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23 August 2013

Online at <https://mpra.ub.uni-muenchen.de/60247/>

MPRA Paper No. 60247, posted 29 Nov 2014 11:28 UTC

# Causality between Malaysian Islamic Stock Market and Macroeconomic Variables

Marjan Naseri<sup>1</sup> and Mansur Masih<sup>2</sup>

## Abstract

This paper makes an attempt to analyse the causality between Islamic stock market and three macroeconomic variables in the case of Malaysia. Although there are numerous studies investigating relationship between conventional stock market and macroeconomic fundamentals, there is a certain gap in the literature pertaining to the relationship between Islamic indices and macroeconomic variables which are becoming an interesting area of research due to fast growing force of Islamic finance. Thus, this paper examines the long-term equilibrium relationships between FTSE Bursa Malaysia Emas Shariah Index as a proxy for Islamic stock market and three selected macroeconomic variables namely, money supply, consumer price index and exchange rate. The methods applied are the Long run structural modelling, vector error correction and variance decomposition techniques. The stability of the functions has also been tested by CUSUM and CUSUM SQUARE tests. Our findings tend to suggest that there is a cointegration between Islamic stock market and chosen macroeconomic variables and as expected, macroeconomic variables have had influences on Islamic stock market in Malaysia. These findings have policy Implications in that controlling the macroeconomic variables such as, inflation rate, aggregate money supply and exchange rate will help enhance Islamic stock market in Malaysia.

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## **I. Introduction: The issue motivating this Paper**

During the last decades, the relationship between stock market index and macroeconomic variables has been an important debate subject for both financial and macro economists. Despite there are a numerous studies that investigate the causal effect relationship between stock market and macroeconomic variables, both the academics and the practitioners have not arrived at a consensus on the causality's direction among these variables. Literature reveals that asset pricing theories do not specify the underlying macroeconomic factors that influence stock prices. These studies including Chen, Roll, & Ross (1986), Fama (1981), Hamao (1988), Chen(1991), Maysami & Kho (2001), and (Paul & Mallik, 2001) have employed cointegration analysis to examine the relationships between stock returns and macroeconomic variables in developed countries like Japan, US, Australia, Canada and European countries. The outcomes of all these studies suggest that, with minor degrees of variation, fundamental macroeconomic dynamics are indeed influential factors for stock market returns.

A large amount of research has been done on the relationship between conventional stock market and macroeconomic variables; however, it is less explored in the context of Islamic stock market. Furthermore, regional stock markets such as in Malaysia have not been fully explored because of their small sizes and geographical locations. Therefore, in this paper, we motivated to examine the relationships between the FTSE Bursa Malaysia Emas Shariah Index and a set of three macroeconomic variables from the period of November 2006 to October 2013 using time-series techniques like cointegration, long run structural modelling, vector error correction, and variance decompositions.

In 2006 Bursa Malaysia, in cooperation with FTSE, introduced a new series of tradable equity indices called FTSE Bursa Malaysia Emas Shariah Index which provides a benchmark for investors seeking to make investments based on Shariah principles and helps them to make better informed decisions. The development of this instrument helps to create more opportunities for investors seeking Shariah investments to benchmark their portfolios, and the asset managers to create new products serving the investment community.

The remainder of the paper is organized as follows: Section II briefly reviews the empirical literature on the relationship between stock index and macroeconomic variables. Section III states the main objective of the study. Theoretical underpinning and methodology used in this paper mentions in sections IV and V. Followed by data, empirical results and discussions in section VI. And finally section VII, concludes and states the policy implications of the study.

## II. Literature Review

There are many empirical studies over the past few decades that tried to investigate the dynamic relationship between conventional stock prices and macroeconomic variables for both developed and developing countries. (Naik and Padhi, 2012; Samadi et al. 2012; Singh et al. 2011; Tajana and Iva, 2011; Herve et al. 2011; Bayezid, 2011; Hsing, 2011; Chong and Goh, 2005; Gunasekarage et al. 2004, Maysami and Sims, 2002; Chen et al. 1986) It is often argued that stock prices are determined by some of macroeconomic variables such as money supply, inflation, real output, exchange rate, interest rate and so on. Anecdotal evidence from the financial press indicates that investors generally believe that monetary policy and macroeconomic events have a large influence on the volatility of the stock prices. (Gan *et al.*, 2006) This implies that macroeconomic forces can influence investors' investment decision and motivated many researchers to investigate the relationship between stock price and macroeconomic variables.

Osamwonyi and Evbayiro (2012) analysed the relationship between macroeconomic variables and the Nigerian capital market index with considering yearly data of several macroeconomic variables of interest rates, inflation rates, exchange rates, fiscal deficit, GDP and money supply from 1975 to 2005 with employing Vector Error Correction Model (VECM) to study the short-run dynamics as well as long-run relationship between the stock market index and the six selected macroeconomic variables from the Nigerian economy. The major finding of their study is that macroeconomic variables influence stock market index in Nigeria. It is recommended that the adoption of appropriate economic policies will be beneficial to the stock market index and this in turn will result in needed growth in the capital market. In a similar study, Gan et al. (2006) while investigating the relationship between New Zealand stock market index and a set of seven macroeconomic variables from January 1990 to January 2003 using cointegration and Granger causality tests found out that there exists a long run relationship between New Zealand's stock market index (NZSE40) and the macroeconomic variables tested. The Granger causality test result shows that NZSE40 is not a leading indicator for changes in macroeconomic variables.

In another study, Pilinkus (2009) examined relationships between a group of macroeconomic variables and the Lithuanian stock market index, i.e. OMX Vilnius index to investigate whether stock prices may serve as a leading indicator for macroeconomic variables in Lithuanian economy or a group of macroeconomic variables may serve as a leading indicator for stock returns in Lithuania. By applying Granger causality tests to estimate the relationship between the OMXV index and 40 macroeconomic variables depicting the health of

Lithuanian economy from December 1999 to March 2008, he found that some macroeconomic variables (e.g., GDP deflator, net export, foreign direct investment, etc.) lead Lithuanian stock market returns, some macroeconomic variables (e.g., GDP, material investment, construction volume index, etc.) are led by the OMXV index and finally, some macroeconomic variables (e.g., money supply, payment balance, etc.) and the stock market returns Granger- cause each other.

With having an adverse result, Mukherjee and Naka (1995) analysed the relationship between the Japanese Stock Market and exchange rate, inflation, money supply, real economic activity, long-term government bond rate, and call money rate. They concluded that a cointegrating relation indeed existed and that stock prices contributed to this relation.

Ibrahim (2003) investigated dynamic linkages between Kuala Lumpur Composite Index (KLCI) as a proxy for Malaysian equity market and four macroeconomic variables including real output, price level, money supply and exchange rate using monthly data for the period from January 1977 to August 1998 with utilizing the methods of cointegration and Vector Autoregression. Empirical results suggest the presence of a long-run relationship between these variables and the stock prices and substantial short-run interactions among them. Besides, the result provided evidence that Malaysian stock market was informationally inefficient. Similarly, Chong and Goh (2005) in a further study postulated that stock prices, economic activities, real interest rates and real money balances in Malaysia were statistically linked in the long run both in the pre- and post- capital control sub periods. Maysami and Koh (2000) in a similar attempt declared that such relationships do exist in Singapore. They found that inflation, money supply growth, changes in short- and long-term interest rate and variations in exchange rate formed a cointegrating relation with changes in Singapore's stock market levels. However to the best of our knowledge there are not many studies that investigate the relationship between Islamic stock market and macroeconomic variables which are becoming interesting area of research due to fast growing force of Islamic finance. As a result in order to contribute to the literature, we would attempt to study the causality between Islamic stock market and some macroeconomic variables with a single country time series study in the case of Malaysia as a fast growing Islamic finance market.

### **III. The Objectives of the Study**

The main objective of this study is to investigate whether there is a relationship between FTSE Bursa Malaysia Emas Shariah Index as a proxy for Malaysian Islamic stock market and some selected macroeconomic variables such as money supply, inflation rate, and exchange

rate and to find out if any, how is the nature of this relationship. In addition, we attempt to contribute to the available literature since they are mostly assessing the causality between conventional stock indices and macroeconomic variables and to fill in the gap of the existing studies. The findings of this study will have distinct policy implications for Malaysia which is a potential global hub for Islamic finance.

#### **IV. Theoretical Underpinnings**

The impact of economic fundamentals on stock prices has been a long debated issue amongst the academicians and professionals. According to the Efficient Market Hypothesis (Fama, 1970), in an efficient market, all the relevant information about the changes in macroeconomic factors are fully reflected in the current stock prices and hence, investors would not be earned abnormal profits in such markets. If the conclusion of Efficient Market Hypothesis is to be believed; then the changes of any macroeconomic variables should not affect the stock returns much. However, conclusion drawn from the Efficient Market Hypothesis has been critically examined by subsequent studies by Fama and Schwert (1977), Nelson (1977) and many scholars which affirm that macroeconomic variables do influence the stock returns by affecting stock prices.

The Arbitrage Pricing Theory (APT) also provides theoretical framework of the linkage between stock prices and macroeconomic fundamentals. (Ross, 1976; Chen et al., 1986) In this connection, several empirical studies have shown that changes in stock prices are linked with macroeconomic fundamental. Study by Chen et al. (1986) is one of the earliest to empirically examine the link between stock prices and macroeconomic variables in the line of APT and provides the basis to believe for the existence of a long-run relationship between them. More recently, an increasing amount of empirical studies have been focusing attention to relate the stock prices and macroeconomic factors for both developed and emerging economies (Maysami et al., 2004; Ratanapakorn and Sharma, 2007; Rahman et al., 2009; Asaolu and Ogunmuyiwa, 2011). These studies conclude that stock prices do respond to the changes in macroeconomic fundamentals but the sign and causal relationship might not hold equal for all the studies.

The cointegration analysis is another approach to investigate the relationship between stock market returns and economic variables. The basis for the belief that there exists a long-term equilibrium between stock prices and economic variables was provided by Chen et al. (1986) and Granger (1986) proposed that this equilibrium relation can be verified through cointegration analysis.

Economic theory postulates that money supply, exchange rates, and inflation as well as other factors are important variables in developing a comprehensive understanding of the behaviour of stock prices and index movements.

Friedman and Schwartz (1963) examined the link between money supply and stock returns. Their study hypothesized that the aggregate economy, and therefore the expected stock returns, is affected by the growth rate of money supply. An increase in M2 growth would indicate excess liquidity available for buying securities, resulting in higher security prices. Empirically, while Hamburger and Kochin (1972), Kraft and Kraft (1977) and Hasan and Javed (2009) found a strong linkage between the two variables, Cooper (1974) and Nozar and Taylor (1988) found that there is no statistically significant link between these two variables. In this study, we hypothesize that increase in money supply will lead to increase in stock prices.

Numerous previous studies have thoroughly investigated the existence and nature of relationship between real stock returns and Consumer Price Index (CPI). The findings of previous works provide evidence on existence of both positive and negative relationship between real stock returns and CPI for various countries around the world. Bearing in mind these empirical findings, this paper would carry on with the assumption of a positive relationship between the CPI and the stock prices due to the historical information in Malaysia.

Traditional economic models argue that changes in exchange rates affect balance sheet items of a firm through its competitiveness as expressed in foreign currency and ultimately profits and equity leading to price adjustments in the capital markets. This volatility in price adjustments of individual firms leads to the impact on the index. Another theoretical argument in the relationship between stock prices and exchange rates is the portfolio adjustment approach. According to this theory, portfolio adjustments occur whenever there is a change in the stock prices. If stock prices are on the increase, they will attract more foreign capital. However, a decline in the stock prices will result in diminished corporate wealth leading to the reduction in the country's wealth. We assume a positive relationship between stock price and exchange rate in this paper.

Based on the aforementioned theoretical underpinning, the lead-lag relationship between stock index and macroeconomic variables has been tested on FTSE Bursa Malaysia Emas Shariah index, Money supply (M2), Consumer Price Index, and Real Effective Exchange Rate. All these variables are expected to have positive relationships. The causality will be

tested mainly through error correction model. Since there are four variables used in this study four equations will be held with each variable being a dependent variable.

## V. Methodology Used

In efforts to arrive at conclusive findings, the study follows a systematic time series econometric techniques of cointegration, Long Run Structural Modelling (LRSM), Vector Error Correction Model (VECM), Variance Decompositions (VDCs), Impulse Response Functions (IRFs) and Persistence Profiles for individual country (Malaysia) to examine the dynamic interactions among the variables of interest as it is more appropriate for testing the temporal or lead-lag relationship between variables.

Most economic variables are non-stationary. In other words, the Means and Variances are not constant. This means that performing ordinary regression on the variables will render the results misleading since statistical tests such as t-test and F-test will no longer be statistically valid when applied to non-stationary variables. For non-stationary variables that are cointegrated, OLS will produce misspecification equation if error-correction terms have not been undertaken. If there are non-stationary variables but not cointegrated, the differenced variables can be estimated but the result may only be valid for short run. This is because, once the variables are differenced, the theoretical elements (the long run relationship between the trend components which are normally embedded in the variables) are taken away. For valid estimation and inference to be made, a set of non-stationary variables must be cointegrated. This means that a linear combination of these variables that is stationary must exist. Conventional regression analysis also assumes a theoretical relationship based on the study and intuition of the researcher.

The methodology steps that are employed in this study are as follows: After examining the unit root tests and the order of the Vector Autoregression (VAR), the Johansen and eagle-granger cointegration tests will be applied. The test of cointegration is designed to examine the long-run theoretical or equilibrium relationship and to rule out spurious relationships among the variables. The cointegrating estimated vectors then will be subjected to exactly identifying and over-identifying restrictions based on theoretical and a priori information of the economy. The evidence of cointegration, however, cannot tell the direction of Granger causality among the variables, i.e., which variable is leading and which variable is lagging. That can be done by the test of the vector error correction model (VECM) that can indicate the direction of Granger causality both in the short and long run. The VECM, however, cannot tell us which variable is relatively more exogenous or endogenous. The variance

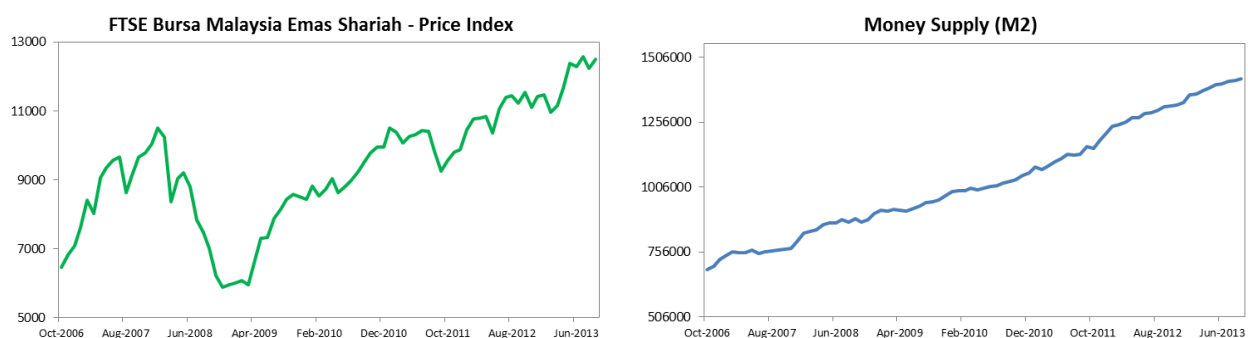


decomposition (VDC) technique is designed to indicate the relative exogeneity/endogeneity of a variable by decomposing the variance of the forecast error of a variable into proportions attributable to shocks (or innovations) in each variable in the system, including its own. The proportion of the variance explained by its own past shocks can determine the relative exogeneity/ endogeneity of a variable. The variable that is explained mostly by its own shocks (and not by others) is deemed to be the most exogenous of all. The variance decompositions also can be represented equivalently by the impulse response functions (IRFs). They are designed to map out the dynamic response path of a variable due to a one-period standard deviation shock to another variable. The IRF is a graphical way of exposing the relative exogeneity or endogeneity of a variable. Finally, one could find out the persistence profiles. They are designed to estimate the speed with which the variables get back to equilibrium when there is a system wide shock to the long-run equilibrium (Masih M. et. al, 2010).

## VI. Data, Empirical Results and Discussion

This paper investigates the dynamic causal linkage between Islamic stock market and three macroeconomic variables. The data used for this research is monthly observations starting from November 2006 to September 2013, a total of 84 months. An earlier start date was not possible since information for index measuring Shariah compliant stock investment in Malaysia was not available prior to that. The explanatory variables selected for this study are: FTSE Bursa Malaysia Emas Shariah Price Index (FTEMS) as a proxy for Malaysian Islamic stock market, Money Supply (M2), Consumer Price Index (CPI) as a proxy for inflation, and Real Effective Exchange Rate (EX) (The reason for choosing this type of exchange rate is that it is the only I (1) variable among other types of exchange rate variables in case of Malaysia). All the data were taken from the DataStream.

Preliminary observation of below graphs for each variable suggests that they are of random walk in nature.



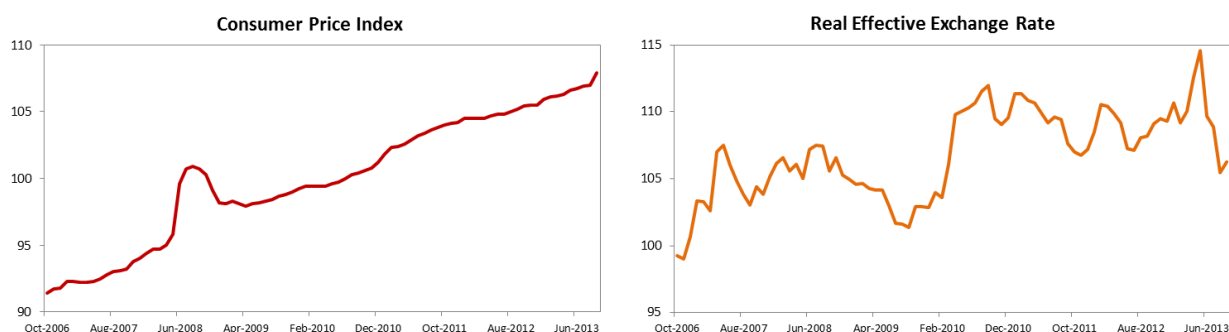


Figure 1: Graphs based on the raw data for each variable

## 1. Testing Stationarity of Variables

In this step, the objective is to test whether the variables chosen are stationary or non-stationary. This can be done by using two methods namely the Augmented Dickey-Fuller Unit Root Test (ADF) and Phillips-Perron Test (PP). A variable is stationary when its mean, variance and covariance are constant over time. In order to proceed with the cointegration testing later, the variables should be in I(1) form which means that in their level forms are non-stationary but in their differenced form, stationary.

### 1.1. Augmented Dickey-Fuller (ADF) Unit Root Test

Augmented Dickey-Fuller’s test statistic can be viewed as Dickey–Fuller statistic that has been corrected for residual autocorrelation. The null hypothesis in the ADF test is that variables are non-stationary. Based on the highest level of AIC and SBC, the corresponding test statistic of each variable is compared against its respective 95% critical value of ADF statistic. The results obtained from the ADF method are summarised as follows:

Table 1: Variables in Level Form

Variable	Test Statistic	Critical Value	Result
<b>LFTEM</b>	-2.7107	-3.4673	Variable is non-stationary
<b>LM2</b>	-2.5043	-3.4673	Variable is non-stationary
<b>LCPI</b>	-3.2695	-3.4673	Variable is non-stationary
<b>LEX</b>	-2.8792	-3.4673	Variable is non-stationary

For the differenced form of each variable, the difference of their log forms has been used.

Table 2: Variables in Differenced Form

Variable	Test Statistic	Critical Value	Result
<b>DFTEM</b>	-4.2403	-2.8991	Variable is stationary
<b>DM2</b>	-6.0357	-2.8991	Variable is stationary
<b>DCPI</b>	-4.9716	-2.8991	Variable is stationary
<b>DEX</b>	-6.1940	-2.8991	Variable is stationary

As table 1 shows all the variables in level form have lower test statistic than critical value, hence we cannot reject the null, therefore variables are non-stationary in level form. On the other hand, as exhibited in table 2, all the variables in differenced form have higher test statistic than critical value, thus we can reject the null and conclude that the variables are stationary in their differenced form. As a result, all the variables we are using for this study are I(1), which indicates that the variables have an infinite variance (it grows over time), shocks are permanent and its autocorrelation tend to be unity, thus we may proceed with testing of cointegration. The detailed results are furnished in Appendix 1A.

### 1.2. Phillips-Perron (PP) Unit Root Test

Phillips and Perron’s test statistics can be viewed as Dickey–Fuller statistics that have been corrected for both the Autocorrelation and Heteroskedasticity by using Newey–West adjusted variance method. The null hypothesis in the PP test is that variables are non-stationary.

*Table 3: Variables in Level Form*

Variable	T-Ratio	Probability	Result
<b>LFTEM</b>	-1.1714	0.245	Variable is non-stationary
<b>LM2</b>	-1.2002	0.234	Variable is non-stationary
<b>LCPI</b>	-.89034	0.376	Variable is non-stationary
<b>LEX</b>	-2.4400	0.117	Variable is non-stationary

*Table 4: Variables in Differenced Form*

Variable	T-Ratio	Probability	Result
<b>DFTEM</b>	-7.3785	0.000	Variable is stationary
<b>DM2</b>	-9.2768	0.000	Variable is stationary
<b>DCPI</b>	-9.4479	0.000	Variable is stationary
<b>DEX</b>	-12.3438	0.000	Variable is stationary

As table 3 illustrates, all the variables in level form have probability of T-Ratio more than 10 percent, hence we cannot reject the null; therefore variables are non-stationary in level form. On the other hand, as exhibited in table 4, all the variables in differenced form have probability of T-Ratio less than 1 percent, thus we can reject the null and conclude that the variables are stationary in their differenced form. As a result, PP test like ADF test shows that all the variables we are using for this study are I(1), which indicates that the variables have an infinite variance (it grows over time), shocks are permanent and its autocorrelation tend to be unity, thus we may proceed with testing of cointegration. The detailed results are furnished in Appendix 1B.

## 2. Determining Order of the VAR Model

Upon determining the stationarity of the data, the test then proceeds to determine the order of the Vector Auto Regression (VAR) that is the number of lags to be used. The following results were obtained (see Appendix 2A):

*Table 5: Order of VAR Model*

Choice criteria	Optimal Order
<b>AIC</b>	6
<b>SBC</b>	0

We chose the optimum lag corresponding to the highest value of AIC and SBC as the selection criteria. Normally AIC will select a higher order compared to SBC. Although the result shows the optimal order is 6 and 0 under AIC and SBC. As illustrated in below table, further investigations have been done to examine whether there is serial correlation in each equation. (Details in Appendix 2B)

*Table 6: Serial Correlation Diagnostic*

Variable	Chi-Square Result ( p-value)	Implication (at 10%)
<b>DFTEM</b>	0.027	There is Serial Correlation
<b>DM2</b>	0.128	There is no Serial Correlation
<b>DCPI</b>	0.114	There is no Serial Correlation
<b>DEX</b>	0.326	There is no Serial Correlation

Results show that among four variables, one has serial correlation. Then lower order than 2 may encounter the effects of serial correlation. We decided to choose lag order 2 as the optimum lag due to not having a long time series data (84 observations) to avoid the risk of over parameterization, and also to lower the loss in the degree of freedom.

## 3. Testing Cointegration

Cointegration implies that the relationship among the variables is not spurious i.e. there is a theoretical relationship among the variables and they are in the equilibrium in the long run. It also indicates that each variable contains information for the prediction of other variables. Although cointegration indicates the presence or absence of Granger-causality, it does not indicate the direction of causality between variables. This direction of the Granger causality can be detected through the vector error correction model derived from the long run cointegrating vectors.

In this study, we employ the Engle-Granger and Johansen methods of testing for the presence of cointegrating vectors. In Engle-Granger method we are testing the stationarity on the residual whereas under Johansen method, determination of cointegration is derived from Maximal Eigenvalue and Trace statistics.

### 3.1. Engle-Granger Test

Table 7: Engle-Granger Test Result

Variable	Test Statistic	Critical Value	Result
<b>Residual</b> ADF(2)	-3.3287	-2.2413	Variable is stationary

The above table shows that at lag 2, test statistic of -3.3287 is greater than the 95% critical value of -2.2413. Therefore, the null hypothesis which says that there is no cointegration can be rejected which means that error term (residual) is stationary and there is one cointegrating relationship in this model. (See Appendix 3B)

### 3.2. Johansen Test

The determination of cointegrating vectors is based on the Maximal Eigenvalue and the Trace tests.

Table 8: Maximal Eigenvalue and Trace test results

Null	Alternative	Statistic	95% Crit.	90% Crit.
<b>Maximal Eigenvalue statistics</b>				
r = 0	r = 1	32.5628	31.7900	29.1300
r <= 1	r = 2	20.6193	25.4200	23.1000
<b>Trace Statistics</b>				
r = 0	r = 1	66.2481	63.0000	59.1600
r <= 1	r = 2	33.6853	42.3400	39.3400

From the above table, we can conclude that there exists one cointegrating relationship among the variables at 95% significance level on the basis of maximal eigenvalue and trace statistics. The evidence of a cointegrating relationship implies that there is a common force that brings variables together in the long term and the relationship is not spurious.

## 4. Long Run Structural Modeling (LRSM)

After determining the number of lags and cointegrating relationship, we use Long-Run Structural Modelling to estimate theoretically meaningful long-run relations among the variables based on theories. We impose restrictions on identifying and over identifying to see

the relations of the variables based on theories. The exact identifying on the variables is on LFTEMS i.e.  $A_1 = 1$ .

*Table 9: Exact and Over Identifying Restrictions on the Cointegrating Vector*

Variable	Panel A	Panel B
LFTEMS	1.0000 (*None*)	1.0000 (*None*)
LM2	1.6014 (2.7191)	0.0000 (*None*)
LCPI	16.3784* (4.1095)	16.6062* (3.8240)
LEX	4.9101* (2.3015)	4.8923* (1.8837)
Trend	-0.0505 (0.0250)	-0.0368 (0.0078)
Chi-Square	None	0.42617 [0.514]

The results illustrated in Panel A of table 9 show that with imposing a normalizing restriction of unity on the FTSE Bursa Malaysia Emas Shariah index (FTEMS), the inflation rate (CPI) and the exchange rate (EX) are significant which means that these two variables affect the normalized variable (FTEMS), so we can keep these variables in the equation. But money supply (M2) is insignificant. To further test the significance of M2, the over identifying restriction is applied on M2 with  $A_2 = 0$  which depicted in Panel B. With this restriction, CPI and EX remain significant but still M2 is not statistically significant with  $CHSQ(1) = 0.42617$  [0.514], hence suggests that the restriction cannot be rejected. Intuitively, according to the theories mentioned earlier, we are more inclined to believe that M2 is a significant variable and affects FTEMS. As a result we keep that variable and proceed with Panel A for the remainder of the analysis.

## 5. Vector Error Correction Model (VECM)

So far study has established that the variables are cointegrated to a significant degree. However, the cointegrating equation reveals nothing about causality, to say which variable(s) is/are the leader variables and which variable(s) is/are the follower variable. Information on direction of Granger-causation can be particularly useful for investors. By knowing which variable is exogenous and endogenous, investors can better forecast or predict expected results of their investment. Vector error correction model allows us to ascertain which variables are in fact exogenous and which are endogenous. At least one of the ECM terms ( $e_{t-1}$ ) should be significant for the validity of the cointegrating relationship among the variables in the long term. If the error correction coefficient in any equation is insignificant (using t-test), that implies that the corresponding dependent variable of that equation is exogenous. It means that the variable does not depend on the deviations of other

variables and that it is a leading variable and initially receives the exogenous shocks resulting in deviations from equilibrium and transmits the shocks to other variables. But if the coefficient is significant, it implies that the corresponding dependent variable is endogenous. This variable depends on the deviations of other variables and that it bears the brunt of short-run adjustment to bring about the long-term equilibrium among the cointegrating variables. The size of the coefficient of the error correction term indicates the speed of a short term adjustment to bring about long term equilibrium and it represents the proportion by which the disequilibrium in the dependent variable is being corrected in each short period. The size is also an indicative of the intensity of arbitrage activity to bring about equilibrium.

*Table 10: Error Correction Model*

Dependent Variables	dLFTEMS	dLM2	dLCPI	dLEX
dLFTEMS (-1)	-0.117 (0.104)	0.578 (0.465)	-0.058 (1.077)	0.138 (0.393)
dLM2(-1)	-0.030 (0.025)	0.093 (0.113)	0.250 (0.261)	0.044 (0.095)
dLCPI(-1)	0.017 (0.011)	0.052 (0.049)	0.546 (0.114)	0.075 (0.042)
dLEX(-1)	-0.042 (0.032)	0.182 (0.141)	0.355 (0.327)	0.145 (0.119)
ECM(-1)	0.160* (0.028)	-0.013*** (0.007)	-0.003 (0.003)	-0.021** (0.018)
Chi-Sq. SC(12)	14.135 (0.292)	16.760 (0.159)	7.206 (0.844)	14.478 (0.271)
Chi-Sq. FF(1)	1.855 (0.173)	0.883 (0.348)	1.386 (0.116)	0.975 (0.323)
Chi-Sq. N(2)	77.3714 (0.000)	2.3847 (0.497)	5836.7 (0.000)	14.210 (0.001)
Chi-Sq. Het(1)	0.027 (0.959)	0.462 (0.497)	1.1142 (0.291)	0.233 (0.629)

Note: Standard Errors are given in parenthesis. The diagnostics are Chi-squared statistics for: Serial Correlation (SC), Functional Form (FF), Normality (N), and Heteroskedasticity (Het).

\* Indicates significance at 1% level. \*\* Indicates significance at 5% level. \*\*\* Indicates significance at 10% level.

By examining the error correction term given in table 10, we found that there is only one exogenous variable, CPI, and other variables were found to be endogenous. However if we consider the significance level at 5%, M2 would be exogenous as well. VECM cannot tell us the relative degree of endogeneity and exogeneity of the variables. Inflation, being the exogenous variable, would receive market shocks and transmit the effects of those shocks to other variables. An investor who invests in say, the FTSE Bursa Malaysia Emas Shariah index, would be interested to monitor movements in the inflation, as changes to this variable is likely to affect his/her investments in a significant way. For further details see Appendix 5A-D.

In addition the diagnostics of all the equations of the error correction model which are testing the presence of serial correlation, functional form, normality and Heteroskedasticity tend to indicate that the equations are well-specified. Besides we tested the stability of the coefficients by the CUSUM and CUSUM SQUARE tests which have been illustrated in Figure 2 and 3. These tests indicate that there is a structural break in the period under analysis, which can be the reason for problem of normality in the equations. But we have not used the dummy variables to correct them.

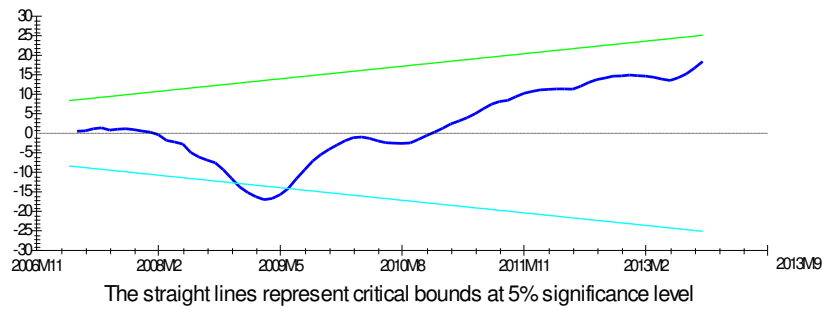


Figure 2: Plot of Cumulative Sum of Recursive Residuals (CUSUM)

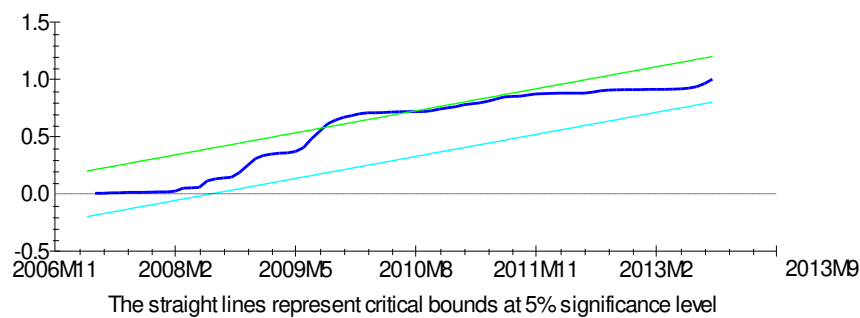


Figure 3: Plot of Cumulative Sum of Squares of Recursive Residuals (CUSUM SQUARE)

## 6. Variance Decompositions (VDCs)

After identifying which variables are exogenous and which are endogenous, the variables are subjected to VDCs to determine which of the exogenous variables is the most exogenous and which of endogenous variables is the most endogenous. The relative endogeneity can be determined by decomposing the variance of forecast error of each variable into proportions attributable to shocks from each variable in the system including its own. The most exogenous variable is the variable whose variation is explained mostly by its own past variations.

VDCs can be done by two methods which are Orthogonalized and Generalized Variance Decompositions. The proportions in the Orthogonalized are added up to become 100%



while in generalized the proportions do not add up to 100%, as such one should make sure to convert the proportions will add up to 100%.

Other than this difference, there are two other differences between the Orthogonalized and the Generalized VDCs. The Orthogonalized VDCs are not unique and in general the results depend on the particular ordering of the variables in the VAR but the generalized VDCs are invariant to the ordering of the variables. The Orthogonalized VDCs assume that when a particular variable is shocked, all other variables in the system are switched off but the Generalized VDCs do not make such a restrictive assumptions. If one variable is shocked, other variables allow changing but it is difficult to isolate.

*Table 11: Percentage of forecast variance explained by innovations in: Orthogonalized Variance Decompositions*

Horizon	LFTEMS	LM2	LCPI	LEX
Relative Variance in LFTESM				
12	<b>11.9</b>	1.4	86.3	0.4
36	6.2	1.5	91.7	0.5
60	5.3	1.6	92.6	0.6
Relative Variance in LM2				
12	3.4	<b>92.3</b>	4.2	0.0
36	4.2	89.5	6.2	0.1
60	4.3	89.0	6.6	0.1
Relative Variance in LCPI				
12	0.3	0.4	<b>89.5</b>	9.8
36	0.6	0.7	86.7	12.0
60	0.6	0.8	85.9	12.6
Relative Variance in LEX				
12	1.2	0.4	3.5	<b>94.9</b>
36	1.2	0.2	4.3	94.4
60	1.2	0.2	4.4	94.3

*Table 12: Percentage of forecast variance explained by innovations in: Generalized Variance Decompositions*

Horizon	LFTEMS	LM2	LCPI	LEX
Relative variance in LFTESM				
12	<b>12.0</b>	1.2	85.5	1.3
36	6.4	1.3	91.4	1.0
60	5.4	1.3	92.4	0.9
Relative variance in LM2				
12	3.4	<b>89.6</b>	6.7	0.3
36	4.1	86.1	9.4	0.3
60	4.3	85.4	10.0	0.3

Relative variance in LCPI				
12	0.4	0.4	<b>97.2</b>	2.0
36	0.6	0.9	95.7	2.8
60	0.7	1.0	95.3	3.0
Relative variance in LEX				
12	1.4	0.5	4.1	<b>94.1</b>
36	1.4	0.2	5.4	93.0
60	1.5	0.2	5.6	92.8

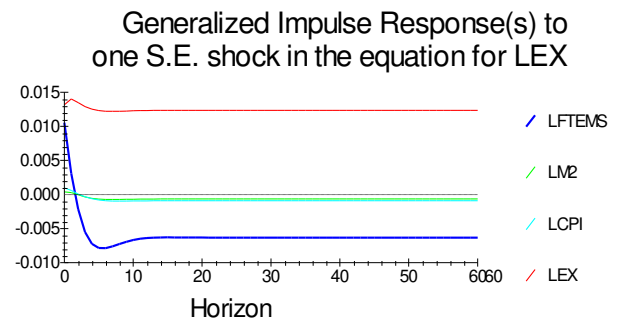
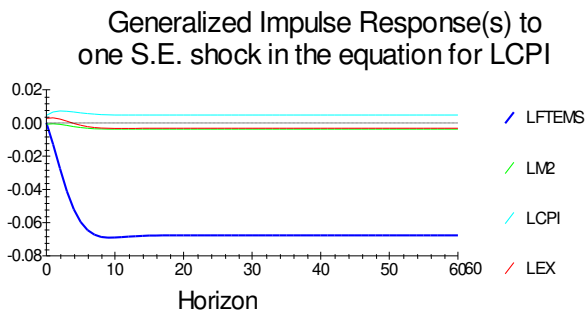
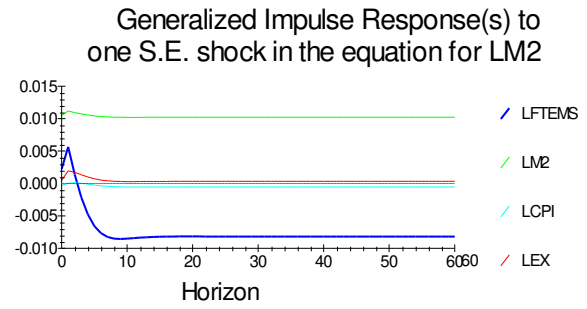
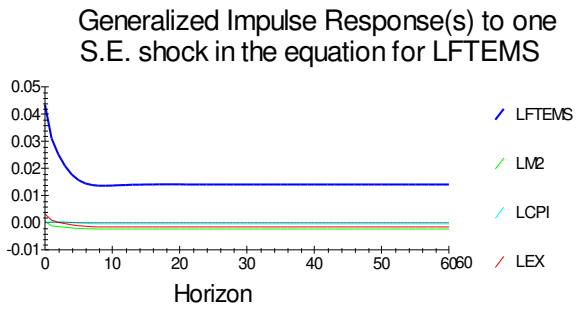
From table 11 and table 12, the results of Orthogonalized and Generalized VDC have been summarized in the below table by ranking for different horizons.

	Orthogonalized	Generalized
1	EX	CPI
2	M2	EX
3	CPI	M2
4	FTEMS	FTEMS

Due to the limitations of Orthogonalized VDC, the results of the Generalized VDC are more reliable. In this case, the result indicates that inflation (CPI) is the most exogenous, followed by exchange rate and money supply. The least exogenous or in other words, the most endogenous variable is FTSE Bursa Malaysia EMAS Shariah index (FTEMS). This result is consistent with the result given by VECM test i.e. FTEMS is the endogenous variable.

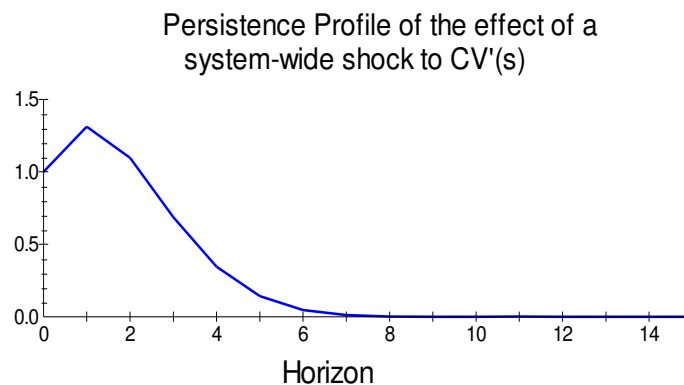
## 7. Impulse Response Function (IRF)

The impulse response functions essentially produce the same information as the VDCs, except that they can be presented in graphical form in Orthogonalized and Generalized forms. The result of VDCs can also be depicted in graphical terms. The IRFs essentially map out the dynamic response of a variable owing to one period standard deviation shock to another variable. The IRFs are normalized such that zero represents the steady-state value of the response variable. Once the individual variable is shocked, there is an increased disturbance however it does not die out over a time horizon of 60. (See the Orthogonalized IRFs in Appendix 7A)



## 8. Persistence Profile (PF)

The persistence profile illustrates the situation when the entire cointegrating equation is shocked, and indicates the time it would take for the relationship to get back to equilibrium. Here the effect of a system-wide shock on the long-run relations is the focus instead of variable-specific shocks as in the case of IRFs.



The above chart indicates that it would take approximately seven months for the cointegrating relationship to return to equilibrium following a system-wide shock.

## VII. Conclusion and Policy Implications

The focus of this study is to investigate the dynamic relationship between FTSE Bursa Malaysia Emas Shariah Index as a proxy for Islamic stock market in Malaysia and three macroeconomic variables namely, money supply, consumer price index and exchange rate. The analysis relies on time series techniques of cointegration and VARs to uncover the long-run relationship among the variables using monthly data from November 2006 to October 2013. From the VAR, we compute variance decompositions and simulate impulse response functions to trace the strength of the Granger causal links among them and the responses of a variable to innovations in other variables. The presence of cointegration between Islamic stock index and macroeconomic variables indicate long-run predictability of the Malaysian stock prices. It means that in long run movements in the Islamic stock indices are tied to the macroeconomic fundamentals. From the analysis has been done, it can be concluded that economy plays an important role on the Islamic stock market in Malaysia. Our findings are in line with the studies stated that macroeconomic events have a large influence on the volatility of the stock prices. The major policy implication of the findings is that controlling the macroeconomic variables such as inflation, aggregate money and exchange rate will help enhancing Islamic stock market in Malaysia. The present study is limited to only three selected macroeconomic variables. Inclusion of more variables with a longer time period may improve the results. A logical extension of the study can be done by including more variables and different types of Islamic stock indices.

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