841

VI. CONCLUSION AND IMPLICATION

This study aims at examining the impact of interest rate volatility and exchange rate volatility on KLCI monthly returns. The dependent variable is monthly Kuala Lumpur Composite Index (KLCI) and the independent variables are interest rates and exchange rates. The study employed two models based on GARCH (1,1). Model one without both variables and model two incorporated both variables (interest and exchange rate). The study period is from 1997 to 2009. The results of this study shows that KLCI returns have significant negative relationship with exchange rates and negative relation with interest rates. The results shows strong predictability power of exchange rates on KLCI return and weak predictive power in the case of interest rate, thus we can predict KLCI returns by analyzing exchange rate. Conditional variance at the same time is negatively related to interest rates and positively related to exchange rates however both of these relationships are not significant. The results indicate that exchange rates and interest rates cannot be used to predict the volatility of the market.

The findings of the study documented that the changes in interest rates did have a negative impact on KLCI. This is consistent with the research-conducted by [6], [8] and with the interest rate theory which suggests that there is a negative relationship between stock prices and interest rates. A lower interest rates kills the motivation to save hence funds will be driven to the stock market. A higher interest rate usually has an opposite effect. According to [7] the interest rates obviously affect stock prices because of their effects on profit and competition in the market place between stocks and bonds. According to him, if interest rate rises sharply, investors enjoy high returns in the bond market, which induce them to sell stocks and buy bonds. The funds flow from the stock market to bond markets. Thus stock sales in response to rising interest rates obviously depress stock prices. If interest rates decline, the reverse occurs.

The results also indicated that there is a negative relationship between interest rates and stock prices. The findings were consistent with those found by [11]. The negative regression coefficient between exchange rate and stock prices indicates that appreciation of exchange rates resulted in the contemporaneous drop in the stock prices. Changes in stock prices are related to exchange rate changes because of its impact on the trade and the capital account of the domestic country's balance of payments. If home exchange (Malaysia Ringgit) rate increase relative to our foreign currency direct foreign investment (DFI) will decrease, the demand for our local shares will decrease which will push local share prices down and therefore decrease the stock return. On the other hands a decline in the value of home currency is expected to stimulate domestic economy activity because of increase in exports and domestic substitution for imported goods and services. Investors should therefore pay attention to the monetary policy as a mean for adjusting their investments.

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