The Relationship between Exchange Rates and Islamic Indices in Malaysia FTSE Market: A Wavelet Based Approach

Ayub, Aishaton and Masih, Mansur

INCEIF, Malaysia, INCEIF, Malaysia

24 August 2013

The Relationship between Exchange Rates and Islamic Indices in Malaysia FTSE Market: A Wavelet Based Approach

Aishahton Ayub[1] and Mansur Masih[2]

The issue of relationship between exchange rate and stock market is still not conclusive even though many studies have been done and the results are mixed. There is no theoretical consensus on the relationship between stock prices and exchange rates. Thus, this paper aims to examine the relationship between exchange rate and Islamic stock return in Malaysia FTSE market and identify the direction of causation between these two variables by using a time scale decomposition analysis based on the theory of wavelets. In particular, we apply the maximum overlap discrete wavelet transform (MODWT), wavelet variance, wavelet correlation and cross-correlations to analyze the association as well as the lead/lag relationship between the two series at different time scales. The findings based on the time-scale decomposition analysis indicate that the relationship between stock returns and exchange rate is not fixed over different time scales and, in particular, the stock returns are leading exchange rate at the shortest scales, i.e. at scales corresponding to periods of 2-4 days. However, in scales with 8-16 days and 64 days and longer, the stock returns and exchange rate mainly lead each other indicating a bidirectional relationship. Such a result accords quite well with the conventional wisdom which suggests that the investors with longer term horizons are likely to be linked with the macroeconomic fundamentals in their investment activity.

Keywords: Multi-scale approach, interest rate, exchange rate, Islamic Indices in Malaysia FTSE market, wavelet transform (MODWT), wavelet variance, wavelet cross-correlation, Granger causality

[1] Graduate research student, INCEIF, Lorong Universiti A, 59100 Kuala Lumpur, Malaysia.

[2] **Corresponding author**, Professor of Finance and Econometrics, INCEIF, Lorong Universiti A, 59100 Kuala Lumpur, Malaysia. Email: mansurmasih@inceif.org

1.0 Introduction: The Issue Motivating The Paper

The stock market has become important in the economy of a country in which it plays a vital role in developing capital formation and sustaining economic growth that eventually affects the economy of the country to a great extent. For instance, if stock values are high it indicates strength in the economies. Hamrita and Trifi (2001) expressing the fact that stock market indices have become an indication of the health of the economy of a country indicates the importance of stock markets. In addition, the growing importance of the stock market has led to researchers to investigate the factors that can cause changes in stock prices and also in formulating theories to describe the working of the stock markets. As a result, there are many theories related to the stock market.

In this study, we attempt to focus more on the relationship between stock prices and exchange rate. Why do we choose the exchange rate as a factor affecting stock prices or vice versa? We tend to believe that the relationship between the stock prices and exchange rates is important since it has impact on the decisions of monetary and fiscal policy. A study done by Gavin (1989) and Dimitrova (2005) shows that a booming stock market has a positive effect on aggregate demand and if the stock market boom is large enough, the real exchange rate and interest rate will be neutralized by an expansion of monetary policies and contraction of fiscal policies. The policy makers have suggested that in order to boost the export sector there is a need to reduce currency exchange rate but at the same time, it is important for the policy makers to be aware whether such policy might depress the stock market activities. They also have explained that they should understand the relationship between the stock market and exchange rate because it will assist to predict the possibility of financial downturn, in addition it would help the multinational corporations in stabilizing their profits by managing their foreign exchange rate risks and foreign exposure. Furthermore they express the view that the currency being more often an asset in investment funds' portfolios, the knowledge about the link between currency and the other assets in a portfolio is vital for the performance of the fund.

Knowledge of the factors that affect the behavior of stock market and exchange rates has attracted more attention from the economists, policy makers and the investment community for a long time. As we mentioned earlier, it is important that we estimate the relationship between stock market and exchange rates. This is because both of these variables essentially play important roles in influencing the development of a country's economy. However, the current literature in financial economics offers differing views about

the relationship between stock prices and exchange rates. In short, the relationship between stock prices and exchange rates has become an issue as to whether they are related or not? If yes, what is the direction of causation between them? However, many previous studies have examined these issues and the results and empirical evidence obtained are mixed. Some studies have found the relationship between stock prices and exchange rates is positive and others found a negative relationship. Likewise on the issue of causation, some studies have found causation runs from exchange rates to stock prices, while others reported a reverse causation. These arguments will be discussed in the theoretical and literature review section. We can conclude that there is no theoretical or empirical consensus on the relationship and causation between stock prices and exchange rates.

This conflict in the relationship between stock prices and exchange rates makes us motivated to study this issue in more depth. Therefore, we decided to study the Malaysian stock market as a case study in estimating the relationship between the stock and exchange rate. Why do we choose a Malaysian stock market as a case study? The reason is that this country has earned a reputation as one of the leading global centers for Islamic finance and product innovation – with a wide range of sophisticated Shari'ah-compliant products underpinned by a comprehensive regulatory infrastructure. Indeed, the development of products with broader international appeal complements the SC's overall strategy to expand its linkages with other major Islamic capital markets.

In this study we use the FTSE Bursa Malaysia index as a measure of stock return. FTSE Bursa Malaysia index is the index to measure the activity of Bursa Malaysia. FTSE group and Bursa Malaysia joined together in the year 2006 on 26 June and they launched a FTSE Bursa Malaysia index series. FTSE Bursa Malaysia index is helpful to the investors since it allows them to do cross border analyses and a comparison for the management of the index series. The FTSE Bursa Malaysia index series includes seven benchmark indices like FTSE Bursa Malaysia KLCI, FTSE Bursa Malaysia mid 70 index, FTSE Bursa Malaysia top 100 index, FTSE Bursa Malaysia small cap index, FTSE Bursa Malaysia fledgling index and FTSE Bursa Malaysia EMAS index.

However in this paper, we focus more on the Islamic market portfolio that consists of FTSE Bursa Malaysia EMAS Index and FTSE Bursa Malaysia Hijrah Shariah. Then, we attempt to compare with the conventional market portfolio (e.g. FTSE Bursa Malaysia KLCI Index, FTSE Bursa Malaysia top 100 Index and FTSE Bursa Malaysia EMAS Index) and

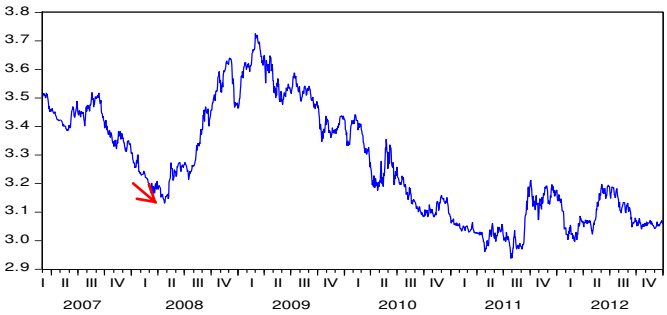
finally look at the comparison between both market indices. Figure 1 below indicates the movement of FTSE indices and exchange rate in Malaysia. As we can see during 2008 financial global crisis, the stock prices and exchange rate declined. In addition the figure 1 indicates a positive relationship between stock prices and exchange rate in Malaysia over the period 2008 to 2012.

The main purpose of the present study is to extend the existing literature on the stock market by introducing a recent method to estimate the relationship between Islamic stock indices and exchange rate at different time scales. Therefore, we attempt to introduce a wavelet analysis to find the empirical evidence of the relationship between Islamic stock indices and exchange rate and the direction of causation as to whether they are related at different time scales or not. This will also benefit the policy makers and investors to make their decisions in their investment activities, in particular.

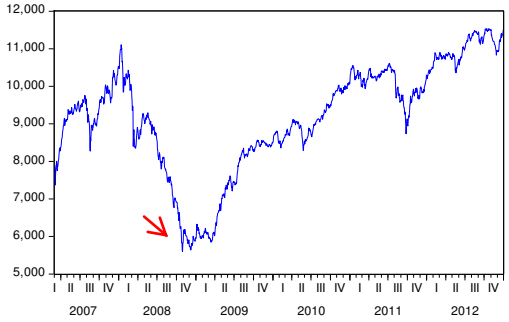
The remainder of paper is organized as follows. The next section is the objective of this paper in section 2. The theoretical framework is described in section 3. The reviewing of some selected existing studies on the stock market and exchange rate is discussed in section 4 and then the very recent methodology used in section 5. Section 6 reviews the data, empirical results and discussions while section 7 concludes the study and gives some policy implications.

Figure 1: The daily movement of Exchange Rate and FTSE Indices in Malaysia

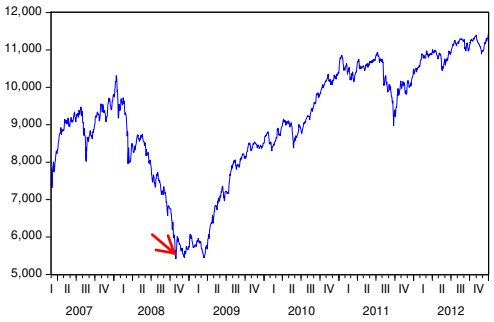
MYR - USD



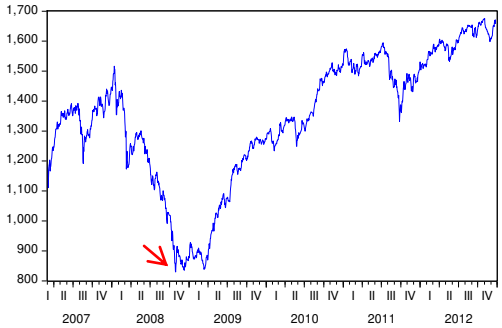
FTSE Bursa Malaysia EMAS SHARIAH



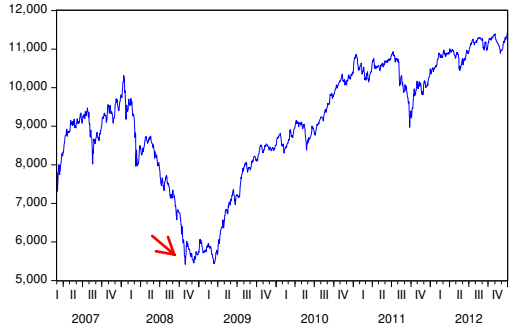
FTSE Bursa Malaysia HIJRAH SHARIAH



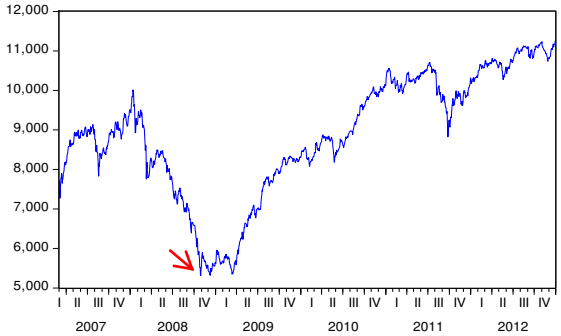
FTSE Bursa Malaysia KLCI



FTSE Bursa Malaysia EMAS



FTSE Bursa Malaysia TOP100



2.0 The Objective of the Study

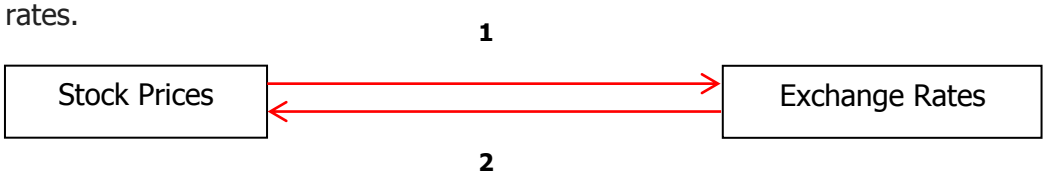
The main objective of this study to examine the relationship between exchange rate and FTSE indices in Malaysian market especially on the Islamic portfolio (FTSE Malaysia Emas Shariah and FTSE Malaysia Hijrah Shariah) and the direction of causation at different time scales which will have distinct policy implications.

3.0 Theoretical Framework

Theoretical framework is developed, described and explained network of associations among variables of interest to the research study. Therefore, one economic factor is selected to test the relationship with the stock market indices in Malaysia. The variable that is a concern in this study is exchange rate as a factor economy and the stock market indices consists of FTSE Bursa Malaysia EMAS SHARIAH Index (FTBMEMS) and FTSE Bursa Malaysia HIJRAH SHARIAH Index (FTBMHJS) as a measure for the Islamic stock market indices and FTSE Bursa Malaysia KLCI Index (FBMKLCI), FTSE Bursa Malaysia EMAS Index (FTBMEMA) and FTSE Bursa Malaysia TOP 100 Index (FTBM100) as a measure for the conventional stock market indices.

Before we discuss on the classical theory that explained the correlation between stock market and exchange rate, we intend to describe the important of the related variables in addressing the issue of relationship and also the direction of causation. Exchange rates play the role of balancing the demand for the supply of assets. For instance, an increase in domestic stock prices lead individuals to demand more domestic assets, if buy more domestic assets local investors would sell foreign assets (in this situation they are relatively less attractive now) then causing local currency appreciation. The currency appreciation means a lowering of decrease in the exchange rate, so the relationship between stock prices and exchange rate is negative. Another channel that we can observe for the negative relationship is increase in foreign demand for domestic assets due to stock price increase and this would cause a domestic currency appreciation. The positive relationship between stock prices and exchange rates with direction of causation running from exchange rates to stock prices can be described as follows: domestic currency depreciation makes local firms more competitive, leading to an increase in their exports and then will raise their stock prices.

Here the diagram that indicates the direction of causation between stock prices and exchange rates.



1) If stock prices and exchange rates are related and the causation runs from stock prices to exchange rates, then authorities can focus on domestic economic policies to stabilize the stock market.
2) If stock prices and exchange rates are related and the causation runs from exchange rates to stock prices, the crises in the stock market can be prevented by controlling the exchange rates.

There are two models that are related with the relationship between stock prices and exchange rates in which come from the Classical economic theory. This theory hypothesizes that stock prices and exchange rates can interact by way of the 'flow oriented' and 'portfolio balance' models.

According to Dornbusch and Fisher (1980), postulate that exchange rate movements cause stock price movements. In language of Granger-Sim causality, this is termed as 'uni-directional' causality running from exchange rates to stock prices, or that exchange rate 'Granger-cause' stock price. However, this approach is built on the macroeconomic view that as stock prices represent the discounted present value of firm's expected future cash flows, any phenomenon that affects a firm's cash flow will be reflected in that firm's stock prices if the market is efficient as the Efficient Market Hypothesis (EMH) suggests. Abdalla and Murinde (1997) investigate the interactions between the exchange rates and stock prices in the financial market of India, South Korea, Pakistan and the Philippines over the period from January 1985 to July 1994. By employing the monthly data in a form of bivariate vector autoregressive (VAR) model, their finding supports the "flow-oriented" model such that exchange rate changes lead stock prices in India, Pakistan and South Korea.

The second model is a 'stock-oriented' or 'portfolio balance approaches' is developed by Branson et. al (1977) postulates the opposite to flow models, which is the movements in stock prices can cause changes in exchange rates via capital account transactions. In the other words, we can say the movements of currency influence a firm's earnings and hence

causes change in stock prices. Simpsom and Evans (2009) has expressed that the buying and selling of domestic securities in foreign currency (either by foreign investors or domestic residents moving funds from offshore into domestic equities) in response to domestic stock market movements has a flow through effect into the currency market. The equity is being part of wealth and it may affect the exchange rates through demand for money. For instance, higher stock price may result in higher demand for money with ensuing higher interest rate. This, in turn would attract foreign capital flow to the country and result in appreciation of domestic currency.

Theoretically, there are two contrasting views on the linkages between stock price and exchange rate. This also can make an empirical analysis of the direction of causality between stock prices and exchange rates. Although theory such the flow and portfolio models hypothesize that a relationship should exist between stock prices and exchange rates, the results of evidence on this relationship is mixed. However there are many studies had examined about the relationship between stock prices and exchange rate and also the direction of the causal relationship empirically. Among the empirical studies that are used to address these issues by using Johansen cointegration technique, Vector Error Correction Modeling and the standard Granger causality test. However, the theoretical or empirical answers are still inconclusive and there is a need for an empirical answer to the issue raised.

4.0 Literature Review

A large number of studies have investigated the relationship between stock prices and exchange rates for a variety of countries and also using a variety of approaches. However, the issue of the relationship between stock prices and exchange rates are still inconclusive even though many studies are done in context to find the evidence empirically. The empirical results are no consensus about the relationship between stock prices and exchange rates. Moreover, the direction of causality also still remains unresolved in both theory and empirical. In this section, we will discuss some of literature about the relationship and direction of causation between stock prices and exchange rates.

The first study that examined about the relationship between stock prices and exchange rates is by Franck and Young (1972) which is they are using six different exchange rates. They found no uniform relationship between these two financial variables. According to Ang and Ghallab (1976), they found that the stock prices did not reflect

anticipation to devaluation but they adjusted rapidly once the devaluation occurred. In their studies, they examined about the reaction of fifteen US MNC's stock returns to US dollar fluctuation from August 1971 to March 1973.

Aggarwal (1981) explored the relationship between change in the dollar exchange rates and change in indices of stock prices over the period 1971 to 1978 and they found that there is a significantly positive effect on the stock prices of US firms from the trade-weighted exchange rate of the dollar. The results indicates that the stock prices will increase when there is raise in the revaluation of US dollar and also found that there is a coincidental relationship between these two variables rather than a predicted one. This is a similar result with the study are handled by Soenen and Hanniger (1988) indicates that a statistical significant negative impact of revaluation on stock prices.

A study by Ratner (1993) using a cointegration technique to determine the nature of relationship between U.S stock prices and U.S Dollar exchange rate. He found that these two financial markets were not related because he could not reject the null hypothesis of no cointegration. Ajayi and Mougoue (1996) also conducted research on relationship between financial markets in developed economies. They studied between capital and currency markets in seven advanced economies such as Canada, France, Italy, Germany, Netherlands and Japan. The results are obtained indicate an increase in aggregate domestic stock price has a negative short-run effect on domestic currency value but in the long-run increases in stock prices have a positive effect on domestic currency value. However, currency depreciation has a negative short-run effect on the stock market. By employed the cointegration technique and tested the long run relationship of stock indices with changes in exchange rates in nine Asian markets, Amare and Mohsin (2000) found that from the period 1980 to 1998, stock prices of only Singapore and Philippine were positively related to exchange rates. Nieh and Lee (2001) supported asset market approach of relationship between stock market and exchange rates with conducted research in G-7 countries and employed two cointegration techniques (Engle-Granger and Johansen's cointegration). However, they did not find any significant relationship between two financial markets over the long run but they found ambiguous and significant short run relationship in these economies.

According to Muhammad and Rasheed (2002) by employed the cointegration, vector error correction modeling technique and standard Granger causality , they did not found any

short-run relationship between stock prices and exchange rates for all countries (Pakistan, India, Bangladesh and Sri Lanka). There is no long-run relationship between stock prices and exchange rates for Pakistan and India as well except Bangladesh and Sri Lanka there appear to be a bi-directional causality between these two financial variables.

Kim (2003) adopted the multivariate cointegration and error correction model in analyzing the relationship between stock and foreign exchange markets in the U.S. from 1974 to 1998. He found that the stock prices and exchange rates whether in the long or short run, are negatively correlated. Ibrahim and Aziz (2003) used monthly data of stock prices, exchange rates, and money supply in Malaysia from 1977 to 1998. The result also shows the relation between stock and foreign exchange markets is negative; when domestic currency depreciates, the stock prices will also decrease.

A study conducted by I-Chun Tsai (2011) using monthly data of the stock and foreign exchange markets in Singapore, Thailand, Malaysia, the Philippines, South Korea, and Taiwan from January 1992 to December 2009, found that negative relation between stocks and foreign exchange markets. He also expressing that the negative relationship is more obvious when the exchange rates are extremely high or low. Phylaktis and Ravazzolo (2005) were examined the long-run and short-run dynamics between stock prices and exchange rates and the channels through which exogenous shocks impact on these markets by using cointegration methodology and multivariate Granger causality tests. They explained that the evidence suggests that stock and foreign exchange markets are positively related and that the US stock market acts as a conduit for these links. They documented that these links are not found to be determined by foreign exchange restrictions. However through the application of recursive estimation, they found that the evidence shows that the financial crisis had a temporary effect on the long-run co-movement of these markets.

Mazila Md-Yusuf and Hamisah Abd Rahman (2013) examined the Granger causality effect between Malaysia equity market and exchange rate volatility. They used multivariate vector autoregression (VAR) framework estimations to capture the interactions between the equity market performance and exchange rate volatility. The results showed that there was a feedback interaction between Malaysia equity market and exchange rate volatility. However, in terms of the sectoral market performance, only the Industrial and Finance sectors that showed similar results as the overall market.

In context of the direction of causation between stock prices and exchange rates also still inconclusive. There is many studies have examined about these two variables. In emerging market analysis, the 1997 Asian currency crisis motivated several researchers to dwell on the causality between exchange rates and stock prices (see Granger et al., 2000; Pan, Fok and Liu, 2007). Granger et al. (2000) reported that exchange rates influence stock prices in Korea, but it is the opposite in Hong Kong, Malaysia, the Philippines, Singapore, Thailand and Taiwan. They also found no relationship between the two variables in Japan and Indonesia. Pan, Fok and Liu (2007) showed a significant causal relation from exchange rates to stock prices for: Hong Kong, Japan, Malaysia, and Thailand, before the 1997 Asian financial crisis, and a causal relation from the equity to the foreign exchange market for :Hong Kong, Korea and Singapore.

Aydemir and Demirhan (2009) investigated the causal relationship between stock prices and exchange rates using daily data and the results show that there was bidirectional causal relationship between exchange rate and all stock market indices (The negative causal relationship from exchange rate to all stock market). But the study conducted by Bhattacharya and Mukherjee (2001) using monthly data showing that there is no causal linkage between stock prices (BSE Sensitive Index) and the macroeconomic variables such as exchange rate, foreign exchange reserves and value of trade balance. As supported a study by Kenani, Maoni, Kaunda and Nyirenda (2012) that investigates the short-run and long-run dynamic relationship between stock prices and exchange rate in Malawi from January 1999 to January 2010, found that no evidence of long-run relationship between the variables. Moreover, the Granger causality results show that stock prices and exchange rates do not cause each other during the period of the analysis. In conclusion, their results indicate that internal and external macroeconomic shocks do not have immediate influence on the stock and foreign exchange markets.

With focus on finding the direction between currency performance and stock market return for selected countries in emerging markets which is important for policy makers, (Akdogu and Buktel, 2011) found that the stock market leads currency performance, appropriately to stock oriented models or portfolio balanced approach. This empirical evidence from panel data set includes the annual data for 10 emerging markets between 1987 and 2007, a period of several crises due to weaker financial liberalization.

According to Chien-Hsiu Lin (2012), the empirical results suggest that the co-movement between exchange rates and stock prices becomes stronger during crisis periods, consistent with contagion or spillover between asset prices, when compared with tranquil periods. Most of the spillovers during crisis periods can be attributed to the channel running from stock price shocks to the exchange rate, suggesting that governments should stimulate economic growth and stock markets to attract capital inflow, thereby preventing a currency crisis. However, his result indicates that the industry causality analysis shows the co-movement is not stronger for export-oriented industries for all periods, such as industrials and technology industries, thus implying that co-movement between exchange rates and stock prices in the Asian emerging markets is generally driven by capital account balance rather than that of trade.

However through a study by Batori, Tsoukalas and Miranda (2010) indicate a different result with others. They employed cointegration analysis, vector error correction (VECM) and vector autoregressive modelling (VAR) and Granger causality tests to examine the effect of exchange rates on the stock market indexes for a group of European Union countries using daily data from 1999-2009. They found that there is no clear causality from stock market to exchange rates, or vice versa, for the direction of the causation and suggesting that exchange rates and stock markets operate as an integrated system continuously influencing each other. Following to Ramasamy and Yeung (2001) considered causalities between the two markets in nine East Asian economies and realized that the direction of causalities can vary according to the period of study. However, empirically also the issue has remained unresolved so far and we would make a humble attempt at addressing the issue with a view to filling up the gap in the literature.

In summary, it can be seen that some of the literatures have contradicting results which maybe because of the different methodologies used and also the variety region/countries that have been studied. So, this paper as we mentioned earlier seeks to contribute to the existing literatures by employing wavelet approach to identify the relationship and the direction between stock prices and exchange rates at different time scales.

5.0 The Methodology Used

The analysis will be conducted with the purpose of investigating the relationship between exchange rate and stock prices in Malaysia for the period 2007-2012. In this

paper, we also look at the methodologies used by the previous studies and we attempt to extend in our study. However we adopt the time series technique based in wavelet analysis. We apply the wavelet cross-correlation between these series based upon the maximum overlap discrete wavelet transform (MODWT) - Percival and Mofjeld (1997) and Daubechies (1992) families of wavelets. The decomposition of a time series on a scale by scale basis has the ability to unveil structure at different time horizons. In this study we employ the Johansen Cointegration Test (Engle and Granger, 1987) and timescale causality investigations (e.g. Granger Causality with wavelet analysis and Wavelet cross-correlation).

5.1 Wavelet Analysis

In this section, we will discuss on the method of wavelet analysis that are used to the issues raised in this paper that we attempt to solve empirically. The series were filtered using wavelet analysis is a relatively new statistical tool that, decomposes a given series in orthogonal components as in Fourier approach, but according to scale (time components) instead of frequencies.

Wavelet means a small wave and it is an oscillation that decays quickly. Mathematically noted that there are two basic wavelet functions; the father wavelets $\emptyset$ and mother wavelets ψ such that:

$$\int_R \emptyset(t)dt = 1 \text{ and } \int_R \psi(t) = 0 \quad (1)$$

Using wavelets, any function in $L^2(R)$ can be written as a linear combination of the type

$$f(t) = \sum_j \sum_k \alpha_{j,k}\, \emptyset_{j,k}(t) = \sum S_{j,k}(t) + \sum_k \sum_{j>J} d_{j,k}\ \psi_{j,k}(t) \quad (2)$$

where $S_{j,k} = \langle f(t), \emptyset_{j,k}(t)\rangle$ and $d_{j,k} = \langle f(t), \psi_{j,k}(t)\rangle$ are the wavelet coefficients and where $\emptyset_{j,k}$, $\psi_{j,k}$ the so-called scaling and wavelet functions, respectively. The formal definition of the father wavelets is the function

$$\emptyset_{j,k} = 2^{-j/2}\emptyset(2^{-j}t - k) \quad (3)$$

Defined as non-zero over a finite time length support that corresponds to given mother wavelets

$$\psi_{j,k} = 2^{-j/2}\psi(2^{-j}\ t - k) \tag{4}$$

Briefly, wavelet analysis provides an important tool for extracting information from stock market data (in case our study) with applications ranging from short term prediction to the testing of market models and the calculation of variance in relation to specific time scales.

5.1.1 Maximal Overlap Discrete Wavelet Transform (MODWT)

The motivation for formulating the MODWT is essentially to define a transform that acts as much as possible like the DWT, but does no suffer from DWT's sensitivity to choice of a starting point for a time series (Percival and Walden, 2000). The MODWT does not decimate the coefficients and therefore the number of scaling and wavelet coefficients at every level of the transform is the same number of sample observations. Even though it loses orthogonality and efficiency in computation, this transform does not have any restriction on the sample size and it is shift invariant. Wavelet coefficients and scaling coefficients are obtained as follows:

$$\tilde{\omega}_{j,t} = \frac{1}{2^{j/2}} \sum_{t=0}^{L-1} \tilde{h}_{jl}, X_{t-1} \tag{5}$$

$$\tilde{v}_{j,t} = \frac{1}{2^{j/2}} \sum_{t=0}^{L-1} \tilde{g}_{jl}, X_{t-1} \tag{6}$$

The wavelet and scaling filters $\tilde{h}_l, \tilde{g}_l$ are rescaled as $\tilde{h}_j = {}^{h_j}\!/_{2^{j/2}}$, $\tilde{g}_j = {}^{g_j}\!/_{2^{j/2}}$. Non-decimated wavelet coefficients represent differences between generalized averages of the data on a scale $\tau_j = 2^{j-1}$ (or level j).

MODWT provides the common functions of the DWT, such as multi-resolution decomposition analysis and cross-correlation analysis based on wavelet transform

coefficients, it can handle any sample size; is translation invariant, as a shift in the signal does not change the pattern of wavelet transform coefficients; and provides increased resolution at coarser scales. In addition, MODWT provides a larger sample size in the wavelet correlation analysis and produces a more asymptotically efficient wavelet covariance estimator than the DWT.

5.1.2 Wavelet variance, covariance, correlation and cross-correlation.

The basic idea of the wavelet variance is to substitute the notion of variability over certain scales for the global measure of variability estimated by sample variance. The wavelet variance of stochastic process X is estimated using the MODWT coefficients for $\tau_j = 2^{j-1}$ through:

$$\hat{\sigma}^2{}_x\tau_j \frac{1}{\widehat{N}}\sum_{k=L_j-1}^{N-1}(\widehat{W}_{j,k})^2 \tag{7}$$

where $\widehat{W}_{j,k}$ is the MODWT wavelet coefficient of variable X at scale τ_j. $\widehat{N}_j = N - L_j + 1$ is the number of coefficients unaffected by boundary, and $L_j = (2^j - 1)(L-1) + 1$ is the length of the scale τ_j wavelet filter.

Although the wavelet covariance decompose the covariance between two stochastic processes on a scale-by-scale, in some situations it may be beneficial to normalize the wavelet covariance by the variability inherent in the observed wavelet coefficients. The wavelet covariance at scale τ_j can be expressed as follows:

$$\gamma_{XY}(\tau_j) = COV_{XY}(\tau_j)\frac{1}{\widehat{N}_j}\sum_{k=L_j-1}^{N-1}\widehat{W}_{j,k}^{X}\widehat{W}_{j,k}^{Y} \tag{8}$$

Given that covariance does not take into account the variation of univariate time series, it is natural to introduce the concept of wavelet correlation. The wavelet correlation is simply made up of the wavelet covariance for {Xt, Yt} and wavelet variances for {Xt} and {Yt}. The MODWT estimator of wavelet correlation can be expressed as follows:

$$\hat{\rho}_{XY}(\tau_j) = \frac{Cov_{XY}(\tau_j)}{\hat{\sigma}^2{}_X(\tau_j)\hat{\sigma}^2{}_Y(\tau_j)} \quad (9)$$

As with the usual correlation coefficient between two random variables, $\left|\hat{\rho}_{XY}(\tau_j)\right| \leq 1$. The wavelet correlation is analogous to its Fourier equivalent, the complex coherency. (Gençay et al (2002: 258).

The wavelet cross-correlation decomposes the cross-correlation between two time series on a scale-by-scale basis thereby making it possible to see how the association between two time series changes as a function of time horizon. Genacay et al (2002) define the wavelet cross-correlation as:

$$\rho_{X,k}(\tau_j = \frac{\gamma_{X,k}(\tau_j)}{\sigma_1(\tau_j)\sigma_2(\tau_j)} \quad (10)$$

where $\sigma^2{}_1(\tau_j), \sigma^2{}_2(\tau_j)$ are, respectively, the wavelet variances for $x_{1,t}$ and $x_{2,t}$ associated with scale and, τ_j and $\gamma_{X,k}$ (τ_j) the wavelet covariance between $x_{1,t}$ and $x_{2,t-k}$ associated with scale τ_j. The wavelet cross-correlation is used to determine lead/lag relationships on a scale by scale between two time series.

5.2 Cointegration Test

The cointegration test is very important in terms of to check whether all variables are theoretically related or not. In addition, this test is useful for this study because we need to examine the relationship between exchange rates and stock prices to find they are related or vice versa. Moreover if they are cointegrated, it means that there is a co-movement among these variables in the long term and get back to equilibrium even they move differently in the short term.

There are several tests of cointegration. In this paper we apply the Johansen Cointegration Test to estimate whether Islamic index are correlated with exchange rate or vice versa. Johansen test is the most fundamental test. Engle and Granger (1987) formulated one of the first tests of cointegration (or common stochastic trends). This test has the advantage that it is intuitive and easy to perform.

5.3 Timescale Causality Investigations

As the issue raised in this paper, if the exchange rate and FTSE indices are related in Malaysia market, what is direction of causation between them? In fact, the issue of the relationship between exchange rate and stock prices has led to extensive research among the scholars, academic communities and practitioners. There are many of different opinions about this relationship, in fact it has debated for many years but there is no consensus on the nature of this relationship. According to Harjito and McGowan, 2011 expressing that even though the scholars and practitioners have studied the subject extensively, the effects of monetary developments on stock markets are still not completely understood. Such as an example that has been argued that a change in stock prices could change exchange rate or a change in exchange rate could change stock prices.

Therefore by humble, we intend to examine this issue at difference time scales using granger causality and also wavelet cross-correlation to identify the lead-lag relationship and cross-correlation between exchange rate and stock prices (FTSE indices is the index to measure the activity of Bursa Malaysia).

5.3.1 Granger Causality Test

The Granger (1969) test is traditionally used to test for causal relationship between two variables. In this paper, we applied the Granger causality to find the relationship between exchange rate and each of FTSE Bursa Malaysia indices and it is examined at different time scales using wavelet decomposition. Wavelet analysis has become increasingly popular for analysing economic time series due its vantages of decomposing at

time series into different time scales (Ramsey and Lampart, 1998; Almasri and Shukur, 2003). Therefore, this approach leads us to analyse more in-depth about the existence of direction of causation between exchange rate and stock prices at different time series.

According to Granger (1969), this is a simple test to define the causality between two variables. For instance, a variable Y_t is said to Granger-cause X_t, if X_t can be predicted with greater accuracy by using past value of the Y_t variable rather than not using such past value, all other things remain constant. Additionally, the researchers do not need to identify whether which variables are exogenous or endogenous as Granger causality will assume all the variables are endogenous.

5.3.2 Wavelet Cross-Correlation

The wavelet cross-correlation decomposes the cross-correlation between two time series on a scale by scale basis thereby making it possible to see how the association between two time series changes as a function of time horizon. According to Genacay et al (2002) define the wavelet cross-correlation as:

$$\rho_{x,k}\ (\tau_j) = \frac{\gamma_{x,k}(\tau_j)}{\sigma_i(\tau_j)\sigma_2(\tau_j)} \qquad (3)$$

where $\sigma_1^2\ (\tau_j)$, $\sigma_2^2(\tau_j)$ are, respectively, the wavelet variances for $x_{1,t}$ and $x_{2,t}$ associated with scale τ_j and $\gamma_{X,k}\ (\tau_j)$ the wavelet covariance between $x_{1,t}$ and $x_{2,t-k}$ associated with scale τ_j . The wavelet cross-correlation is used to determine lead/lag relationships on a scale by scale between two time series.

6.0 Data, Empirical Results And Discussions

6.1 Data Analysis

The data are used in this study consists of three FTSE Bursa Malaysia indices which indicate the market portfolio such as FTSE Bursa Malaysia KLCI Index (FBMKLCI), FTSE

Bursa Malaysia EMAS Index (FTBMEMA) and FTSE Bursa Malaysia TOP 100 Index (FTBM100) and two other indices which represent the Islamic portfolio such as FTSE Bursa Malaysia EMAS SHARIAH Index (FTBMEMS) and FTSE Bursa Malaysia HIJRAH SHARIAH Index (FTBMHJS). Further, to identify the relationship between these indices and exchange rate in Malaysia market, we use MYR-US as the exchange rate. The definitions of each variable are presented in Table 1. However our data are limited because of restricted by the availability of data owing to the launching of both FTBMEMS and FTBMHJS in 2007. In terms of data frequency, the study employs daily data series for the period from 01 March 2007 to 31 December 2012 providing 1523 observations in total. All data are retrieved from DataStream. In this study, we investigate for the return series $r_t = \ln(p_t) - \ln(p_{t-1})$

Table 1 :
Descriptions of the variables

Variable	Descriptions
(i) Islamic portfolio	
FTSE Bursa Malaysia EMAS SHARIAH Index (FTBMEMS)	FTBMEMS used as the proxy for Islamic stock market in Malaysia
FTSE Bursa Malaysia HIJRAH SHARIAH Index (FTBMHJS)	FTBMHJS used as the proxy for Islamic stock market in Malaysia
(ii) Market portfolio	
FTSE Bursa Malaysia KLCI Index (FBMKLCI)	FBMKLCI used as the proxy for conventional stock market in Malaysia
FTSE Bursa Malaysia EMAS Index (FTBMEMA)	FTBMEMA used as the proxy for conventional stock market in Malaysia
FTSE Bursa Malaysia TOP 100 Index (FTBM100)	FTBM100 used as the proxy for conventional stock market in Malaysia
(iii) Exchange Rate	The real exchange rate of MYR - US Dollar as the expectation in affecting FTSE Market

6.2 Empirical Results and Discussions

The descriptive statistics for the return series of exchange rate and each of FTSE index are shown in the Table 2. As shown in Table 2, the average daily returns for all FTSE indices are negative. This negative sign maybe is caused of the 2008 global financial crisis. Therefore, we found that the 2008 global financial crisis has a significant effect on both conventional and Islamic stock indices in Malaysia. The standard deviation of different

indices returns show that the dispersion of the Islamic indices is higher than the market portfolio. Even though, we found that both of Islamic portfolio has a negative sign in average daily returns but their standard deviation values indicate that still bear higher risk compared with their conventional counterparts. The standard deviation of return series of exchange rate had shown less volatile than stock indices in Malaysia during period of March 2007 to December 2012. In addition, the skewness implies that all of the data are negative skewed which indicates that they are non-symmetric. The large values of kurtosis states that the distribution of return series for all variables has thicker tails than the normal distribution. In this case, the daily return series of FBTBM100 tend to have high excess kurtosis.

Table 2:
Descriptive Statistics for return series

	Min	Max	Mean	Std. Dev.	Skewness	Kurtosis
(i) Islamic portfolio						
FTBMEMS	-9.351903	0.040747	-0.005892	0.239811	-38.90435	1516.694
FTBMHJS	-9.447381	0.045368	-0.005883	0.242271	-38.89989	1516.463
(ii) Market portfolio						
FBMKLCI	-7.431862	0.042587	-0.004645	0.190634	-38.86904	1514.860
FTBM100	-9.332769	0.041961	-0.005878	0.239312	-38.90859	1516.916
FTBMEMA	-9.344709	0.044184	-0.005887	0.239620	-38.90774	1516.872
EXC	-1.117859	0.019833	-0.000824	0.028944	-37.77776	1458.495

Time series plots for each FTSE Bursa Malaysian are shown in Figure 1. Possible trend and sesonal variation of the series might be explained by the plots and results suggests that the indices are not stationary. In general the indices show the fluctuation all the time and have almost same pattern of price movoments. The stock prices at different rate with minor corrections along the way.

In this case, the unit root test namely Augumented Dickey Fuller (ADF) and Phillip and Perron Tests are used to check the stationarity of the FTSE indices. The results are presented in Table 3. The series are test by using the closing price as well as the return of each series. As can be seen at Table 3 is suggests that all the stock indices are non-stationary as the null hypothesis of unit root cannot be rejected at 10% level of

significance. However the series become stationary after they are being transformed into return series.

Table 3
Unit Root Test Results For FTSE Bursa Malaysia Indices

Index	Level		1st Differenced	
	ADF	PP	ADF	PP
FTBMEMS	0.2545	0.2545	0.0107	0.0107
FTBMHJS	0.4169	0.4169	0.0721	0.0721
FBMKLCI	0.3943	0.3943	0.0692	0.0692
FTBMEMA	0.3373	0.3373	0.0463	0.0463
FTBM100	0.3754	0.3754	0.0461	0.0461

* Significant at 10%

Therefore, we can progress to the cointegration analysis because all the stock indices are integrated in the same order as essential for cointegration. Since all stock indices are stationary at the 1st differenced, we proceed to test for cointegration where to investigate whether there are exists long run relationship of exchange rate with the each of FTSE Bursa Malaysia indices, especially to the Islamic market index.

6.2.1 Cointegration Test

The results are shown in Table 4. Therefore, as an evidence of cointegration implies that the relationship among the variables is not spurious. In other words, we can say there is a theoretical relationship among the variables and that they move together in the long run. In view of economic interpretation, besides the results of cointegration analysis below, we inclined to believe that there exists a long run relationship between exchange rate and stock indices. In other words, the 2 variables are cointegrated, which is, their interactions to one another is not merely spurious or by chance.

Table 4
Result of Cointegration Tests

Trace

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	Critical Value
None	0.213878	1484.81	117.7082
At most 1	0.194249	1119.52	88.8038
At most 2	0.173064	791.66	63.8761
At most 3	0.157651	503.19	42.91525
At most 4	0.145823	242.76	25.87211
Maximum Eigenvalue			
Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	Critical Value
None	0.213878	365.2968	44.4972
At most 1	0.194249	327.8593	38.33101
At most 2	0.173064	288.4634	32.11832
At most 3	0.157651	260.4289	25.82321
At most 4	0.145823	239.262	19.38704

The statistics refer to Johansen's log-likehood maximal eigen value and trace test statistics trends. * Critical value at 5%

In our study, we tend to observe the causal relationship between exchange rate and FTSE market in Malaysia at the different time scales (exact time interval). So, firstly we employed the "maximal overlap discrete wavelet transform (MODWT)" to see more description is available in this analysis.

On the issue of causation between exchange rate and stock prices is a long time period is debated among the scholars, academic communities and practitioners and then result or evidence is found are mixed. Some studies have found causations runs from exchange rates to stock prices while the other reported that a reverse causation. Furthermore, according to Bahmani-Oskooee and Sohrabian (1992) claimed that there is a bidirectional causality between stock prices and exchange rates in the short-run but not in the long-run. Therefore, we humble are attempting to test the causality between these variables at the different time scales using multi scale analysis. As a recent methodology such as "Wavelet Analysis" is described in methodology section as mentioned above, here we therefore have a vector of 1523 observations, which enables us to use 5 levels of wavelet decomposition.

6.2.2 Multiscale Analysis

We apply the maximal overlap discrete wavelet (MODWT) transform to the daily returns of FTSE indices and exchange rates into a set of five orthogonal components D_1, D_2, D_3, D_4 and D_5 which stands for different frequency components of the original series (S_0), and a final component (A_5) stands for the long-run trend in the return series. The application of the translation invariant wavelet transform with a number of scales J = 5 produces five vectors of wavelet filter coefficients, that is w5, w4, w3, w2, w1, and one vector of scaling coefficients, v5. This paper use daily data, the wavelet filter coefficient; w5,k,..., w1,k represent progressively finer scale deviations from the smooth behaviour, and correspond to 32-64, 16-32, 8-16, 4-8 and 2-4 days period, respectively.

Since we derived the wavelet coefficients using MODWT, then we can observe the changes of coefficients at particular scale. This is actually one advantage of wavelet approach which is we can see the movement of FTSE indices and exchange rate at different time scales. Thus, make our interest to examine either these variables are related at different time scales or only in the short term and long term period. To answer the issues that is mentioned in this paper, we humble attempt to give the explanatory empirically based on the methodologies are used with referring to the theories, economic and financial framework and also to the institutional in Malaysia.

Before we proceed to the Granger causality, we employ the wavelet correlation to examine the correlation between exchange rate and stock indices.

6.2.3 Wavelet Correlation

The results are presented in Figure 2 show that the correlation between each of FTSE indices in Malaysia and exchange rates. As can be seen in Figure 2 show the wavelet correlation between Islamic indices and exchange rate has a negative correlation at all levels. This is implies that if one variable moves in either direction the variable that is perfectly negatively correlated will move in the opposite direction. In 2008 financial global crisis, we can see that the value of stock prices and exchange rate in Malaysia are decreasing. In scale 1 – 2, clearly stock prices and exchange rate indicates decrease. This is similar with the figure 3, the wavelet correlation between conventional indices and exchange rate also indicate negative correlated. This is implies that FTSE market in Malaysia is influenced by the global financial crisis effect.

Figure 2: Islamic Portfolio of FTSE Market

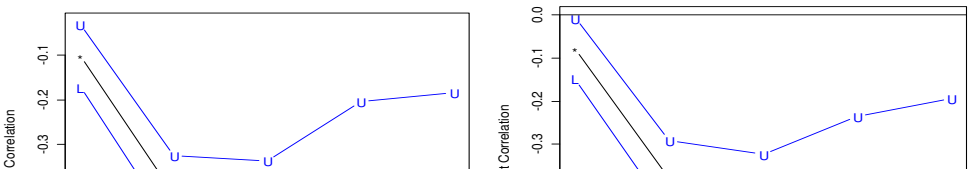


Figure 1(a): Wavelet Correlation between FTBMEMS and exchange rate

Figure 3: Conventional Portfolio of FTSE Market

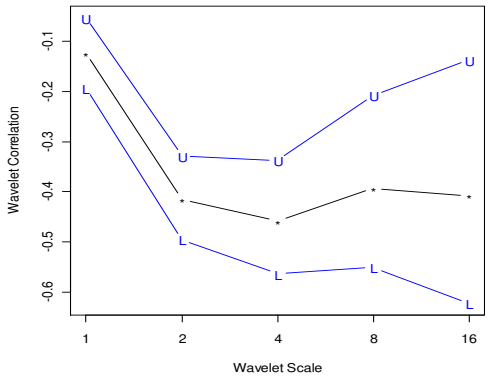


Figure 2(a): Wavelet Correlation between FBMKLCI and exchange rate

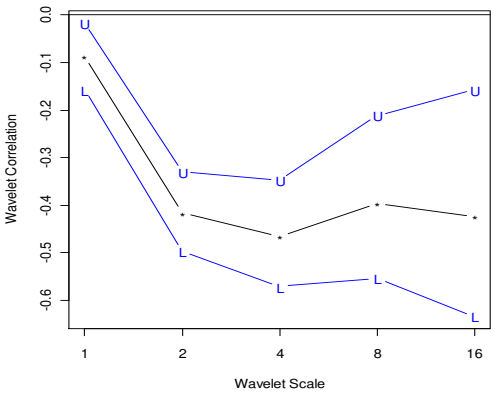


Figure 2(b): Wavelet Correlation between FTBM100 and exchange rate

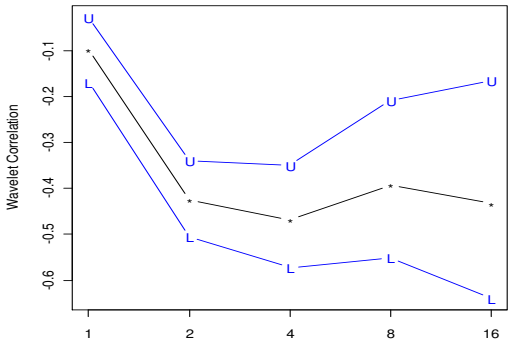


Figure 2(c): Wavelet Correlation between FTBMEMA and exchange rate

t and

gative correlated, then we examine the lead-lag relationship and cross-correlation between FTSE market and exchange rate over the various time scales using wavelet analysis. In this case, firstly we employed the Granger causality test. From the result we can find the direction of the either bi-directional or uni-directional of causality between FTSE market and exchange rate.

6.2.4 Granger Causality

Granger causality test is applied to find the lead-lag relationship or the direction of causation between exchange rate and each stock index at different time scales. The results are presented in Table 5 based on F-statistics and P-value. The stock market and exchange rate show a feedback relationship only at D1, D3 and S5. The results show that all stock indices at scale D1 have a unidirectional causality that running from stock market to exchange rate. The null hypothesis indicates that stock market does not Granger Cause exchange rate or exchange rate does not Granger Cause stock market. In Scale D1 that we reject the null hypothesis at 1% which is stock market does not Granger Cause exchange rate but we could not reject the null hypothesis that exchange rate does not Granger Cause stock market at 1%. Therefore in Scale 1 indicates that has a positive causal relationship from stock market to exchange rate. This scenario implies that the authorities focus on domestic economic policies to stabilize the stock market. As the issues raised, this paper finds that Islamic stock market and conventional stock market causes the fluctuation of exchange rates in Malaysia during 2-4 days (see scale 1 - Table 5). This result supports stock-oriented model which mean that the movement of stock market influence exchange rates.

The results show also, scales D3 indicates that the exchange rate and stock indices are bidirectional causality. Therefore, we could not accept the null hypothesis that exchange rate does not Granger Cause stock market or vice versa. Indeed, there is a strong bidirectional causal relationship between stock indices and the exchange rate for this time horizon (8-16 days). The bidirectional causality between stock indices and the exchange rate also corresponding at scales S6 (more 64 days).

Table 5
Multiscale Granger Causality

	A1	D1	D2	D3	D4	D5	S5
a) FTSE Bursa Malaysia EMAS SHARIAH							
FTBMEMS → EXC	0.61192 (0.5424)	*26.8736 (3.E-12)	0.76555 (0.4653)	*6.80645 (0.0011)	0.88683 (0.4122)	1.03166 (0.3567)	*6.26946 (0.0019)
EXC ← FTBMEMS	0.00994 (0.9901)	0.11290 (0.8932)	0.18933 (0.8275)	*6.92951 (0.001)	0.41608 (0.6597)	0.88999 (0.4109)	*6.35966 (0.0018)

b) FTSE Bursa Malaysia HIJRAH SHARIAH								
FTBMHJS →	EXC	0.4852 (0.6157)	*24.8422 (2.E-11)	0.68508 (0.5042)	*6.46859 (0.0016)	1.02743 (0.3582)	0.82940 (0.4365)	*5.73608 (0.0033)
EXC ←	FTBMHJS	0.01015 (0.9899)	0.27550 (0.7592)	0.18793 (0.8287)	*6.66749 (0.0013)	0.44425 (0.6414)	0.79995 (0.44950	*5.58447 (0.0038)
c) FTSE Bursa Malaysia KLCI								
FBMKLCI →	EXC	0.52418 (0.5921)	*26.5752 (5.E-12)	0.80906 (0.4455)	*7.13545 (0.0008)	0.81807 (0.4415)	1.27992 (0.2784)	*6.05916 (0.0024)
EXC ←	FBMKLCI	0.01142 (0.9886)	0.21276 (0.8084)	0.19938 (0.8193)	* 7.23960 (0.0007)	0.36100 (0.6970)	1.58027 (0.2063)	*5.91154 (0.0028)
d) FTSE Bursa Malaysia EMAS								
FTBMEMA →	EXC	0.51339 (0.5986)	*26.9862 (3.E-12)	0.74873 (0.4731)	*6.80974 (0.0011)	0.67418 (0.5097)	1.06644 (0.3445)	*6.48438 (0.0016)
EXC ←	FTBMEMA	0.00617 (0.9938)	0.09478 (0.9096)	0.18798 (0.8287)	*6.93234 (0.0010)	0.29894 (0.7416)	1.13360 (0.3221)	*6.70489 (0.0013)
e) FTSE Bursa Malaysia TOP 100								
FTBM100 →	EXC	0.57098 (0.5651)	*26.3791 (5.E-12)	0.71014 (0.4917)	*6.55298 (0.0015)	0.69131 (0.5011)	1.03776 (0.3545)	*5.92248 (0.0027)
EXC ←	FTBM100	0.00740 (0.9926)	0.12498 (0.8825)	0.19181 (0.8255)	*6.66655 (0.0013)	0.29992 (0.7409)	1.2714 (0.2807)	*6.05473 (0.0024)

Note: A1 is the original data transformed by the wavelet filter D(5). The significances levels in parentheses. * Significance at the 1% level

6.2.5 Wavelet Cross-Correlation

Now, the second purpose to examine the cross-correlation between the stock indices and exchange rate in various time scales. In this case also, we attempt to find 3 things that identified by wavelet cross-correlation such as the significant/insignificant cross-correlation, positive or negative relationship and to examine who is leader/driver among stock indices and exchange rate. Figure 4 – 8 report the wavelet cross-correlation between stock return and exchange rates for the five levels of resolution. The results show that Islamic indices and conventional indices have a same pattern of wavelet cross-correlation. (See figure 4 - 8).

At the shortest scales, i.e. scales 1 to 2, the magnitude of the association between the two variables is generally close to zero at all leads and lags. On the other hand, at the coarsest scales, i.e. 3 to 5, we report a negative relationship between two series. We can observe that the first wavelet level, only one significant correlation on right side of the graph. It implies that the stock return leads exchange rate. At the second and third wavelet,

noted the relationship between stock return and exchange rate is negative significant correlation. The results are same at the fourth and fifth wavelet where there is a negative correlation between two variables. This result indicates that any movement of stock return will change the exchange rate and the changes of exchange rate will increase/decrease the value of stock return. (i.e. a reducing of exchange rate will increase the value of stock return or vice versa).

The exchange rate and stock returns mainly led each other and mainly did so for levels 3, 4 and 5. In this case, we can see that there is a significant positive and negative cross-correlations are observed in both the right and left side of the graph. These feedback effects between exchange rate and stock returns probably emerged as a consequence of the increased interdependence observed with the onset of the financial crisis. Additionally, this means the existence a relationship bidirectional between the two series as we estimate with Granger causality where in scale 3 shown that a strong bidirectional causal relationship between stock indices and the exchange rate for 8 – 16 days. Level 5 also presented that exist the bidirectional relationship between two variables for long horizons. Our findings are consistent with those Ibrahim and Aziz (2003) who used monthly data of stock prices, exchange rates, and money supply in Malaysia from 1977 to 1998. The result also shows the relation between stock and foreign exchange markets is negative; when domestic currency depreciates, the stock prices will also decrease.

In summary, Granger causality indicates in scale 1 (2 - 4 days) suggest that the results is stock-oriented or portfolio balance wherein the movement of stock return can cause the exchange rates. In scale 3 and 5, Granger causality and wavelet cross-correlation reveal that the existence of bidirectional relationship between exchange rate and stock returns.

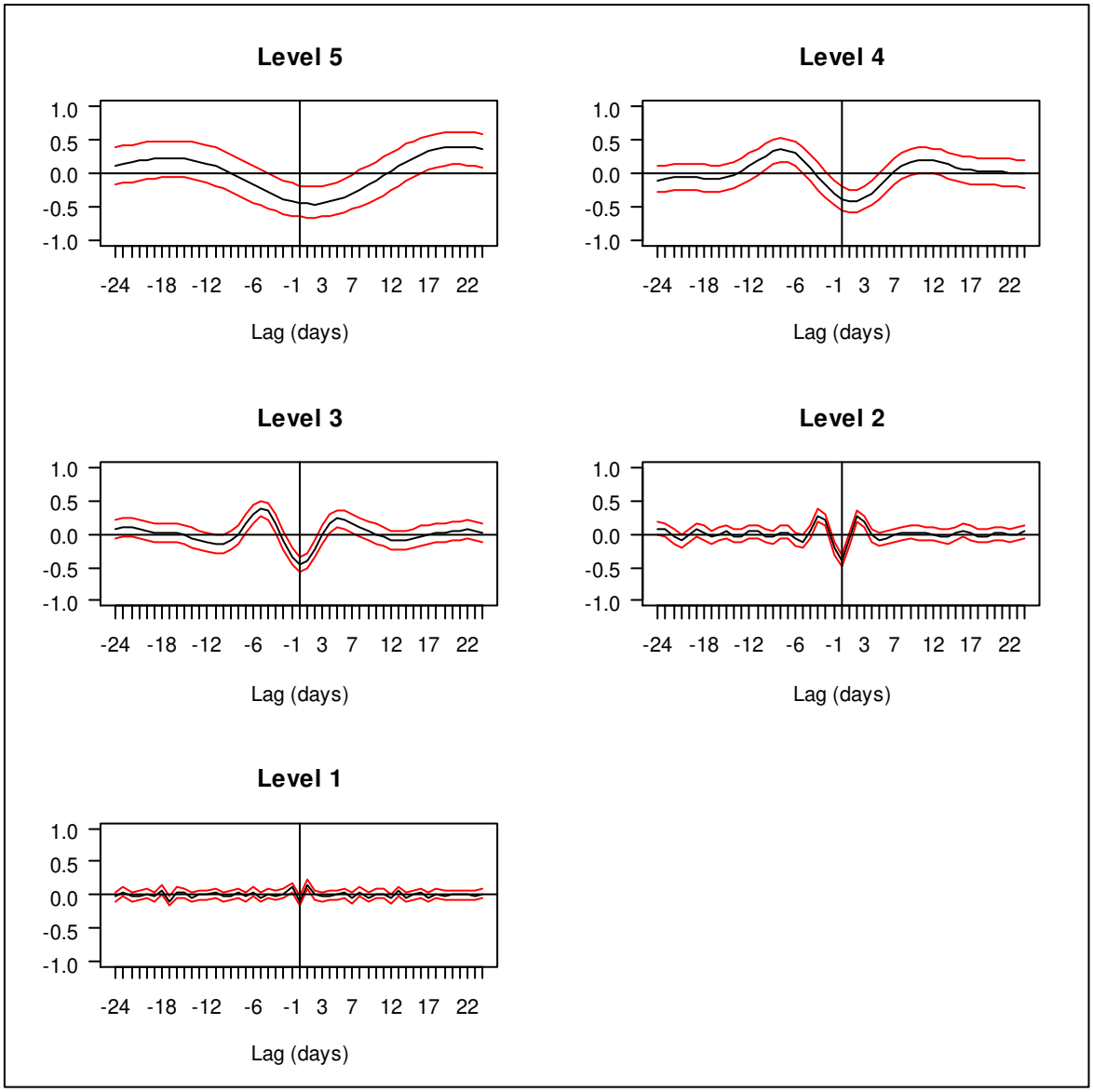


Figure 4: Wavelet cross-correlation between Exchange rate and FTBMEMS index

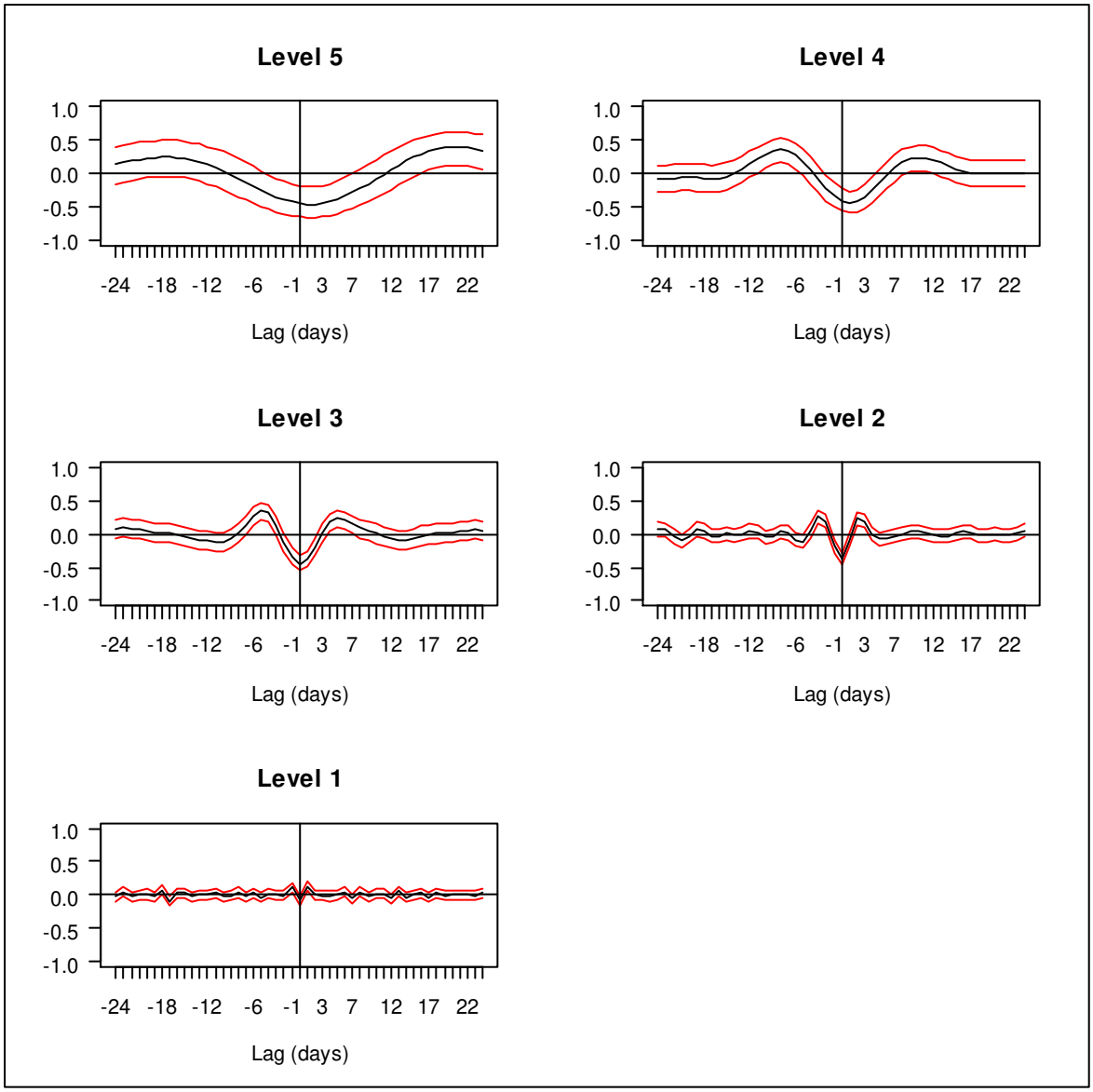


Figure 5: Wavelet cross-correlation between Exchange rate and FTBMHJS index

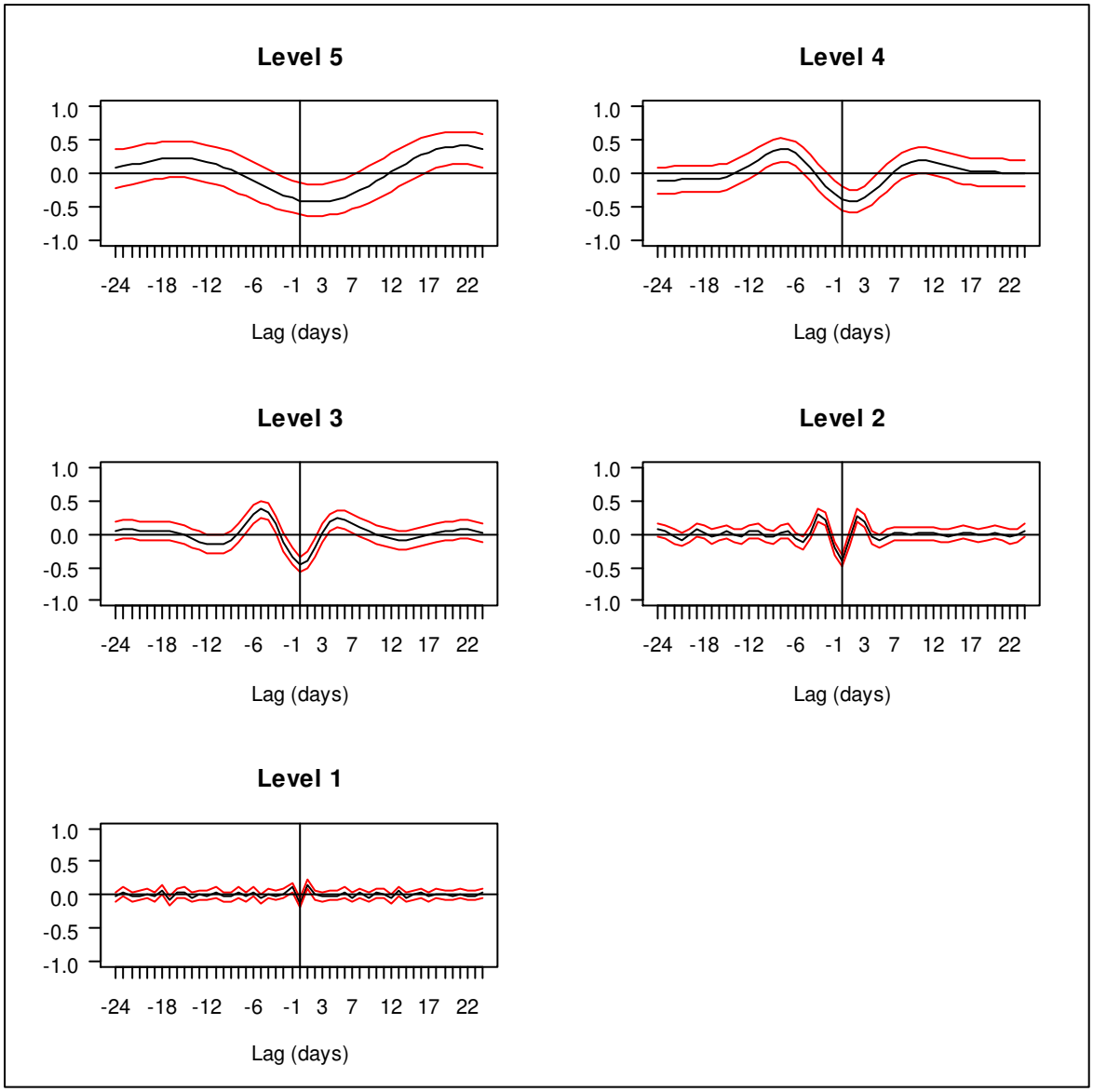


Figure 6: Wavelet cross-correlation between Exchange rate and FBMKLCI index

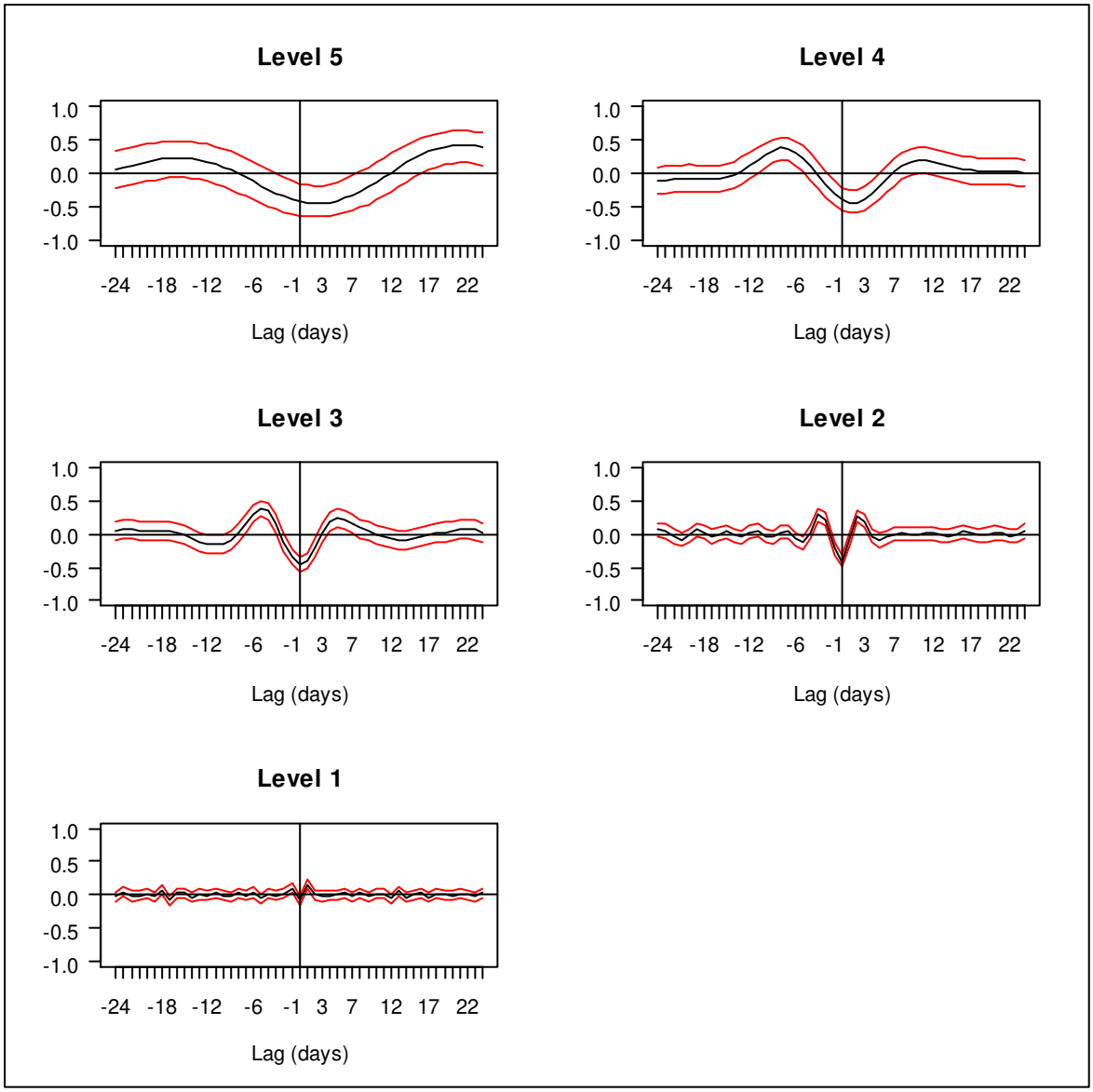


Figure 7: Wavelet cross-correlation between Exchange rate and FTBM100 index

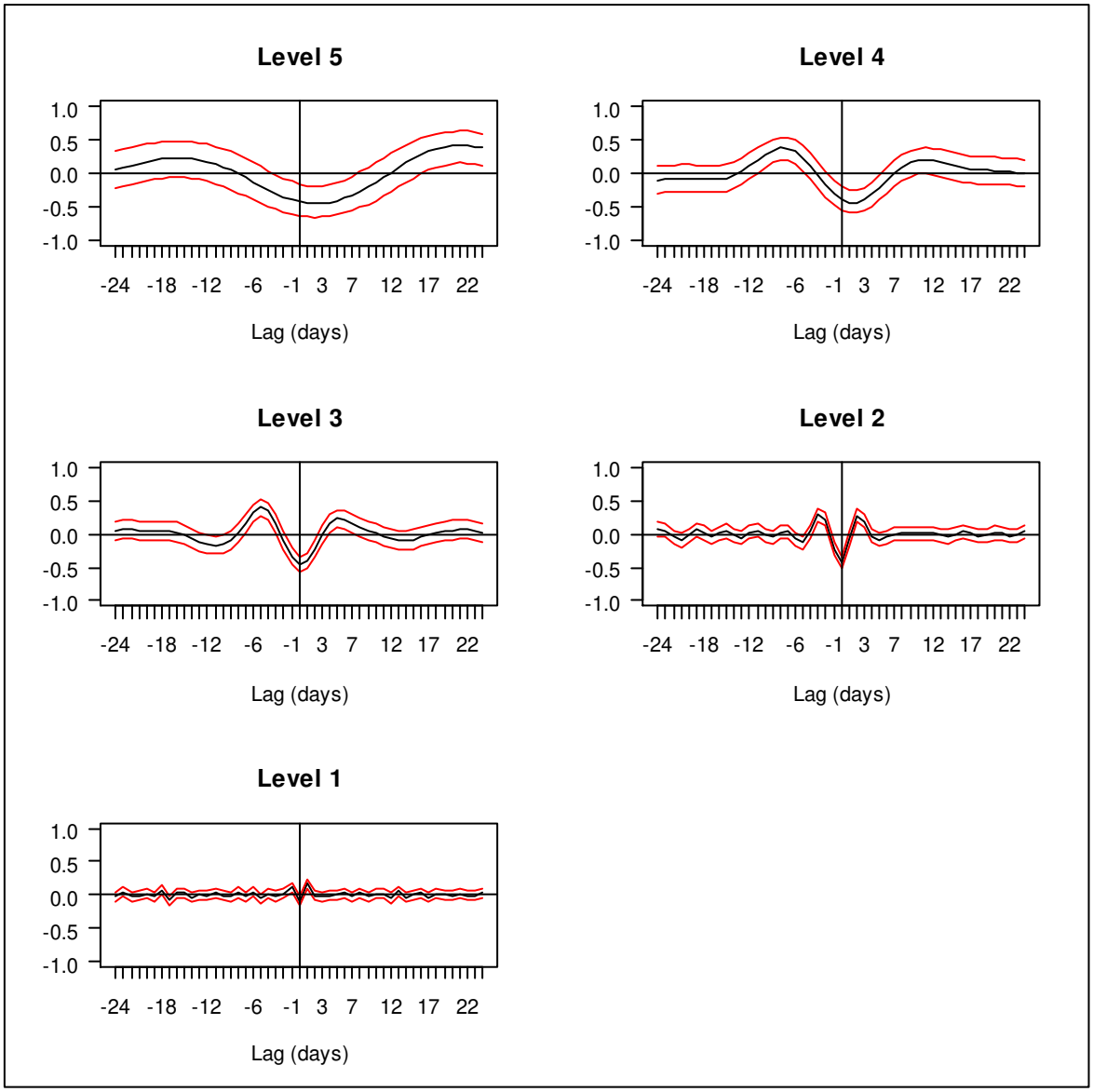


Figure 8: Wavelet cross-correlation between Exchange rate and FTBMEMA index

7.0 Conclusions and Policy Implications

The existing evidence provided by the past literature shows that the relationship between stock returns and exchange rate is varying whether in the long run or short run and, in particular, tends to increase as data frequency decreases (from monthly, to quarterly and annual). Wavelet filtering is a tool which, going beyond that of current methodology, provides a useful way to decompose the underlying structure of a relationship across different time scales. Thus, in this paper we apply a multi-scaling approach based on a maximum overlap discrete wavelet transform (MODWT) in order to investigate the relationship between stock returns and exchange rate over different time scales

Through a scale by scale decomposition of the cross-correlation between two time series, we make an attempt to shed some light on the scaling properties for the relationship at different time horizons. Related to the issues raised at the beginning our study as to whether the exchange rate and FTSE Bursa Malaysia indices (Islamic stock index, in particular) are related or not? If they are related, what the direction of causation among the exchange rate and each of FTSE Bursa Malaysia index? Although this issue is not a new issue among researchers, but there is no consensus about the nature of the relationship between exchange rate and stock indices whether from theoretical or empirical studies. The main results are summarized as follows:

- Johansen cointegration test indicates that the Islamic stock returns and exchange rate are related in the long run.
- The Granger causality based on wavelet analysis show that in scale 1 is a stock-oriented. On the other hand, scale 3 and 5 reveal a bidirectional relationship between stock returns and exchange rate.
- The Islamic stock indices (FTBMEMS and FTBMHJS) are significantly related with the exchange rate. This result is similar with conventional stock indices (FBMKLCI, FTBM100 and FTBMEMA) wherein a significant relationship with exchange rate has. The wavelet cross-correlation analysis shows that the relationship between exchange rate and all FTSE Bursa Malaysia index are negative significant correlation at different time scales. The analysis provides evidence that stock market is leading the exchange rate in scale 2-4 days. The wavelet cross-correlation also shows that in

other timescales there is a significant positive and negative cross-correlations in both the right and left side of the graph. These feedback effects between exchange rate and stock returns probably emerged as a consequence of the increased interdependence observed with the onset of the financial crisis.

In short, time-scale decomposition analysis indicates that the relationship between stock returns and exchange rate is not fixed over different time scales and, in particular, the stock returns are leading exchange rate at the shortest scales, i.e. at scales corresponding to periods of 2-4 days. However, in scales with 8-16 days and 64 days and longer, the stock returns and exchange rate mainly lead each other indicating a bidirectional relationship. Such a result accords quite well with the conventional wisdom which suggests that the investors with longer term horizons are likely to be linked with the macroeconomic fundamentals in their investment activity (Gallegati, 2007).

The application provided here gives an indication of the potential deeper understanding that wavelets may provide in analyzing the relationships that characterize markets where the agents involved consist of heterogeneous agents making decisions over different time horizons at each moment on different time scales, as it is the case of financial markets.

Policy makers must be wary of exchange rate movement as it may result in the stock price. As the exchange rates play the role of balancing the demand for the supply of assets. For instance, an increase in domestic stock prices lead individuals to demand more domestic assets, if buy more domestic assets local investors would sell foreign assets then causing local currency appreciation. Therefore, this application (wavelet analysis) contributes to policy maker in making decision in case of two situations (flow oriented or stock-oriented) i.e. when the exchange rate running to stock market or vice versa at different time scales.

8.0 Limitations and Recommendations for Future Research

In this paper, the FTSE index is used to represent stock market in Malaysia. To identify the relationship exchange rate and the movement of Islamic stock markets, in particular, should be use the various of FTSE Shariah index, i.e FTSE Shariah global indices and Down Jones indices. Thus, for future research it worth to examine the relationship

between stock price and exchange rates using FTSE Shariah global indices and Islamic Down Jones to identify the relationship between these two variables globally.

9.0 References

Aggarwal, R. (1981). "Exchange rates and stock prices: A study of the US capital markets under floating exchange rates". Akron Business and Economic Review 12, 7-12.

Ajayi, R. A. and M. Mougoue (1996). "On the Dynamic Relation Between Stock Prices and Exchange Rates". Journal of Financial Research, 19, 193-207.

Amare, T., and M. Mohsin (2000). "Stock Prices and Exchange Rates in leading Asian Economies: Short Run versus Long Run dynamics". Singapore Economic Review, 45 (2), 165-181.

Ang. James S. and Ghallab, Ahmed (1976). "The Impact of US Devaluation on the Stock Prices of Multinational Corporation", Journal of Business Research, 4, 25-34.

Aydemir, O., Demirhan, E., (2009). "The relationship between stock prices and exchange rates: Evidence from Turkey". International Research Journal of Finance and Economics, 23, 207–215.

Batori, Tsoukalas and Miranda (2010). "Exchange Rates And Equity Markets: Evidence From Some European Countries". Journal of Applied Business Research, November/December.

Bhattacharya B. and J. Mukherjee (2001), Causal relationship between stock market and exchange rate, foreign exchange reserves and value of trade balance: a case study for India.

Chien-Hsiu Lin (2012) The comovement between exchange rates and stock prices in the Asian Emerging Markets. International Review of Economics and Finance, 22,161–172

Christopher Torrence and Gilbert P. Compo (1998). A Practical Guide to Wavelet Analysis.

Dr. Gaurav Agrawal (2010). "A Study of Exchange Rates Movement and Stock Market Volatility". International Journal of Business and Management, 5, 12

Franck, P. And Young, A., (1972). "Stock price Reaction of Multinational Firms to Exchange Realignments", Financial Management, 1, 66-73.

Granger, C.W.J., Huang, B.-N., Yang, C.-W., (2000). "A bivariate causality between stock prices and exchange rates: evidence from recent Asian flu". Quarterly Review of Economics and Finance, 40, 337–354.

I-Chun Tsai (2012). "The relationship between stock price index and exchange rate in Asian markets: A quantile regression approach". International Financial Markets, Institutions and Money, 22, 609– 621

Ibrahim, Mansor H. and Aziz, H., (2003)." Macroeconomic variables and the Malaysian equity market: a view through rolling subsamples". Journal of Economic Studies, 30 (1), 6–27.

Kim, K. (2003). "Dollar Exchange Rate and Stock Price: Evidence from Multivariate Cointegration and Error Correction model". Review of Financial Economics, 12, 301-313.

Kenani, Maoni, Kaunda and Nyirenda (2012). "Short-run and Long-run Dynamics of Stock Prices and Exchange Rates in Developing Economies: Evidence from Malawi". European Journal of Business and Management www.iiste.org ISSN 2222-1905 (Paper) ISSN 2222-2839 (Online) Vol 4, No.18, 2012

Kim, K., (2003). "Dollar exchange rate and stock price: evidence from multivariate cointegration and error correction model". Review of Financial Economics, 12, 301–313

Mazila Md-Yusuf and Hamisah Abd Rahman (2013). "Granger Causality Relationship between Malaysia Equity Market and Exchange Rate Volatility". International Journal of Trade, Economics and Finance, 4(1).

Ming-Shiun Pan, Robert Chi-Wing Fok and Y. Angela Liu (2007). "Dynamic linkages between exchange rates and stock prices: Evidence from East Asian markets". International Review of Economics and Finance, 16, 503–520

Naeem Muhammad and Abdul Rasheed, (2002). "Stock Prices and Exchange Rates: Are they Related ? Evidence from South Asian Countries," The Pakistan Development Review, Pakistan Institute of Development Economics, 41(4), 535-550

Nieh, C. C. and Lee, C. F. (2001). "Dynamic relationship between stock prices and exchange rates for G-7 countries". Quarterly Review of Economics and Finance, 41, 477–490.

Pan, M.-S., Fok, C.-W.and Liu, Y.A., (2007). "Dynamic linkages between exchange rates and stock prices: evidence from East Asian markets". International Review of Economics and Finance, 16, 503–520.

Parsva and Lean (2012). "Performance of Islamic Indices in Malaysia FTSE Market: Emipirical Evidence from CAPM". Journal of Applied Sciences 12(12), 1274-1281.

Phylaktis and Ravazzolo (2005). "Stock prices and exchange rate dynamics". Journal of International Money and Finance 24, 1031-1053

Ramasamy, B. and Yeung, M. (2001). "The Causality between Stock Returns and Exchange Rates: Revisited". The University of Nottingham in Malaysia,Division of Business and Management Research Paper Series, no. 2001-11.

Ratner, M., (1993). "A cointegration test of the impact of foreign exchange rates on U.S. stock market prices". Global Finance Journal 4, 93-101.

Soenen, L., and Hennigar, E. S. (1988). "An Analysis of Exchange Rates and Stock Prices: the U.S. experience between 1980 and 1986". Akron Business and Economic Review, 19, 7-16.