Are the Islamic and conventional money markets really highly correlated ? MGARCH-DCC and Wavelet approaches

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Abstract

Criticisms of Islamic banks and financial products motivate us to re-examine whether the profit rate of Islamic financial products and conventional interest rate are highly related or not. It is well known that interest rate is highly influenced by the economic policies, so, in this research we will check the relation between several rates (Islamic and conventional) of return and economic policy uncertainty index respectively to make a judgement on the criticisms. We applied MGARCH-DCC and Continuous Wavelet Transform analyses to see the relations of these variables among different time scales with data collected from different sources. Unlike previous studies, economic policy is incorporated in the analyses in order to explain the issue. Our results tend to indicate that the Islamic profit- and- loss sharing (PLS) rates have divergent relations with interest rates. Islamic Murabahah profit rate is less correlated with LIBOR, while Islamic Mudarabah profit rate is highly correlated with LIBOR. That shows both the uniqueness and similarity of Islamic financial products with the conventional interest rate. Hence the policy makers, if they intend to, can make Islamic money market more independent of the influence of conventional market.

*Keywords***: *MGARCH; Wavelet; PLS; Islamic profit rate; Murabahah; Mudarabah; LIBOR*

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Introduction

Islamic finance has been introduced for decades, different financial instruments have been invented to compete with its conventional counterparts. Islamic financial products are believed to be based on profit-and-loss sharing (PLS) paradigm, by which financial institutions and investors share the profit and loss together. In contrast, conventional financial products have the fixed interest rate, financial institutions bear no risks at all. Interest rate is highly influenced by economic policies (e.g. the monetary policies and fiscal policies of the government change the demand and supply of loanable funds and change the amount of currency in the money market). Thus, usually the movement of economic policies issued by the government should have a high correlation with the movement of interest rate. However, according to the definition of Islamic financial products (e.g. Murabahah, Mudarabah, Wakalah,), the profit rate shouldn't be highly influenced by the economic policies but should be related to the real economy.

Some of the studies on the comparison between the conventional interest rate and the profit rate of Islamic financial product show controversial findings in that there is no big difference between Islamic profit rate and conventional interest rate, and that Islamic profit rate is mimicking interest rate. They argue that the Islamic financing is not very different from conventional financing, only a small portion of Islamic financing is really based on profit-and-loss sharing paradigm. And because of the high competition with conventional counterparts, the Islamic profit rate is pegged to the conventional interest rate.

However, there are also findings which advocate Islamic financing being different from conventional financing. The findings indicate the advantages of Islamic financing, like Islamic financing profit rate which can adjust to equilibrium in a faster speed than the conventional interest rate.

The controversial findings above result in the curiosity about the experimental evidences of the relation between Islamic profit rate and interest rate in depth. And based on the theory about the causes of change in interest rate, we want to include the index of economic policy uncertainty which is considered as the cause of fluctuation of interest rate in our study. Comparison of the impact of economic policy uncertainty on the two rates is expected to give

the evidence as to that whether Islamic profit rate is different from conventional interest rate or not.

Most of these studies examine the relation between interest rate and Islamic profit rate directly, they seldom consider the cause of the fluctuation of interest rate. And these studies lack experimental evidence to support the judgement. Unlike those studies, we use data of economic policies, LIBOR, and several Islamic profit rates to do the econometric experiment, instead of only doing experiment with Islamic profit rate and interest rate. It gives us new statistical evidence with relatively new methods to examine the previous findings. MGARCH-DCC gives us the unconditional and conditional volatilities and correlations among these variables which are in line with the intuition that volatilities and correlations are varying over time. Wavelet gives the robustness of the findings, correlation of these variables at different time scales as well as the lead-lag relations between economic policy uncertainty and two different rates. These two methods give us a new angle to investigate the controversial issue of whether Islamic profit rate is really pegged with the interest rate or not.

Our results tend to indicate that Mudarabah rate behaves similar to that of LIBOR, correlation of these two variables is high. It may be due to the pressure given by the conventional bank to attract deposits of customers. Islamic banks need to adjust their rate according to the interest rate. However, unlike some previous studies which criticize Islamic financial products for almost totally replicating the interest rate based on conventional financial products, our results of Murabahah rate and Wakala rate tend to show some evidence to support the point that Islamic profit rate is not fully pegged with interest rate. In short, our findings indicate that not all the Islamic profit rates of different financial products are pegged with the interest rate. They have different paradigms, some of the products like Mudarabah may be influenced by the interest rate because of the pressure given by the conventional counterparts. However, generally, Islamic financing products should not be considered as replicates of conventional interest rate.

There are five parts of this paper, first is the introduction, second is the literature review about previous studies, then the third part is the explanations of the methodology we used, fourth part is the explanation of the results and discussions, the last part is the conclusion.

Literature Review

In general, Islamic financial institution and financial products are ruled under Shariah law, the primary feature of Islamic finance is the prohibition of interest (Riba). Since 1963 when the first modern Islamic banking organization has been established, Islamic banking has grown very fast in more than 50 countries. However, there are issues related to whether Islamic financial products are really designed under the profit-and-loss sharing (PLS) paradigm. Criticisms from different studies show that Islamic profit rates are pegged with interest rate. Beng Soon Chong and Ming-Hua Liu (2009) find that Islamic banking is not very different from conventional banking. Their study on Malaysia shows that only a negligible portion of Islamic bank financing is strictly PLS based and that Islamic deposits are not interest-free, but are closely pegged to conventional deposits. They addressed reasons why Islamic financing can't perform PLS paradigm very well. It is because of the greater market discipline Islamic banks are subjected to the constrain to highly follow the PLS paradigm. Beng Soon Chong and Ming-Hua Liu (2009) say that Islamic banks are required to put in more effort to distinguish good customers from bad ones because they have more to lose than conventional banks. The banks also need to monitor their investments and borrowers more closely to ensure truthful reporting of profits and losses. Islamic bank depositors, furthermore, are required to choose their banks more carefully and to monitor the banks more actively to ensure that their funds are being invested prudently. These requirements make it difficult to realize PLS in practice. Daher, Masih, and Ibrahim (2015) also indicate that there is problem in practicing PLS, they find that in regions with important participatory financing, complexities from monitoring PLS arrangements might lead to rising adverse selection and moral hazard problems.

Relasari and Soediro (2017) explain the Islamic profit rate that the idea of interest is replaced by profit and loss sharing, however, a mark-up for delayed payments and trade-financing commissions are allowed under the Islamic banking model. In their study, the finding shows that there is no difference between rate of return and interest rate. The result is in accordance with Ismal (2013) that stated there is an indication the rate of return on deposits mudharabah tend to mimic the interest rate. Kaleem and Isa (2003) found that Islamic banks in Malaysia is commonly seen as conventional bank interest rate before adjusting the rate of return or profit. There is evidence that Islamic banks' managers are willingly to follow conventional banks' interest rate. And the evidence is also found by Zainol and Kassim (2010) that the relationship between Islamic banks' rate of return and conventional banks' interest rate is shown to be very strong and positive. For the lead-lag relation, Hamza (2016) found that the interest rate leads the Islamic banking pricing and remains its principal determinant.

Nevertheless, Islamic financing may not be as bad as "usury", and some studies advocate Islamic financing for its advantages over conventional financing. They argue that PLS paradigm can be practised well and it does have benefit for the economy and financial stability. It is commented by Khan (1986) that a primary advantage of PLS banking is that it leads to a more efficient allocation of capital because the return on capital and its allocation depend on the productivity and viability of the project.

Murabahah is one of the most commonly used Islamic financial instruments, it may represent the behavior of Islamic financial market in general. According to Almsafir and Alsmadi (2014), the effect of macroeconomic variables on Murabahah is acceptable compared with its impact on interest rate and Murabahah can make equilibrium faster than interest rate. He recommends the policy makers in Jordan to pay more attention to the Islamic finance as an alternative of conventional finance. Sukmana and Ibrahim (2017) give the conclusion in their study using Non-linear ARDL method that Islamic banks do not strictly follow conventional banks in the pricing of their investment deposits. They are quite different.

Most of these findings show that PLS return rate of Islamic financial instruments are correlated with interest rate, however, there are still some findings showing that PLS return rates have some unique features in Islamic financial market. So, to know more about the fact of PLS return rate, we need to know the cause of the fluctuation of interest rate and PLS rate. From the findings above, PLS rate is thought to be pegged with the interest rate. For interest rate, it is thought to be related to economic policies. Friedman (1968) shows it is generally believed that an increase in the quantity of money tends to lower interest rates. Madura (2014) indicates in his book that the relevant factors that affect interest rate movements include changes in economic growth, inflation, the budget deficit, foreign interest rates, and the money supply. These factors can have a strong impact on the aggregate supply of funds and/or the aggregate demand for funds and can thereby affect the equilibrium interest rate. Economic growth has a strong influence on the demand for loanable funds, and changes in the money supply have a strong impact on the supply of loanable funds. Thus, we test the hypothesis whether the PLS return rates are pegged with the interest rate or not.

Methodology

MGARCH-DCC:

In this study, we use this model (Multivatiate GARCH-DCC) introduced by Engle (2002) to assess the time varying volatility and correlation mainly between PLS return rates, LIBOR, and economic policy uncertainty. Except for the matrix, it gives first to show the unconditional volatilities of variables and correlations between each two, it also applies a Dynamic Conditional Correlation (DCC) method to improve modelling flexibility. Unlike the other methods applied for volatility and correlation, DCC model relaxes the assumptions that means and variances of variables and co-movements are invariable.

This is done by calculating a current correlation between the variables as a function of past realizations of both the volatility within the variables and the correlations between them. The link between variables can be observed to vary over time in a way that not only depends upon whether and to what degree the variables are moving in the same direction but also takeing into account the variance history that each series has experienced. The DCC approach allows series to have periods of positive, negative, or zero correlation. Thus, both direction and strength of the correlation can be observed (Nagayev, R., Disli, M., Inghelbrecht, K., & Ng, A., 2016). According to this method, there would be an increase of the positive correlation if two series move in the same direction, and on the contrary, when they move in the different directions, the correlation of two series will decrease and become negative.

So, the estimates of dynamic correlation can be used to analyze how significant events affect the integration between the variables.

First, in search for a suitable distribution, we run maximum likelihood tests on two kinds of distribution of returns, the standard normal distributions and t-distributions. Then, we use a two-step approach for the estimation of DCC models, for the first step we use a GARCH model to obtain univariate volatility parameters, the second step we use residuals as inputs for the estimation of time-varying correlations. (Pesaran and Pesaran, 2009).

Continuous Wavelet Transform (CWT):

Many researchers started using the continuous wavelet transform method in researches. According to the study of Nagayev, Disli, Inghelbrecht and Ng (2016), the CWT maps the original time series, which is a function of just one variable time-separate into function of two different variables such as time and frequency, it also maps the series correlations in a two-dimensional figure that allows the researcher to easily identify and interpret patterns or hidden

information.The analysis of correlation between two CWT is generally known as the wavelet coherence, these figures would indicate the extent of correlation between two variables with both time and time scale/frequency changing.

For CWT method, we use the Daubechies (1992) least asymmetric wavelet filter of length L=8 denoted by LA (8) based on eight non-zero coefficients. In choosing the wavelet filter, we have applied the principal of maintaining a 'balance' between the sample size and the length of the wavelet filter (In and Kim, 2013). Previous studies on high-frequency data have shown that a moderate-length filter such as L = 8 is adequate to deal with the characteristic features of time-series data (Gencay et al., 2001, 2002, In and Kim 2013). It has been shown in many studies that an LA (8) filter can give more smooth wavelet coefficients than other filters.

Continuous wavelet transform (CWT) is obtained by creating a mother wavelet for the examined time series, formula for CWT has been shown below:

$$W_X(u,s) = \int_{-\infty}^{\infty} x(t) \frac{1}{\sqrt{s}} \psi\left(\frac{t-u}{s}\right) dt \qquad _3$$

The position of the wavelet in the time domain is determined by u, its position in the frequency domain is determined by s, so, the wavelet transform, by mapping the original series into a function of u and s, gives us information simultaneously on time and frequency (Nagayev, R., Disli, M., Inghelbrecht, K., and Ng, A, 2016). To research on the interaction between two-time series, we apply a bivariate framework (wavelet coherence). Formula of the wavelet coherence is defined as:

$$R_n^2(s) = \frac{\left|S(s^{-1} W_n^{xy}(s))\right|^2}{S(s^{-1}|W_n^x(s)|^2. S(s^{-1}|W_n^y(s)|^2} \qquad _4$$

Compared to the GARCH-DCC method, the CWT method allows us to assess the co-movement between two different variables in each time scales, thus, it completes our MGARCH-DCC results.

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[3] Mother wavelet: ψ. Time series: $x(t) \in L^2(\mathbb{R})$.

[4] To explain it briefly: S reperesents a smoothing operator, s is a wavelet scale, $W_n^x(s)$ is the continuous wavelet transform of the time series X, $W_n^y(s)$ is the continuous wavelet transform of the time series Y, $W_n^{xy}(s)$ is a cross wavelet transform of the two-time series X and Y (Madaleno and Pinho, 2012).

Data:

We here use six variables to do the research, ECO represents economic policies uncertainty in US, MDR represents the Mudarabah rate, Mrb6M is the Murabahah 6-months rate, OIL is oil price and L6 indicates the LIBOR for 6 months. Time period range from 1-May- 2012 to 22-Mar-2015.

Results and Discussions

First, we get the results of two MGARCH-DCC models (Gaussian DCC Model and T-DCC model), by estimating, we get the Lambda1 and Lambda 2 tables for normal distribution (Gaussian DCC) model and t-distribution model. Also under each distribution, we get the on-diagonal and off-diagonal matrixes for unconditional correlations and unconditional volatilities. By comparing the maximum likelihood estimates results of normal distribution and t-distribution, we will decide which volatility and correlation matrix to use for interpretation. The tables of lambda1 and lambda 2 estimates and matrixes of volatilities and correlations are shown next page.

Table 1: Maximum Likelihood estimates of the Gaussian DCC model:

Parameter	Estimate	S.D.	t-ratio	Probability
lambda1_ECO	0.7301	0.091861	7.9479	[.000]
lambda2_ECO	0.20945	0.062926	3.3286	[.001]
lambda1_L6	0.80097	0.036859	21.7306	[.000]
lambda2_L6	0.171	0.030178	5.6665	[.000]
lambda1_MDR	0.70216	0.11054	6.3523	[.000]
lambda2_MDR	0.28483	0.10279	2.771	[.006]
lambda1_MRB6M	0.74537	0.053668	13.8885	[.000]
lambda2_MRB6M	0.18328	0.032688	5.6071	[.000]
lambda1_OIL	0.53373	0.068349	7.8089	[.000]
lambda2_OIL	0.39865	0.054128	7.3649	[.000]
lambda1_WH6M	0.82566	0.025192	32.7743	[.000]
lambda2_WH6M	0.1319	0.020205	6.5282	[.000]
delta 1	0.98128	0.002784	202.235	[.000]
delta 2	0.00927	0.001239	9.0043	[.000]
Maximized Log-Likelihood	29014.7			

Table 2: Unconditional Correlation and volatilities:

	MDR	OIL	ECO	L6	MRB6M	WH6M
MDR	**3.0843**	0.9428	0.84326	0.94272	0.9184	0.90295
OIL	0.9428	**92.3312**	0.88876	0.83833	0.829	0.83387
ECO	0.84326	0.88876	**125.951**	0.80057	0.77679	0.81206
L6	0.94272	0.83833	0.80057	**0.51967**	0.9318	0.94176
MRB6M	0.9184	0.829	0.77679	0.9318	**0.50177**	0.89288
WH6M	0.90295	0.83387	0.81206	0.94176	0.89288	**0.6043**

From the tables above, we can observe that economic policies uncertainty has the highest volatilities (125.951) among the six variables, which is followed by oil price. One of the Islamic profit rate index (Murabahah-6-months) is found to be the most stable one, with an unconditional volatility of 0.50177. It's worth noting that Mudarabah rate has a relatively high volatility (3.0843).

However, when we look at the unconditional correlations, the results show that Mudarabah rate is more related with economic policies uncertainty than LIBOR which is beyond our expectation, but another major Islamic profit rate Murabahah rate has a less correlation with economic policies uncertainty than LIBOR which is in line with our expectation. Correlation between economic policies uncertainty and oil price index is also high, this may due to the high impact of oil to the world's different economic departments. In many researches people find that Islamic banks use interest rate as the reference for determining the Wakalah fees, so that's why we can find that the correlation between Wakala-6-months rate and economic policies uncertainty is similar with the one of LIBOR. What's more, correlations between Mudarabah, Wakalah and LIBOR are also high, whereas, the one of Murabahah is relatively lower.

Similar results can be found in the t-DCC estimation as well in the tables below:

Table 3: Maximum Likelihood estimates of the t- DCC model:

Parameter	Estimate	S.D.	t-ratio	Probability
lambda1_ECO	0.8371	0.076861	9.461903906	[.000]
lambda2_ECO	0.11645	0.047926	5.19004159	[.000]
lambda1_L6	0.90797	0.021859	24.03749023	[.000]

lambda2_L6	0.088	0.015178	7.783948915	[.000]
lambda1_MDR	0.80916	0.09554	8.802347344	[.000]
lambda2_MDR	0.11183	0.08779	7.341846025	[.000]
lambda1_MRB6M	0.85237	0.021668	15.87806721	[.000]
lambda2_MRB6M	0.10028	0.000688	8.082542958	[.000]
lambda1_OIL	0.64073	0.036349	9.837359623	[.000]
lambda2_OIL	0.32565	0.022128	9.209417786	[.000]
lambda1_WH6M	0.93266	1.02966	34.69872156	[.000]
lambda2_WH6M	0.0389	0.1359	8.580848516	[.000]
delta 1	0.89128	0.97128	204.0681836	[.000]
delta 2	0.09927	0.17927	10.89140358	[.000]
df	8.9762	0.45866	18.24444386	[.000]
Maximized Log-Likelihood	34014.7			

Table 4: Unconditional Correlation and volatilities:

	MDR	OIL	ECO	L6	MRB6M	WH6M
MDR	**3.0843**	0.9428	0.84326	0.94272	0.9184	0.90295
OIL	0.9428	**92.3312**	0.88876	0.83833	0.829	0.83387
ECO	0.84326	0.88876	**125.951**	0.80057	0.77679	0.81206
L6	0.94272	0.83833	0.80057	**0.51967**	0.9318	0.94176
MRB6M	0.9184	0.829	0.77679	0.9318	**0.50177**	0.89288
WH6M	0.90295	0.83387	0.81206	0.94176	0.89288	**0.6043**

The tables above show similar results with the normal distribution estimation, economic policies uncertainty still has the highest volatility. Murabahah is still the most stable in volatility, correlation between Mudarabah and LIBOR is still high, this draws our attention. It

may because of the force given by conventional deposit rate to attract more customers for the banks to survive. Murabahah seems to be less correlated with economic policies uncertainty than LIBOR, which gives us a strong evidence that there are indeed some Islamic financial instruments have its own features and not purely pegged on interest rate. Because Murabahah account for a big amount of Islamic financial instruments, so, in general, it can be considered that Islamic profit rate does not necessary to follow interest rate.

While there are two estimation methods, so we need to choose the most significant one to do the explanation.

By checking the tables for Lambda, we notice that the values of 'Lambda1 +Lambda 2' are all close to one and less than one, it shows a very slow decay in volatilities of the variables in DCC model. And the t-distribution maximized Log-likelihood value is larger than the one of Gaussian DCC model. And the estimated degrees of freedom for the t-distribution is below 30, so it is suggested that t-distribution is a more appropriate model for capturing the fat-tailed nature of the distribution of these variables. Based on the t-DCC results we make the ranking tables below for unconditional volatilities and correlations with economic policies uncertainty.

Table 5: Ranks of the unconditional volatilities:

Index	Ranking	Volatility
ECO	1	125.951
OIL	2	92.3312
MDR	3	3.0843
WH6M	4	0.6043
L6	5	0.51967
MRB6M	6	0.50177

Table 6: Ranks of the correlation with economic policy uncertainty:

Index	Ranking	Correlation with ECO
OIL	1	0.88876
MDR	2	0.84326
WH6M	3	0.81206
L6	4	0.80057
MRB6M	5	0.77679

The ranking above demonstrates that economic policies are not stable, it is quite volatile, Murabahah rate is the least volatile one, volatilities of Mudarabah and Wakalah are higher than LIBOR. This may be because of the correlation between oil and Islamic finance and the high volatility of OIL shown in the table.

For the correlation part, we can see that LIBOR is more correlated with economic policies than Murabahah rate. This finding show that there are evidence showing that Islamic financial instrument is not purely following conventional interest. However, correlations of ECO with Mudarabah rate and Wakalah rate are relatively higher than LIBOR, which require more studies further.

Then we examine the relations again by ploting the charts of conditional volatilities and dynamic conditional correlations which can give us the information of time-varying properties in the volatilities and the correlations, because the values of different variables range in a large scope, we create three charts to show the information clearer. Below are the charts for the results:

Figure 1: Conditional volatilities-ECO MDR OIL L6 MRB6M WH6M
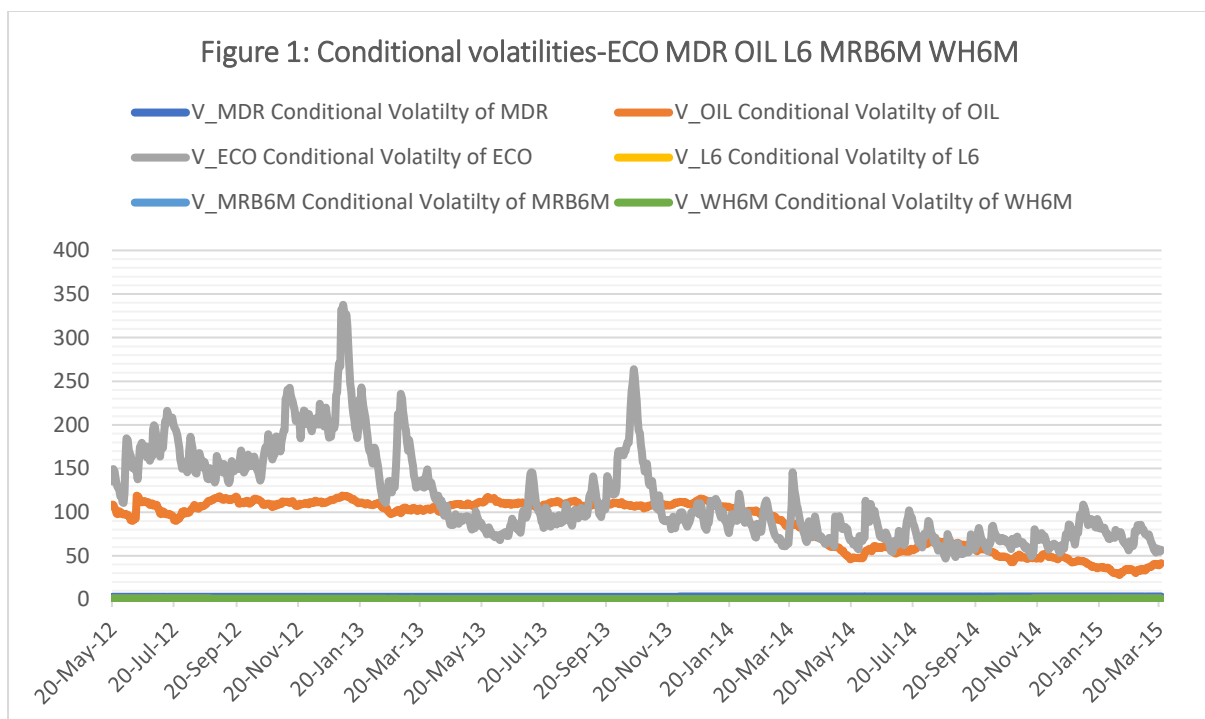
For this chart, we can observe that the volatility of ECO is still the highest, the second one is the OIL, however, both experienced a decreasing trend from 2012 to 2015. Around January 2013 and October 2013, there were big fluctuations of the volatilities, these may be related to some changing of the economic policies in US. However, the values of LIBOR and other Islamic profit rates are quite small compared to ECO and OIL. So, we need to refer to the next two charts to observe more information.

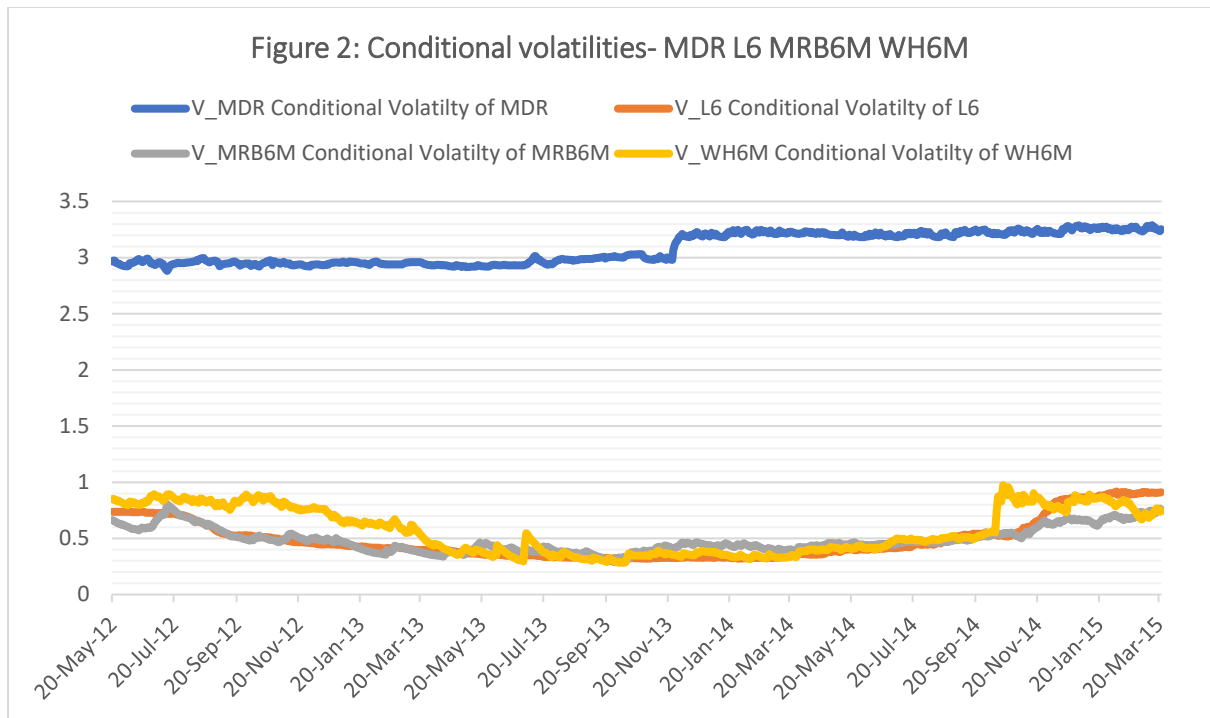Figure 2: Conditional volatilities- MDR L6 MRB6M WH6M

Figure 2 shows the same results with unconditional volatility table, Mudarabah volatility is still high here, Mudarabah is a kind of joint venture, so according to its nature, it should be correlated more to the real economy which is highly influenced by the economic policies, thus the high volatility of the Mudarabah can be regarded as the impact of the high volatility of the economic policies uncertainty. However, more results like correlation should be considered as well.

Figure 3: Conditional volatilities-L6 MRB6M WH6M
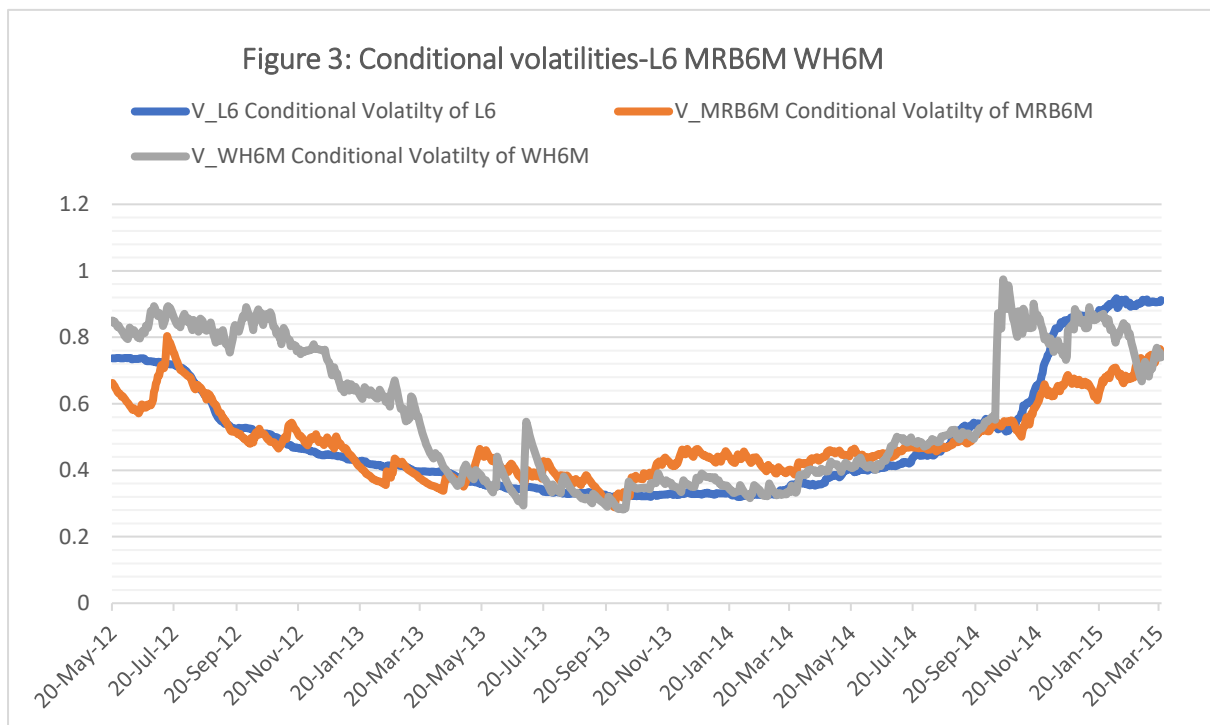
By zooming the lines on the bottom of figure 2 which are not easy to observe, we find that, volatility of LIBOR and two Islamic profit rates (Murabahah and Wakalah), are co-integrated together, they reached the bottom in September 2013, which may be because of the changing of economic policies at that time, this may show that all these rates of return are influenced by the economic policies. Changing of LIBOR is relatively stable, while the volatility of Wakalah rate is quite instable. Murabahah rate behaves similar with LIBOR.

Next are figures for conditional correlations, we plot the correlations between ECO and rate of return indexes (Both Islamic and conventional), to show whether Islamic profit rates are correlated with economic policies uncertainty or not. We want to know whether it is similar with the correlation of LIBOR with ECO or not. In such way, we can give judgement about whether PLS rate is pegged on interest rate or not.

Below are the figures:

Figure 4: Conditional Correlations
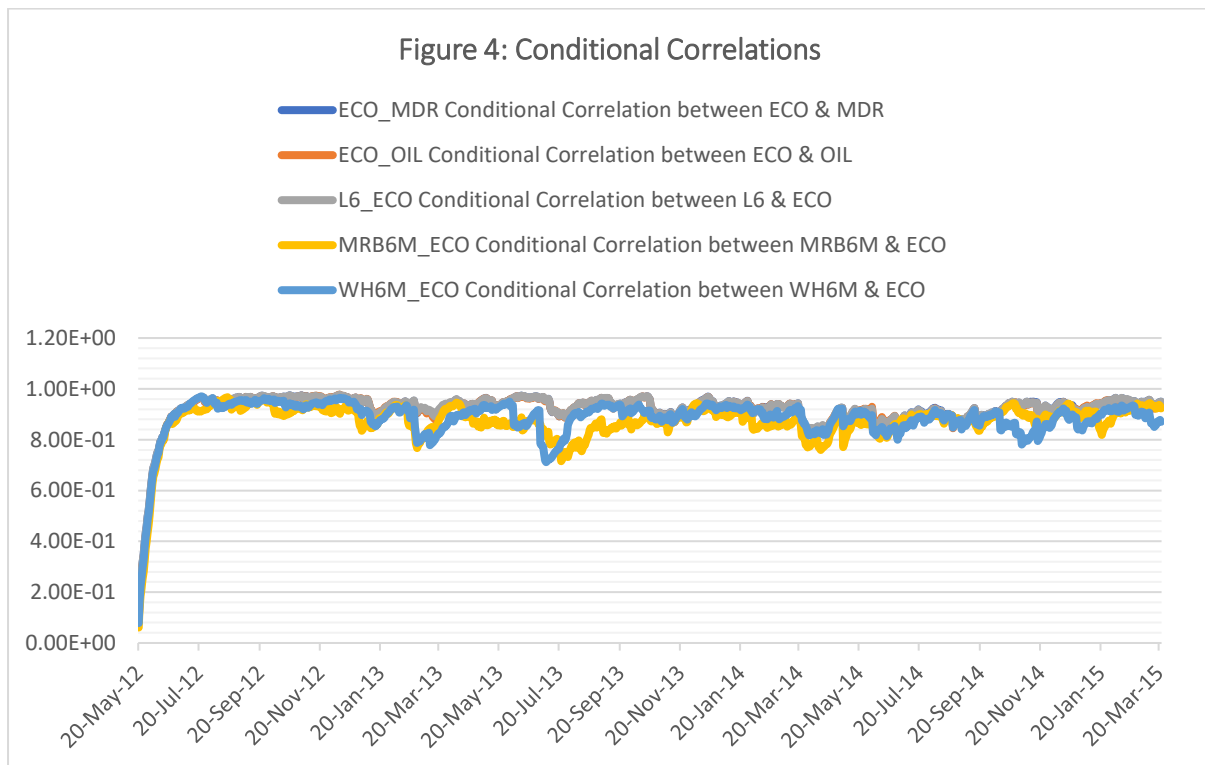
As shown in the figure above, the grey line which represents the correlation between ECO and L6 is always above the other lines. It shows a high correlation between economic policies uncertainty and LIBOR, it is in line with the theory to explain the change of interest rate by economic policies. Interestingly, the other two lines are moving very close to the grey line, they are the lines representing correlation between OIL and ECO and correlation between Mudarabah-6-months and ECO, this shows the same result with the one we obtained in unconditional correlation matrix. From the result, we know that the criticism from the public

about the replication of Islamic banking deposit rate (Mudarabah rate) from conventional banks may be true. However, it doesn't mean that all the Islamic financial instruments are replications of conventional ones. The correlation between Murabahah and economic policies uncertainty and the correlation between Wakalah and economic policies uncertainty are relatively lower, and they are not totally co-integrated with the trend of LIBOR-ECO correlation. This is a good evidence showing that there are Islamic financial instruments behave in a unique way, they are not pegged on interest rate totally.

This different trending indicates that, Islamic PLS return rates are not fully influenced by the economic policies. While, for interest rate which is represented by LIBOR here, both the theory and the experimental results show the high influence of economic policies on interest rate. These two different experimental results give us a conclusion that Islamic financial instruments cannot be easily considered as the replications of the interest based financial instruments.

To test the robustness of previous findings, we applied Continuous Wavelet Transform, also, we use this method to check the lead-lag relation among these variables in different time scale. Below are the figures showing the CWT results:

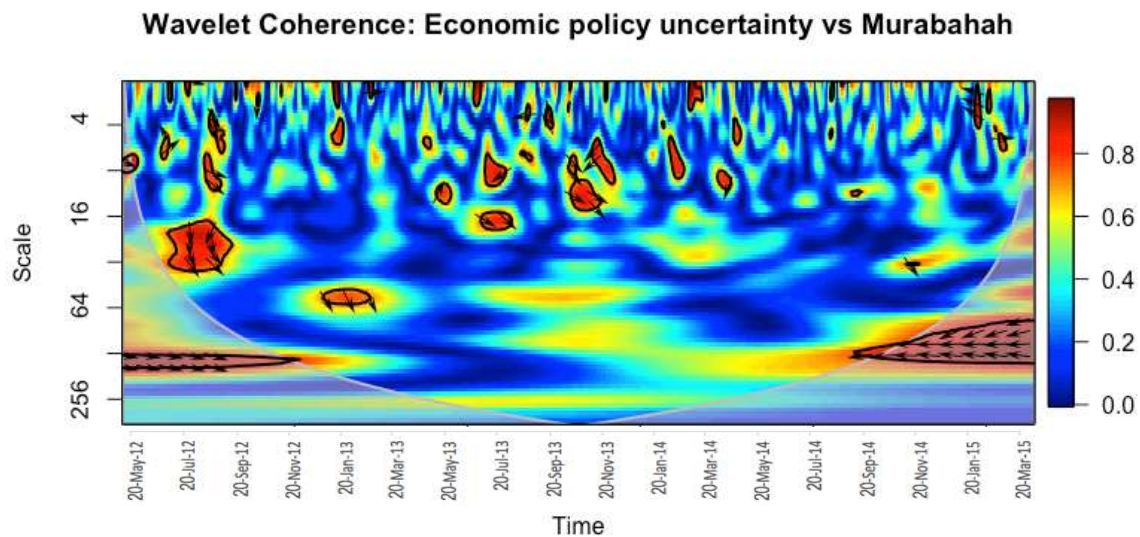**Figure 5: Continuous Wavelet Transform ECO vs Murabahah**

Wavelet Coherence: Economic policy uncertainty vs Murabahah

Figure 6: Continuous Wavelet Transform ECO vs LIBOR

Wavelet Coherence: Economic policy uncertainty vs LIBOR
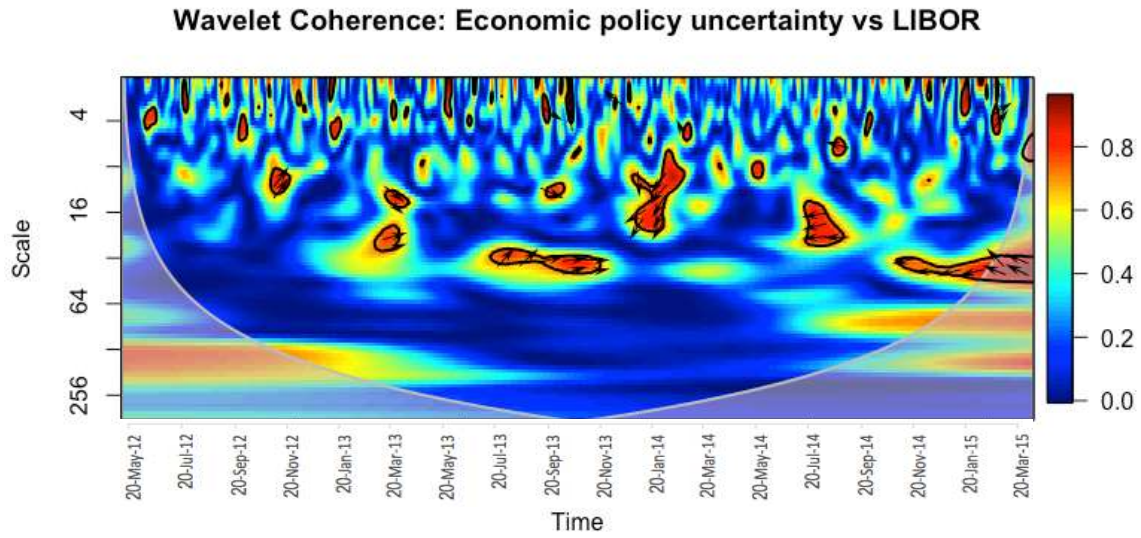
Figure 7: Continuous Wavelet Transform ECO vs Mudarabah

Wavelet Coherence: Economic policy uncertainty vs Mudarabah
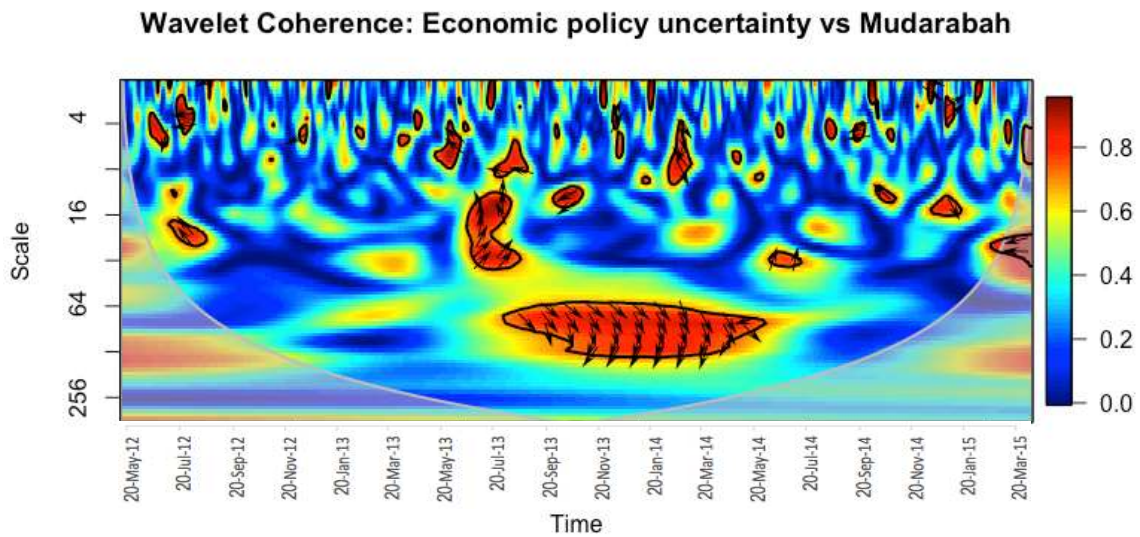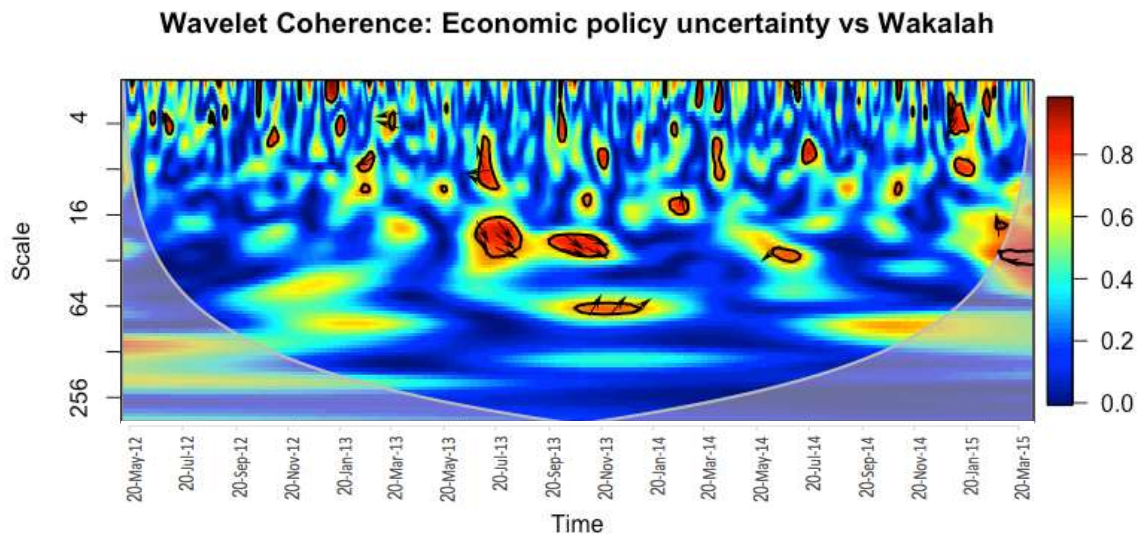
Figure 8: Continuous Wavelet Transform ECO vs Wakalah

Figures above show the dynamic correlations in different time scale and time line. Each figure is divided by a curve into two parts, part above the curve represents the results at 95% confidence level, we only refer to the results in this part, the red area shows the two variables are highly correlated at the time point and time scale. Blue area shows that there is no correlation at all.

By observing these figures, we find the results which support the previous findings. Mudarabah is still highly correlated with the economic policies, especially between 2013 and 2014, in the time scale between 64 and 256. The results for Wakala and Murabahah seem to be less than Mudarabah, however correlatin between LIBOR and ECO, is not significantly higher than Wakala and Murabahah, the reasons need more researches.

In general, except for Mudarabah, Islamic PLS rates are not highly correlated with economic policies unvertainty. What's more, the big red area shown in the figure of Mudarabah draw our attention, further researches need to do more work on finding the reason for the extremely high correlation with ECO during this time.

However, for the leading and lagging relations, it is ambiguous to make a conclusion, the arrows in the figures change frequently. It is beyond our expectation that economic policies are the leading reason for the changing of LIBOR and indexes which are pegged on it.

Below are some figures showing the correlation between OIL and Islamic financial instruments, we do this test to check the expectation that Islamic money market is leaded by oil price. If so, we can further enhance our previous finding.
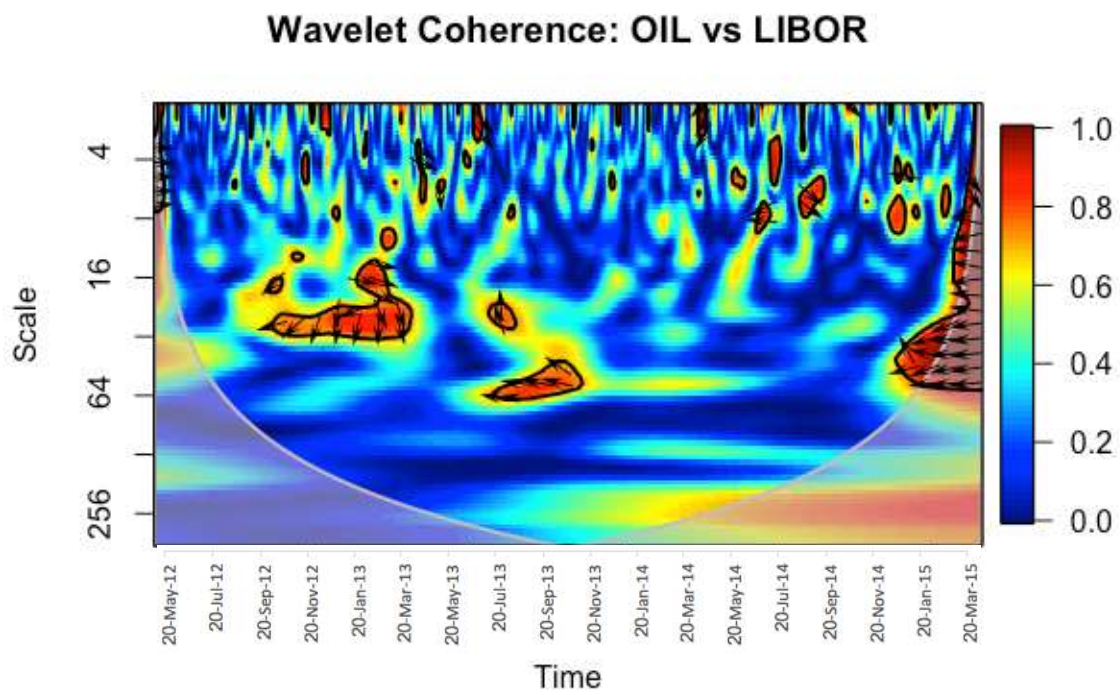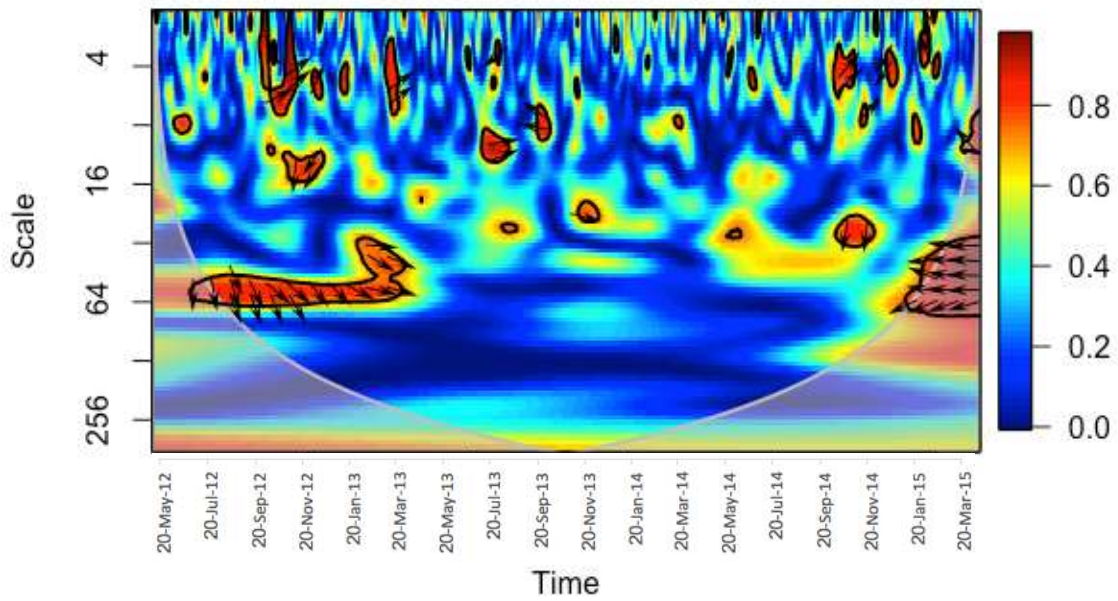
Figure 9: Continuous Wavelet Transform OIL vs LIBOR

Wavelet Coherence: OIL vs LIBOR

Figure 10: Continuous Wavelet Transform OIL vs Mudarabah

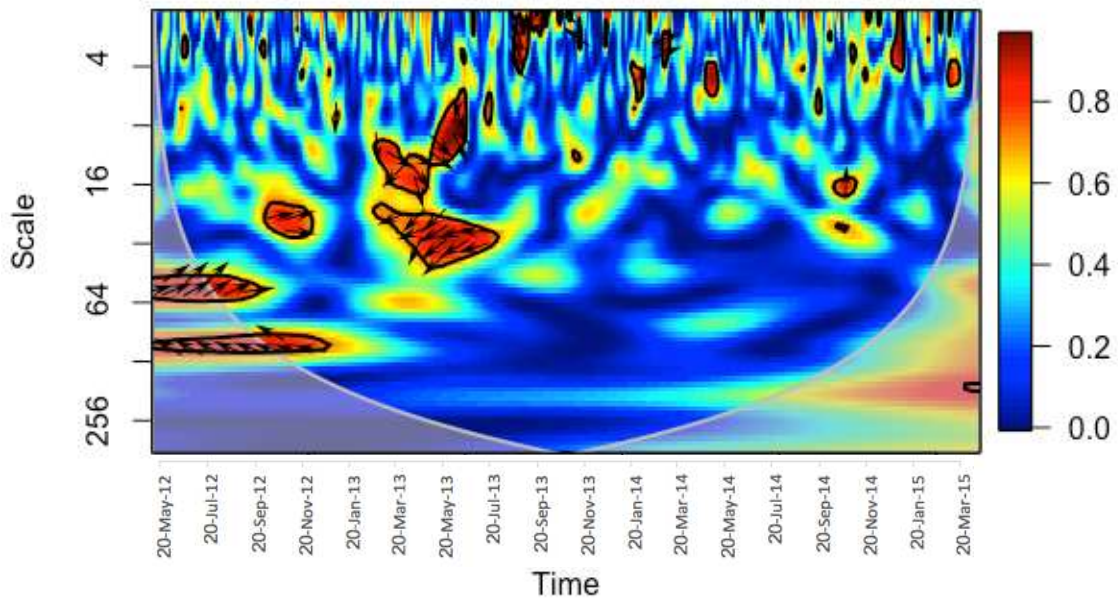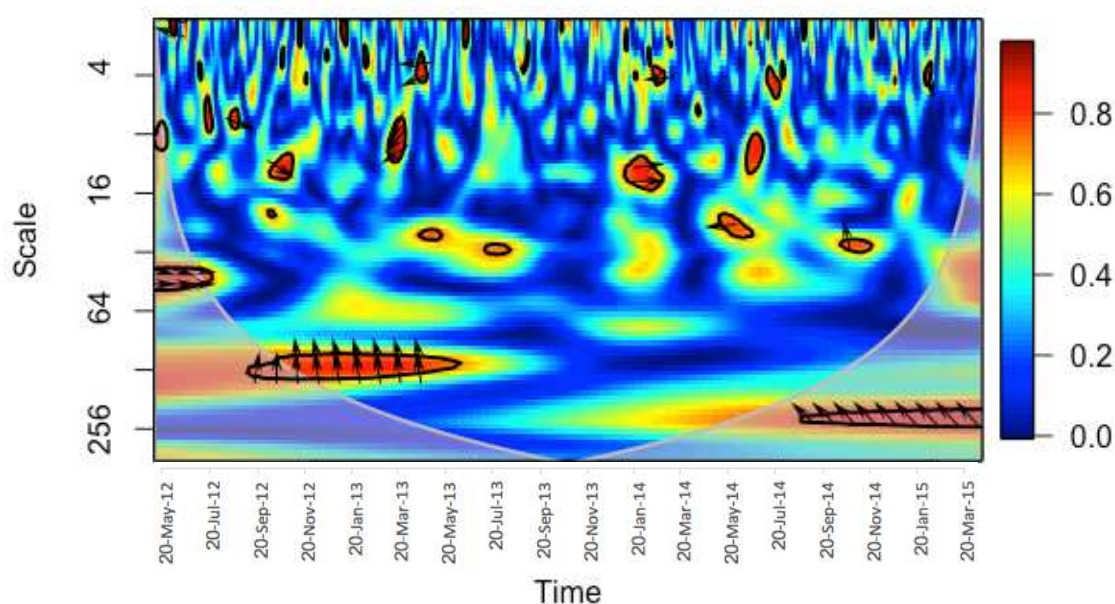**Figure 11: Continuous Wavelet Transform OIL vs Murabahah**

Figure 12: Continuous Wavelet Transform OIL vs Wakalah

Wavelet Coherence: OIL vs Wakalah

The figures show that Murabahah is most correlated with oil price, however, the leading-lagging relation is not consistent, oil is not always leading the Murabahah rate. Result of LIBOR is less than the one of Murabahah, which gives us a strong evidence for the judgement that Islamic financial Instruments are not interest-following. Mudarabah had a high correlation with oil price from July-2012 to March-2013, and it has been shown significantly that oil price was leading the Mudarabah price, this would be used as a new evidence to protect Mudarabah from the criticism. From the result, Wakalah is not highly correlated with oil price, except for a small period (Sep-2012 to May-2013), with the arrow showing that oil was leading Wakalah rate.

In general, oil price plays and important role in Islamic money market, both from experience and the experimental evidence, so, together with the previous findings, we can make a conclusion that, mostly, Islamic money market does not totally follow conventional one, there might be some contracts influenced by the interest rate, this might be due to the high competition of their conventional counterparties. The fundamental structure of these Islamic financial contracts may still have the function to make Islamic money market independent and real-economy based. However, more efforts should be made by the leaders of Islamic financial institutions to make Islamic money market more independent from the interest based financial system, and connect it much closer to the real economy.

Conclusions

Whether Islamic finance is really interest free? This question has been discussed many years since the establishment of the first Islamic bank. Islamic financial products are believed to be based on profit-and-loss sharing (PLS) paradigm, by which financial institutions and investors share the profit and loss together. While in practice, this issue has caused a debate. Some make strong criticisms against the Islamic banks for its replications of the conventional financial institutions. However, some advocate Islamic bank for the incentives of real profitable economic behaviors it brings to the market. But most of the discussions and researches on this issue are qualitative, only a few do it in detail with quantitative methods. This study re-examines the discussion and criticisms with new econometrics methods to see the relation of the rates of return for two types, Islamic and conventional. Economic policies uncertainty which is regarded as the cause of fluctuation of interest rate has been included in this study. We make comparison for the correlations between two types of rates of return and economic policies uncertainty. By using the new methods (MGARCH-DCC and CWT), we examine the unconditional volatilities and unconditional correlations of these rates, as well as the conditional volatilities and dynamic conditional correlation to see the features of these variables in different time and time scale. Then Continuous Wavelet Transform gives the robustness of the findings, correlation of these variables in different time scales as well as the lead-lag relations between economic policies uncertainty and two different rates. These two methods help to investigate the controversial issue with a new angle.

Our results mainly show that, in summary, Islamic PLS rates are not totally following interest rate. And we find that Murabahah profit rate is less correlated with economic policies volatilities than LIBOR. However, Mudarabah profit rate behave quite similar with LIBOR. The CWT results show that the results of MGARCH-DCC are significant, and most of the Islamic financial contracts are correlated with the oil price, this gives a further evidence to support the judgement that Islamic money market is different with conventional ones. In conclusion, Islamic financial instruments are not so bad as being described in those criticisms, but both the uniqueness of Islamic financial products and similarity of Islamic financial products (e.g. Mudarabah) with conventional interest rate exist in today's Islamic money market, and more efforts should be made by the headquarters of Islamic financial institutions to make Islamic finance more independent from the interest based financial system, and make Islamic finance to be a catalyst for the development of the real economy.

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