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Causals of Time-Scaled Volatility, Business Cycles and Macro-Economic Indicators: A Wavelet Analysis of Selected Islamic Countries

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Abstract

The inconsistent nature of the RBC makes necessary to understand the relationship between stock performance and economic activity. This study attempts to establish the relationship between ISI with selected macroeconomic indicators and RBC. By using 12 years' monthly data the results have extracted after using ARCH/GARCH, wavelet analysis with MOWDT Daubechies filter of at scale 3 of symmlet 8 as well as panel ARDL for three Islamic countries. The findings confirms that ISI appears to be less volatile in expansion phase of RBC and high during recession but decreases gradually as the time scale expands. Moreover, TO, OP, CPI and BD have also significant relationship with ISI. Countrywide analysis showed that Islamic stock markets of selected countries are receptive to shrinkage and expansion of economic activities. The outcome of the study brings insight that how shock in ISI stability may affect future output and ISI is a useful variable of economic stability.

Key Words: Islamic stock indices (ISI), Real Business Cycles (RBC), Banking development (BD), Trade openness (TO), oil prices (OP)

Jel Codes: E32, G12, L16

1. Introduction

The performance of the corporate sector heavily depends on the economic growth of the country. Companies make financial decisions under the light of their current financial position and according to the policies devised by the government time to time. Keeping this fact in mind, one can understand that the interaction between macroeconomic indicators and the corporate world is quite firm.

Capital markets create a multidimensional impact on the country's economic growth and well-being to the corporate world at the same time. On the

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other hand, stock market is a vital component of the capital markets in every country (Alam & Hussein, 2019)

The consideration of interdependency of the stock market and economic growth has overwhelmingly increased over the last few decades. It is evident that the deterioration of stock markets impacts the country's financial well-being (Osaseri & Osamwonyi, 2019). At the same time, the economic downturn brings some unpleasant changes that restrain the country stock markets to perform efficiently and smoothly. Economic activities and stock markets is relatively straightforward and bilateral; however, the role of economic activities is quite dominant due to its scale and vitality (Hossin & Islam, 2019).

Economic activities of every country are subject to contraction and expansions because of variability in the policies and procedures of the government as well as due to specific national and international factors. This kind of movement in the economy could be termed as business cycle. Business cycles are the results major economic forces in the country. Thus by virtue of this, it ultimately affects business activities and automatically to the stock markets of the concerned countries (Horvath, 2018).

Islamization in banking and finance has enough reputation over the last few decades, and the growth in this sector is now tremendous. As a result, it has now successfully been operationalized in many Islamic and non-Islamic countries as well. Islamic banks work under the Shari'ah guidelines are engaged with only these business ventures who follow ethical guidelines and adopt permissible activities (A. Abdullah, Mohd Salleh, M.Z.,& Muhammad, M.Z., 2018).

The business operations are permissible or considered 'Halal' when the company is not engaged in trading alcohol, liquor, pork, pornography, arms, tobacco, profit from gambling, and revenues derived by granting a loan in the form of interest. Moreover, if the animals are not slaughtered Islamically, the operations are also considered 'Haram' and not permissible under Shari'ah guidelines (M. A. Abdullah, & Azam, M.S.E 2020) .

From 2014, the growth in Islamic finance assets has increased tremendously; Refinitive (2020) confirms that the accumulated growth of the Islamic finance assets from 2014 to 2019 has increases from US $ 1.7 billion to US $ 3.5 trillion. However, according to IFDI, the prospective accumulation at the end of 2024 would be 3.5 billion US$. Fig 1 shows the growth of Islamic finance from 2014 to 2019.

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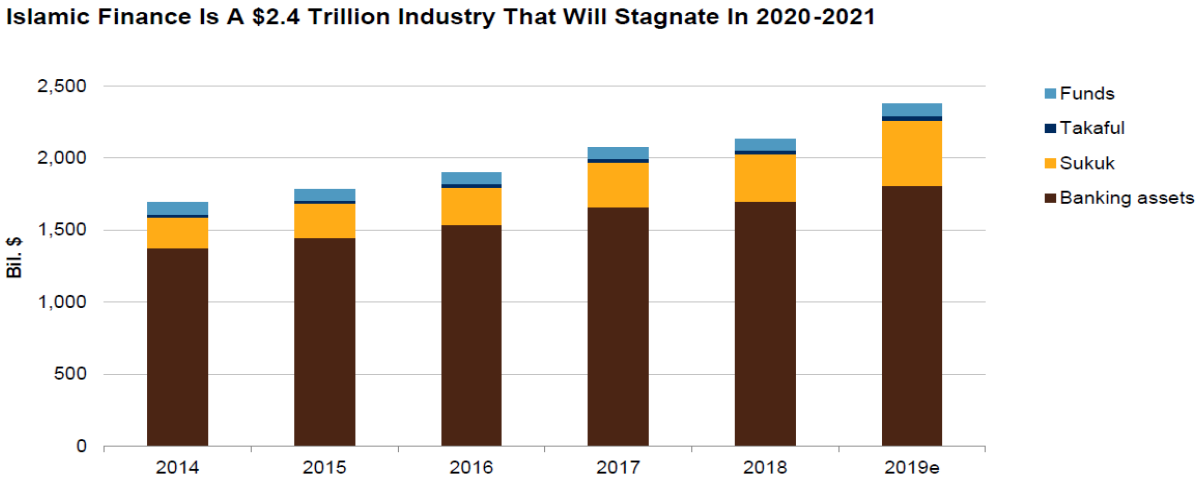
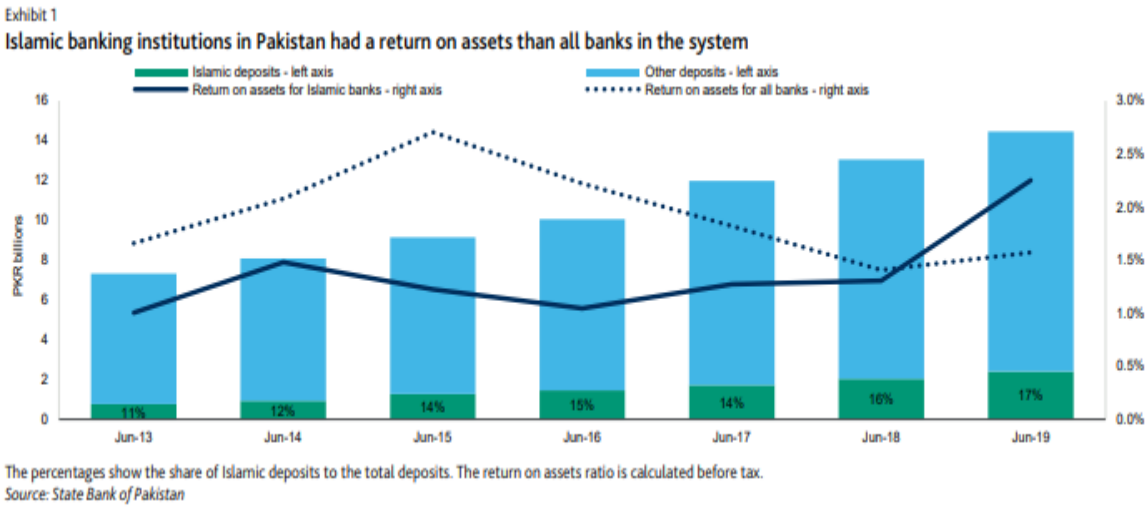
Fig. 1: Accumulated Global Islamic Finance Assets



Source: (SBP, 2020)

The growth of Islamic banking is remarkable, specifically in the case of Pakistan. From Fig 1, we can see that from June 13 to June 19, there is 6% upward growth in Islamic banking, and now the overall share of Islamic banking is approximately 17% as compared to its conventional counterpart.

Fig. 2: Performance of Islamic Banking in Pakistan



Source: (SBP, 2020)

Thus along with the conventional setup of stock markets, Islamic stock is now working concurrently fully and efficiently (S. Ali, Shahzad, Raza, & Al-Yahyaee, 2018). Another critical aspect of the Islamic stock markets, as supported by the past studies, is that they are more resilient to the economic and financial shocks, proving that they are not chasing the false alarm as in conventional stock markets (Jawadi, Jawadi, & Idi Cheffou, 2020).

A large number of studies has conducted which shows the comparison of the conventional stock market with the Islamic stock market; however, very few studies are there which shows that how volatility of the ISI individually interacts with business cycles along with other macro-economic indicators. Hence, it is imperative to examine the impact of real business cycles and Marco-economic variables on the performance of ISI.

1.1. Research Objective & Motivation

The main aim of the study is to find out the relationship of ISI volatility with the business cycles along with certain macro-economic indicators. The author's endeavors to provide a preliminary study to unravel the idea that whether ISI show more stability during the troughs of business cycles. The novel of the study is of twofold first it incorporates extraction of volatility from Islamic stock price by using ARCH/GARCH and the application of wavelet analysis to decompose the volatility into multiple time scale followed by empirical testing the relationship of extracted time scaled volatilities with the business cycles and selected economic indicators.

The motivation of the study is due to growing interest in the field of Islamic finance and capital markets. Islamic markets are now being considered as expedient avenue for the investors and relevant stockholders all over the globe. There are lot of studies undertaken to address the impact of crisis on financial growth and vice versa. The outcome of the findings mainly believes that conventional economy subject to many discomforts and more vulnerable due to its major reliant on non-real activities thus affects heavily on the capital and stock markets.

Islamic finance on the other hand is based on the concept of real asset and real sector. This kind of relationship demands a study, which enlightens the areas of capital markets under the concept business cycles, macro-economic indicators and multi horizon timescale with Islamic finance. This study contribute to fill the gap of this very concept.

The present study is an effort to fill the dearth in the present literature and focusses empirically to substantiate, that Islamic stock could be a safer option to the investor's class of capital market. Hence, with the above stated motivation this research will address the following questions:

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(1) Real business cycles has significant impact on the volatility of ISI in long run and short run?

(2) Trade openness creates impact on the volatility of ISI?

(3) Oil prices have significant impact on the volatility of ISI? (4) CPI has significant on the volatility of ISI?

This paper comprises five sections, following this introduction; the next section is literature review, afterwards methodology, results, and discussion and lastly the conclusion and policy implication.

2. Literature review

The economic growth of the country largely depends on many economic factors however, at same time capital markets and financial institution also play vital role. Islamic banks, since their emergence, act as critical players to bring growth in the economic conditions, precisely where its network is sound and worthwhile. Tabash and Dhankar (2014) confirm that in Islamic countries the relationship between Islamic banking and economic growth is positive and significant with each other.

M. Ali and Azmi (2017) on the other hand narrate that although the scale of Islamic banking is not very large in many Islamic countries; their very nature of less volatility proves to be more effective and supportive as far as economic development is concerned. The emergence of Islamic banking gives rise to Islamic stock markets in many Islamic and non-Islamic countries. The term Islamic equity means the share of companies are operating permissible businesses, which is Halal and confirms the Shari'ah guidelines drafted by the Shari'ah scholars. The Shari'ah scholars review the business operations from time to time, and the very process is called Islamic stock screening (Rahman, 2010).

In the wake of performance of ISI many studies has conducted which tested the relationship of ISI with macro-economic variables such as IPI, GDP, CPI, Interest rates, TO , money supply, exchange rate, oil price, structural changes and similar other variables. Hussin, Muhammad, Abu, and Awang (2012) narrate that Islamic stock prices show positive and robust relationship with industrial production index and consumer price in case of Malaysian Shari'ah stock indices.

In similar context M. Rashid, Hassan, and Yein (2014) also narrate that the interest rates and the currency index show a more significant relationship with the ISI in Malaysia, whereas the industrial production index, CPI, money supply, and investors sentiment index do not show a substantial relationship with ISI. Irfan (2016) also supports that the ISI do matter for the economic growth of the country and the relationship of the ISI has long run and positive relationship with Interest rates, CPI, Money supply and exchange rate in case of India. Shamsuddin (2014) suggests that Islamic equity funds, compared to the conventional indices, are less subject to interest rate risk.

Said and Grassa (2013) of the view that GDP per capita, economy size, TO and percentage of Muslims play vital and significant role for the development of Islamic capital markets especially in the case of Sukuk. The selected countries include Saudi Arabia, Kuwait, UAE, Bahrain, Qatar, Indonesia, Malaysia, Brunei, Pakistan, and Gambia observed for the period 2003-2012. (Jamaludin, Ismail, & Ab Manaf, 2017) narrates that TO does not create any impact on the stock market moreover on the development of the economy the effect is also not emphasize able

Sakti and Harun (2015) conclude that that ISI show a long-term relationship with the exchange rate, industrial production index, inflation and money supply. They argued that government should establish policies to stabilize Islamic stock indices. Vejzagic and Zarafat (2013) deduced that shariah indices show significant results with interest rates, exchange rates and money supply. They show the relationship with interest rate and exchange raters where the relationship with the money supply is positive. However, they further argued that CPI shows an insignificant pattern with the shariah indices

Stock market performance, macro-economic variables in the context of structural break show that interest rates significantly affect the performance of stock markets in the short run whereas CPI do not display any action on the performance of the stock market. (A. Rashid, 2008) .While testing GDP, per capita income and inflation with stock return in presence of structural breaks Ahmad, Abdullah, Abdullahi, and Muhammad (2015) suggest that solid evidence presents that per capita income and inflation impact the stock market performance; however, the relationship is uni-direction.

Oil prices play a constructive role in the growth of the economy. In this aspect, A. M. Abdullah, Saiti, and Masih (2016) deduce that the Philippines price of crude oil is less correlated with the Islamic stock indices; thus, investors must take those measures to avoid potential hazards for their portfolios. In line with the above-stated scenario, Arshad (2017) believes that oil prices volatility is concurrent with stock price volatility. He further argued that as the country's economy is heavily reliant on the oil price thus, it directly affects its stock markets.

The pattern of volatility of ISI in various economic conditions shows different results for instance, Arshad (2016) Claims that ISI in the recession period became more volatile and less volatile during the economic boom. Al-Khazali, Leduc, and Alsayed (2016) Narrate that ISI are less volatile in the recession period than their conventional counterpart; moreover, they claim that the Islamic stocks are less volatile and more resilient. The theory tested under the context of the Martingale Difference Hypothesis (MDH) and Random Walk Hypothesis (RWH) by taking nine conventional and Islamic indices of various Islamic and non-Islamic countries. Milly and Sultan (2012) claim that ISI are less volatile and shows greater efficiency in the period of economic downturn as compared to the conventional stock indices during the period 2000 to 2009.

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Arshad and Rizvi (2013) reviewed the pattern of ISI concerning business cycles narrates that in the period of recession, ISI shows less volatility whereas in peak session the same shows less volatility Girard and Hassan (2008), confirm that Islamic stock showing a more stable trend in the period of crises as compared to their conventional equivalents.

Ho, Rahman, Yusuf, and Zamzamin (2014) found that ISI showed greater efficiency during the dotcom crisis and became less volatile. Rizvi and Arshad (2014) have found a week and low relationship between ISI and conventional indices. They further suggest that during the period of recession, investing in ISI is more viable as compared to the traditional way of investment.

Naseri and Masih (2013) tested the relationship of macro-economic variables with ISI in presence of unknown structural breaks. It shows that inflation, aggregate money and exchange rate do count to uplift the performance of the stock market in Malaysia. Based on the literature reviewed we have come up the following hypothesis for the present study:

2.1.Hypothesis of the study

H_1: Real Business Cycle has a significant impact on the volatility of ISI in the Long run
$H_{1\,(b)}$: Real Business Cycle has asymmetrical impact on the volatility of ISI in the Short-run
H_2: Internationalization (TO) has a significant impact on the volatility of ISI
H_3: Oil prices have a significant impact on the volatility of ISI
H_4: Consumer Price Index has Significant Impact on the Volatility of ISI

3. Methodology

3.1. Data

The economic data for selected three countries has obtained from World development indicators, central banks and economical and statistical bureau of the relevant country. For stock related data, the monthly prices of ISI has obtained from the stock exchanges of the respective countries for a period of 12 years comprising 2007 to 2019.

3.2. Model of the study

For empirical analysis, the following models are developed with the help of extracted stock indices volatility, business cycles, structural breaks and selected macro-economic indicators:

$$\delta SI(16-32\ days) = \boldsymbol{\alpha} + \sum_{i=0}^{n} \beta 1RBC1 + \sum_{i=0}^{n} \beta 2RBC2 + \sum_{i=0}^{n} \beta 3BD + \sum_{i=0}^{n} \beta 4TO + \sum_{i=0}^{n} \beta 5CPI + \sum_{i=0}^{n} \beta 6OP + \sum_{i=0}^{n} \beta 7Str + \boldsymbol{\varepsilon} \quad \textbf{(1)}$$

$$\delta SI(32-64\ days) = \boldsymbol{\alpha} + \sum_{i=0}^{n} \beta 1RBC1 + \sum_{i=0}^{n} \beta 2RBC2 + \sum_{i=0}^{n} \beta 3BD + \sum_{i=0}^{n} \beta 4TO + \sum_{i=0}^{n} \beta 5CPI + \sum_{i=0}^{n} \beta 6OP + \sum_{i=0}^{n} \beta 7Str + \boldsymbol{\varepsilon} \quad \textbf{(2)}$$

$$\delta SI(>64\ days) = \boldsymbol{\alpha} + \sum_{i=0}^{n} \beta 1RBC1 + \sum_{i=0}^{n} \beta 2RBC2 + \sum_{i=0}^{n} \beta 3BD + \sum_{i=0}^{n} \beta 4TO + \sum_{i=0}^{n} \beta 5CPI + \sum_{i=0}^{n} \beta 6OP + \sum_{i=0}^{n} \beta 7Str + \boldsymbol{\varepsilon} \quad \textbf{(3)}$$

Table 1. Definition of variable

δSI	*volatility of Stock indices*	*OP*	*Oil Prices*
RRBC 1	Real Business Cycle (Increase) *DE trending *IPI using band pass filter*	*CPI*	*Consumer Price Index (Inflation)*
RRBC 2	Real Business Cycle (Decrease)	*STR*	*Structural Break (Unknown)*
TO	*Trade openness (Internationalization) = Imports + Exports / GDP*	*BD*	*Banking Development (M2)*

**IPI Industrial Production index*

Source: Authors' calculations

3.3. Construction of Variable

Dependent variable

The dependent variable of the study consists of stock prices of the selected countries. ARCH/GARCH (R. Engle, 2001) is applied to the stock price to check the volatility in the first instance. Statistically, volatility clustering implies time-varying conditional variance, which means that today's considerable volatility may lead to big volatilely tomorrow. ARCH model in this regard can have a property of time-varying conditional variance and handles volatility clustering easily, specifically in the case of stock markets.

Volatility

The volatility of the stock indices has generated with the help of Autoregressive conditional heteroskedasticity (ARCH) and Generalized Autoregressive conditional heteroskedasticity (GARCH). ARCH model has been developed by (R. F. Engle, 1982) in a study of inflation rates following these

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(Enders, 2004; Greene, 2008; Wooldridge, 2009) and other similar texts have incorporated this model. The ARCH model assumes that there is a clear trend, the shocks contain high persistency, volatility is not constant over time, series is most of the time shows random walk, and two or more series tend to co-move. The ARCH model was further generalized by (Bollerslev, 1986) by including lag values of the conditional variance and termed as GARCH. Although it appears to be the same as ARCH, hence considered better in capturing the persistence of volatility and fits better on finance-related data.

Mean Equation:

$$y_t = a + \varepsilon_t \quad \text{or} \quad y_t = a + bX_t\,\varepsilon_t \qquad \textbf{(4)}$$

ARCH (p) Model:

$$\sigma_t^2 = \omega + \alpha\,\varepsilon_{t-1}^2 + \vartheta_t \qquad \textbf{(5)}$$

$\omega>0,\ \alpha>0,\ \vartheta_t$ *is i.i.d.*

GARCH (p, q) model:

$$\sigma_t^2 = \omega + \gamma_t\varepsilon_{t-1}^2 + \gamma_t\varepsilon_{t-1}^2 + \gamma_t\sigma_{t-1}^2 + \vartheta_t \qquad \textbf{(6)}$$

$\omega>0,\ \alpha>0,\ \beta>0$

Data relating to the stock market has a property of high frequency. The ARCH model determines to estimate the time-dependent volatility as a function of past volatility in the variables.

Wavelet Analysis

Economic time series features time-varying characteristics such as non-stationery, seasonality, as well as structural breaks. Wavelet filters decompose and reconstruct the time series and its correlation structure across time scales. Thus as the decomposition can be orthogonalized, decomposition of one scale is uncorrelated with the decomposition at another. Wavelet functions as compared to fourier series transform well as they are localized in scale and time (Burrus, Gopinath, & Guo, 1998; Marco Gallegati, 2008)

C (scale, position) = $\int_{-\infty}^{\infty} x_t\,\varphi\,(scale, position, t)dt$ **(7)**

F(a,b) = $\int x_t\,\varphi\left(t - a/b\right)dt$ **(8)**

With an inverse transform of:

$$x_t = \int \int F(a,b)\ \varphi\left(t - a/b\right) da\ db \qquad \textbf{(9)}$$

Wavelet filters

Like traditional filters, wavelet filters are also designed to capture low and high frequencies and particular lengths (Vetterli & Herley, 1992) ,(M Gallegati & Semmler, 2014) The length suggests that how much information of the original series is to extract in low and high frequency phenomena. The role of the length is almost identical to autoregressor (AR) as in traditional time series where high AR cause more historical observations to present.

The two most common filters used in this scenario are Haar and Daubechies (1992). Compared to Haar, which can only capture constant and linear functions, Daubechies can capture polynomial degree index. As higher length tends to higher smoothness thus is this length eight selected for wavelet analysis.

Lastly, Maximum Overlap Discrete Wavelet Transformation (MODWT) (Marco Gallegati, 2008) is applied to the extracted residuals from the ARCH/GARCH model by sampling the residuals evenly spaced points in time. In this analysis, the residuals sampled at different scale crystals. Utilizing its filtered output at each scale, a time series can also be decomposed into its wavelet details and smooth as follow:

$$x_t = \sum_{j=1}^{J} D_j + S_j \qquad \textbf{(10)}$$

(*Wavelet graphs for each country see Appendix- II)*

3.4.Formulation of the business cycle

To obtain real business cycles , Christiane Fitzgerald bandpass filter (Christiano & Fitzgerald, 2003) is applied to Industrial production index (IPI) data. The current study incorporates IPI for extracting the business cycle. (Mohanty, Singh, & Jain, 2003) After wards, NARDL approach is applied to extract positive and negative directions of real business cycle. Appendix-1.

3.5. Unit Root, Structural Breaks & Panel ARDL

In addition to this Global information criteria as developed by (Jushan Bai, 1997; Jushan Bai & Perron, 1998, 2003) has applied for determining multiple structural breaks. For unit root test, we have applied ADF, Fisher and Pasarran tests (Dickey & Fuller, 1979) For current study, we deployed ARDL (Pesaran & Shin, 1995) model to establish relationship between the performance of ISI with the business cycles and IPI, TO, CPI, BD, OP and structural breaks. In addition to this

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optimal lag criterion, (AIC Akaike inform criteria) also used so to determine the optimal lag length for each model.

4. Findings

Empirical Results and Discussion

Table 2 represent the descriptive statistics of the study. The mean value for the negative business cycles yields -4, whereas the maximum mean value yield for CPI is a proxy for inflation, which is 4.8. Standard deviation suggests that as far as variation is concerned, the extracted values are approximately identical except for business development whose value is more than 2.

Table 3 shows the unit root test results individually for all the selected variables in the study. After applying ADF, Fisher and pasarran confirm that TO, oil pricing, banking development, and CPI have unit root or non-stationary at level. Thus, to produce reliable results, all the variables must be stationary otherwise; it would lead to spurious results. Business cycles in both directions and volatility w1, w2, and w3 show stationery results at level and first difference.

Table 1 -Descriptive Statistics

Variables	Mean	Maximum	Minimum	Std. Dev.	Sum Sq. Dev.	Observations
W1	0.0001	0.1049	-0.1239	0.0356	0.863	681
W2	0.0003	0.0938	-0.1433	0.0266	0.4823	681
W3	0.0001	0.0878	-0.0956	0.0194	0.2567	681
RBC2	-4.6729	0.3841	-6.6218	1.0533	754.4547	681
RPC1	4.6856	6.6322	0.2029	1.0354	729.0452	681
CPI	4.8235	5.5016	4.34	0.2285	35.5123	681
M2A	2.2009	8.7118	-1.1133	2.8626	5572.254	681
OP	4.2858	4.889	3.3938	0.3391	78.2081	681
TO	0.0551	0.1612	0.0000	0.0412	1.1563	681

Source: Authors' calculations

Table 3 - Unit root results At *level* and First difference

		without trend					
		At Level		**At First Difference**			
Variables	**Method**	**Statistic**	**Prob.****	**Statistic**	**Prob.****	**Order**	**Con**
RBC1	Im, Pesaran and Shin w-stat	-9.99829	0.0000	-12.7395	0.000	I(1)	S
	ADF - fisher chi-square	120.421	0.0000	167.424	0.000		
	PP - fisher chi-square	207.790	0.0000	318.230	0.000		
RBC2	Im, Pesaran and Shin W-stat	-10.2215	0.0000	-9.34103	0.000	I(1)	S
	ADF - Fisher Chi-square	122.726	0.0000	113.968	0.000		
	PP - Fisher Chi-square	240.745	0.0000	400.801	0.000		
BD	Im, Pesaran and Shin W-stat	-0.98128	0.1632	-14.1497	0.000	I(1)	S
	ADF - Fisher Chi-square	20.9776	0.0213	189.701	0.000		
	PP - Fisher Chi-square	23.5628	0.0088	411.809	0.000		
TO	Im, Pesaran and Shin W-stat	0.11455	0.5456	-10.9206	0.0000	I(/1)	S
	ADF - Fisher Chi-square	7.91643	0.6370	134.445	0.0000		
	PP - Fisher Chi-square	39.2259	0.0000	333.097	0.0000		
OP	Im, Pesaran and Shin W-stat	-0.86250	0.1942	-9.62903	0.0000	I(1)	S
	ADF - Fisher Chi-square	11.2445	0.3388	111.363	0.0000		
	PP - Fisher Chi-square	10.9875	0.3585	226.423	0.0000		
CPI	Im, Pesaran and Shin W-stat	1.73641	0.9588	-10.0994	0.0000	I(1)	S
	ADF - Fisher Chi-square	6.37636	0.7827	121.183	0.0000		
	PP - Fisher Chi-square	13.7750	0.1835	254.554	0.0000		
W1	Im, Pesaran and Shin W-stat	-32.4122	0.0000	-34.9457	0.0000	I(1)	S
	ADF - Fisher Chi-square	443.646	0.0000	450.129	0.0000		
	PP - Fisher Chi-square	92.1034	0.0000	92.1034	0.0000		
W2	Im, Pesaran and Shin W-stat	-16.4796	0.0000	-17.3192	0.0000	I(1)	S
	ADF - Fisher Chi-square	233.561	0.0000	249.326	0.0000		
	PP - Fisher Chi-square	360.164	0.0000	433.277	0.0000		
W3	Im, Pesaran and Shin W-stat	-7.36496	0.0000	-8.67346	0.0000	I(1)	S

ADF - Fisher Chi-square	78.0133	0.0000	96.8781	0.0000
PP - Fisher Chi-square	17.9047	0.0566	84.1359	0.0000

Source: Authors' calculations

The study incorporates a two-step approach first to determine the volatility of ISI by applying the ARCH/ GARCH model. The stock markets data for the individual country has passed through the ARMA, ARIMA, ARCH and GARCH. After wards, wavelet analysis has applied on the extracted residuals of the ARCH-GARCH model by using MOWDT with a filter of Debauchees 8 at scale 3. This augments three-time scales models as w1, w2 and w3. W1 represents the frequency at a short time scale, whereas w2 and w3 are medium and long run time scales respectively. In addition to this, business cycles have also been transformed using industrial production index data of each country.

Table 4 consists of long-term results of panel ARDL for three models. Model W1 confirms that only TO plays a significant role to explain the volatility of ISI at this time scale. Other variables show no response to explain the volatility of the selected ISI of Islamic countries. The time scale in this model is very short hence it suggests the phenomena that selected variables are not enough vibrant except TO which confirms that there would be 22% change in volatility if TO changes by 1%.

Model W2 in table 3, reveals that business cycles along with OP and TO show significant results with the volatility of the stock indices. Positive business cycles confirm that when the scale of business activity expands then stock market becomes less volatile, as in this case it shows that 1% expansion in business cycle brings approximately 65% negative change in volatility . In contrast, when the economic activities contract, it affects the volatility in positive direction but the magnitude is not strong enough. At the same time, OP also shows positive and significant relationship with the volatility. The results of OP also confirm that impact the volatility as it brings 57% change in the volatility at this time scale. On the contrary, the TO has negative relationship and it brings more than 50% variation in the Islamic stock indices. BD and CPI shows that at this time scale they does not affect the volatility of Islamic stock indices.

Model W3 on the other hand shows significant results for all the selected variables except the negative business cycles. At this time level, the positive business cycles confirm that with the expansion of time, the ISI become more volatile and the expansion of economic activities plays a significant role to bring enormous change in volatility in the long -run. BD on the other hand has negative relationship with the volatility suggesting that strong banking networking in the long-run causes less variation in the Islamic stock market. In addition to this TO, OP and inflation play a critical role to explain the volatility of the ISI. As compared to positive business cycle the magnitude of TO, OP and inflation are strong enough

as in this case all these variables bring more than 100% change in the volatility of ISI.

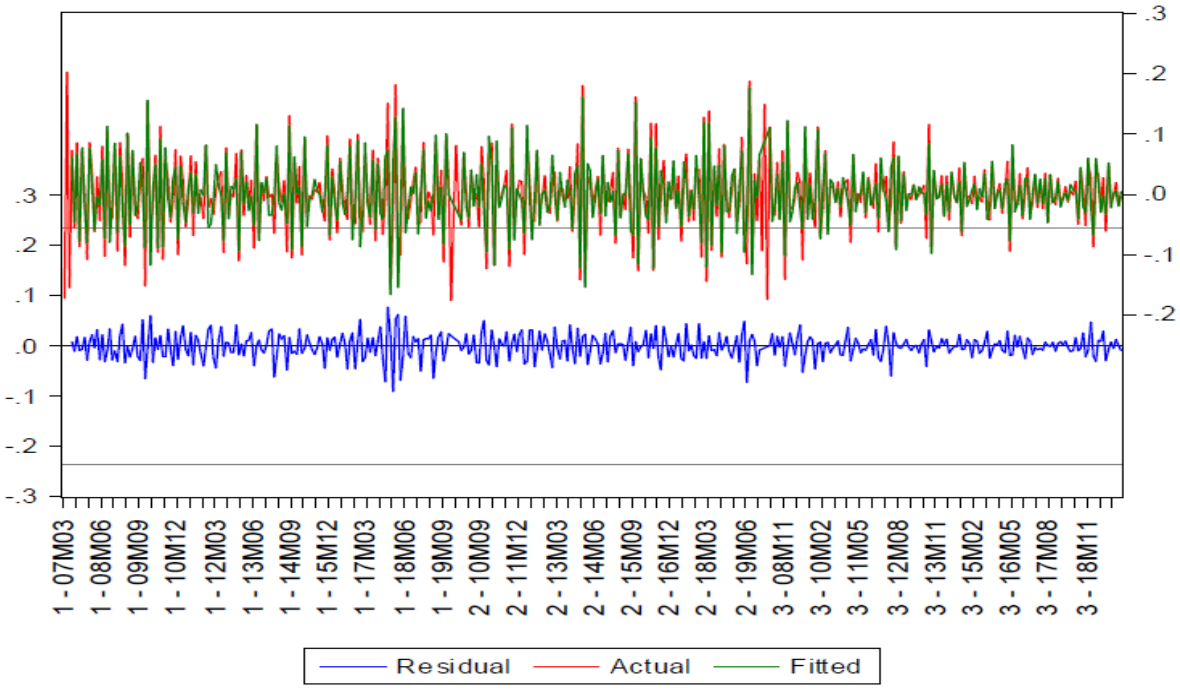
Considering the extracted results, we support the findings of (Arshad, 2017; Hussin et al., 2012; Irfan, 2016; Sakti, Harun, & Business, 2015) that IPI, CPI and oil prices shows significant results with the Islamic stock whereas for banking development it is partially acceptable because findings are acceptable for model w3 and not for model w1 and w2. For trade openness we are in line with (Jamaludin et al., 2017; Naseri & Masih, 2013; Said & Grassa, 2013). For Business cycles and volatility our result support the findings of (Al-Khazali et al., 2016; Arshad, 2016; Arshad & Rizvi, 2013).

Table 4 - Long Run Results

Variables	Model W1		Model W2		Model W3	
	Coefficient	Prob.*	Coefficient	Prob.*	Coefficient	Prob.*
RBC1	-0.014332	0.7453	-0.655403	0.0689	1.820799	0.0287
RBC2	-0.006838	0.8662	0.021139	0.0751	-0.033609	0.1046
BD	0.025667	0.2196	0.022241	0.6967	-0.474989	0.0071
OP	0.004699	0.3394	0.570641	0.0188	1.473773	0.0608
TO	-0.222085	0.0895	0.578202	0.0232	1.441197	0.0576
CPI	-0.01963	0.5253	-0.008027	0.9165	0.892125	0.0027

Source: Authors' calculations

Graph1. Actual, fitted & residuals of Panel ARDL Model for W1 time scale



Source: Authors' calculations

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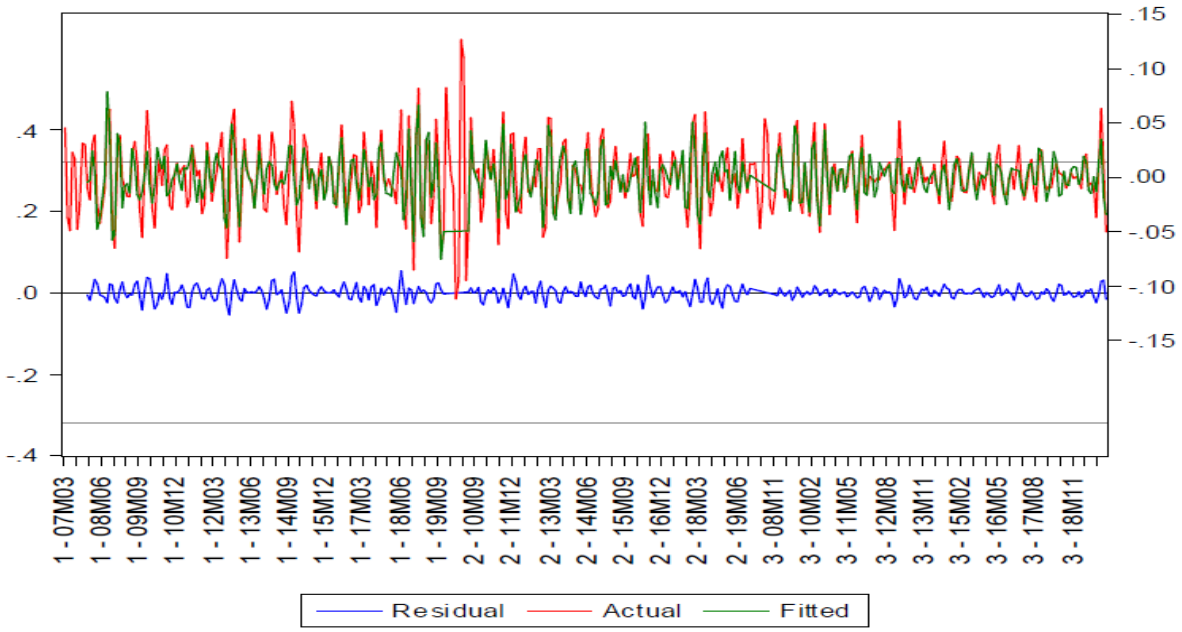
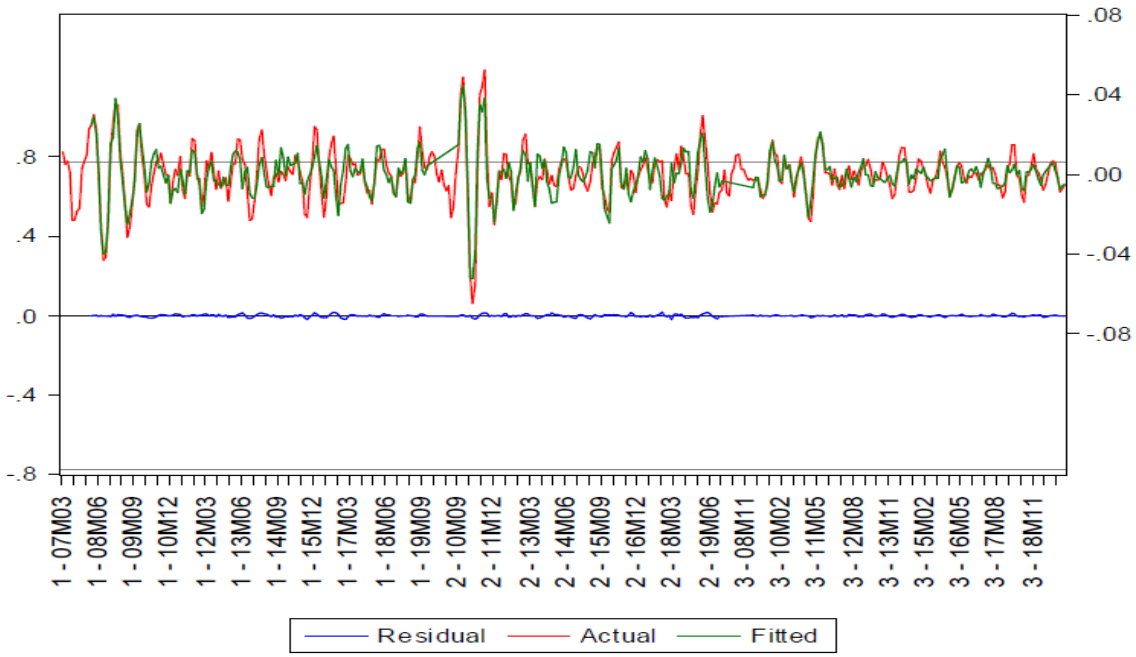
Graph 2: Actual, fitted & residuals of Panel ARDL Model for W2 time scale



Source: Authors' calculations

Graph 3: Actual, fitted & residuals of Panel ARDL Model for W3 time scale



Source: Authors' calculations

Table 5. Shows that the value of co-integration is significant for all three models. The coefficient value suggests that for all models, time-scaled volatility

converging from long run to short run (Granger & Newbold, 1974; Yule, 1926), moreover all the values extracted for the error correction model are within the allowable limit and the co-efficient show negative sign.

Table 5 - Co integration Value

Model	Coefficient	Std. Error	t-Statistic	Prob.*
W1	-0.603435	0.019458	-82.40334	0.0000
W2	-0.69954	0.045644	-15.3259	0.0000
W3	-0.180051	0.007156	-25.15946	0.0000

Source: Authors' calculations

4.1.Short Run Results for Selected Countries

Country-level results in the short run show that in Turkey's (Table 6a); the business cycles play a significant role in explaining the volatility of ISI at this time scale. However, the relationship is negative when there is increasing trend in business cycle and positive when the economic activity contracts. BD has considered a vital one in selected countries wherein the relationship of Pakistan and Malaysia is negative, which means that a strong banking network causes less volatilities in Islamic stock indices. OP positively, whereas inflation negatively affects the volatility; however, TO currently scale does not show any impact. The result also confirms that unknown structural break shows significant and positive result in case of Pakistan and Malaysia; however, in the case of turkey, the relationship is negative.

Table 6(a) – Country Wise Results – W1 time scale

	Turkey		**Pakistan**		**Malaysia**	
Variable	Coefficient	**Prob. ***	**Coefficient**	**Prob. ***	**Coefficient**	**Prob. ***
COINTEQ01	-0.564767	0.0000	-0.626578	0.0000	-0.626578	0.0000
D(RBC1)	0.095788	0.0008	0.158309	0.0002	0.158309	0.0002
D(RBC1(-1))	-0.015353	0.1058	-0.003189	0.2431	-0.003189	0.2431
D(RBC 1(-2))	-0.088582	0.0004	-0.105080	0.0000	-0.105080	0.0000
D(RBC 2)	-0.060491	0.0006	-0.127222	0.0003	-0.127222	0.0003
D(RRBC2(-1))	0.034646	0.0030	0.047706	0.0038	0.047706	0.0038
D(RRBC2(-2))	0.079390	0.0001	0.109784	0.0002	0.109784	0.0002
D(BD)	0.109566	0.0148	-0.673691	0.0006	-0.673691	0.0006
D(BD(-1))	-0.199998	0.0045	0.422047	0.0035	0.422047	0.0035
D(BD(-2))	0.013984	0.6268	0.339053	0.0037	0.339053	0.0037
D(OP)	-0.031990	0.0001	-0.047350	0.0000	-0.047350	0.0000
D(OP(-1))	0.001603	0.2877	-0.007834	0.0088	-0.007834	0.0088
D(OP(-2))	0.022253	0.0003	0.013411	0.0018	0.013411	0.0018
D(TO)	0.636924	0.1733	3.727252	0.1422	3.727252	0.1422

D(TO(-1))	-0.449355	0.3163	3.116301	0.2801	3.116301	0.2801
D(TO(-2))	-0.751677	0.2271	0.701572	0.6761	0.701572	0.6761
D(CPI)	-0.452073	0.0251	0.378701	0.0633	0.378701	0.0633
D(CPI(-1))	0.732716	0.0073	-0.161944	0.3010	-0.161944	0.3010
D(CPI(-2))	-0.483642	0.0196	-0.427934	0.0631	-0.427934	0.0631
SB1	-0.005198	0.0000	0.002808	0.0007	0.002808	0.0007
C	0.206568	0.0517	0.095960	0.0947	0.095960	0.0947

Source: Authors' calculations

For model 2 at the country level, the results of table 5(b) show that except for TO and banking development, all the selected variables become responsive and show significant relationship with the volatility of ISI. This conceptualizes that currently scale, the ISI do not need a banking network. Neither the internationalization element in the economic activities cause any movement in the volatility of Islamic stock indices. However, other economic elements such as inflation in the case of turkey and Malaysia affect the dependent variable. In the case of Pakistan, it remains silent, suggesting that ISI grasp the shock of inflation at this time scale and become stagnant.

OP is an integral part of business activities and, ultimately, the economy at large; thus, it causes volatility in the Islamic stock indices. However, the magnitude at this scale is not very convincing. Positive movement in the business cycles causes volatility in the ISI, and the relationship is positive in Malaysia and turkey; however, it shows a negative sign for Pakistan. The negative movement of business cycles shows significant results in Turkey and Pakistan, whereas it shows inconsistent results for Malaysia. Structural breaks confirm that all the Islamic stock markets of the selected countries are subject to volatility. In contrast, for Pakistan and Turkey, it shows a negative relationship, and in Malaysia, the relationship is positive.

Table 6(b) – Country Wise Results – W2 time scale

	Turkey		**Pakistan**		**Malaysia**	
Variable	Coefficient	**Prob. ***	**Coefficient**	**Prob. ***	**Coefficient**	**Prob. ***
COINTEQ01	-0.666497	0.0000	-0.642364	0.0000	-0.789759	0.0000
D(TO)	1.926745	0.0088	0.555689	0.7468	0.101424	0.3725
D(TO(-1))	2.152537	0.0074	0.327542	0.8927	0.578192	0.0142
D(TO(-2))	-0.942985	0.3339	-1.343502	0.6285	1.276759	0.0020
D(TO(-3))	-0.416258	0.6943	-1.261003	0.6660	1.040577	0.0044
D(TO(-4))	0.791460	0.4328	-0.240043	0.9303	0.495302	0.0378
D(TO(-5))	0.741077	0.4640	1.315663	0.6117	0.247041	0.1427
D(TO(-6))	0.763426	0.4271	2.189186	0.4239	0.155692	0.2682
D(TO(-7))	1.165024	0.1980	-1.473164	0.5842	-0.129704	0.1637
D(TO(-8))	0.899470	0.1787	-3.105612	0.1501	-0.088595	0.0834
D(OP)	-0.051662	0.0000	-0.049857	0.0000	-0.002712	0.0046
D(OP(-1))	-0.037927	0.0000	0.002926	0.0442	-0.004602	0.0025
D(OP(-2))	0.013945	0.0007	0.009744	0.0015	-0.012327	0.0001

D(OP(-3))	0.016640	0.0004	-0.003342	0.0353	-0.028628	0.0000
D(OP(-4))	0.006930	0.0050	-0.029883	0.0001	-0.079820	0.0000
D(OP(-5))	-0.013262	0.0008	-0.068933	0.0000	-0.034754	0.0000
D(OP(-6))	-0.053131	0.0000	-0.010618	0.0022	0.011474	0.0001
D(OP(-7))	-0.004143	0.0215	0.040316	0.0000	-0.011734	0.0001
D(OP(-8))	0.004856	0.0109	0.048727	0.0000	0.016780	0.0000
D(BD)	-0.045380	0.0739	-0.190684	0.0354	0.544407	0.0008
D(BD(-1))	0.163404	0.0041	0.355415	0.0112	0.004820	0.9102
D(BD(-2))	0.007043	0.7576	0.810847	0.0010	-0.460582	0.0020
D(BD(-3))	-0.217143	0.0020	0.200046	0.0487	-0.051773	0.2944
D(BD(-4))	-0.176535	0.0041	-0.417396	0.0033	0.107955	0.0648
D(BD(-5))	0.096256	0.0236	-0.144015	0.0645	0.031781	0.4825
D(BD(-6))	0.099618	0.0186	0.468625	0.0033	0.108843	0.0732
D(BD(-7))	-0.072064	0.0411	0.485891	0.0021	0.546863	0.0009
D(BD(-8))	-0.076154	0.0311	0.250463	0.0090	0.264382	0.0078
D(RBC 2)	-0.230931	0.0018	-0.516408	0.0008	-0.622810	0.0006
D(RBC 2 (-1))	-0.048472	0.0493	-0.468630	0.0010	-0.666767	0.0008
D(RBC 2 (-2))	0.022641	0.3401	-0.260687	0.0128	-0.852952	0.0003
D(RBC 2 (-3))	0.357207	0.0017	-0.255819	0.0091	-0.787206	0.0003
D(RBC 2 (-4))	0.395754	0.0017	-0.187527	0.0496	-0.583067	0.0004
D(RBC 2 (-5))	0.357347	0.0018	-0.379982	0.0033	-0.498649	0.0003
D(RBC 2 (-6))	0.388798	0.0004	-0.329983	0.0013	-0.491835	0.0001
D(RBC 2 (-7))	0.371043	0.0001	-0.210439	0.0007	-0.322115	0.0001
D(RBC 2 (-8))	0.186838	0.0000	-0.031152	0.0549	0.007673	0.1702
D(RBC 1)	-0.275553	0.0032	-0.323298	0.0020	-0.469935	0.0017
D(RBC 1 (-1))	-0.113122	0.0379	-0.245629	0.0075	-0.619410	0.0005
D(RBC 1 (-2))	0.017782	0.6388	-0.166305	0.0307	-0.768292	0.0003
D(RBC 1 (-3))	0.253769	0.0098	-0.212914	0.0251	-0.784850	0.0002
D(RBC 1 (-4))	0.539323	0.0010	-0.426061	0.0049	-0.663497	0.0002
D(RBC 1 (-5))	0.524837	0.0008	-0.206975	0.0090	-0.575920	0.0001
D(RBC 1 (-6))	0.374042	0.0011	-0.070438	0.0527	-0.473156	0.0001
D(RBC 1 (-7))	0.320338	0.0005	-0.122794	0.0003	-0.262826	0.0001
D(RBC 1 (-8))	0.196206	0.0002	-0.103533	0.0001	-0.101563	0.0000
D(CPI)	0.116393	0.2598	-0.504039	0.0354	-0.611529	0.0344
D(CPI(-1))	-0.058785	0.5737	0.089084	0.6042	0.375088	0.1082
D(CPI(-2))	-0.392879	0.0346	0.526360	0.0301	0.399816	0.0853
D(CPI(-3))	0.183054	0.2143	0.070993	0.6680	0.072569	0.6865
D(CPI(-4))	0.234479	0.1370	-0.093527	0.5675	-0.245471	0.2189
D(CPI(-5))	-0.290252	0.0854	-0.516678	0.0362	-0.256959	0.1615
D(CPI(-6))	-0.255465	0.1204	-0.144443	0.3702	0.626485	0.0115
D(CPI(-7))	0.080547	0.5211	-0.551025	0.0267	0.224209	0.1086
D(CPI(-8))	0.247357	0.0676	0.113971	0.4268	-0.360450	0.0257
SB2	-0.001409	0.0012	-0.001456	0.0282	0.035616	0.0000
C	-0.045919	0.5950	-0.099692	0.0784	-0.059884	0.5567

Source: Authors' calculations

For model 3, the countrywide results of table 5(C) show that TO is vital for Turkey and Malaysia. In contrast, Pakistan does not show any significant pattern with stock volatility. OP and BD at this time scale confirm that it cause volatility for the Islamic stock indices. However, for Malaysia banking development, Islamic stock markets become less volatile in the presence of developed banking channels.

Business cyclical movements confirm that the ISI become volatile and affected by the presence of business; however, in the case of Malaysia, the presence of positive business cycles makes this market less volatile at this time scale. Inflation at this time scale also confirms its vitality as it shows a significant pattern with the independent variable. Structural breaks show that it confirms that all the selected stock markets become sensitive because of these irregularities in the short run. Overall results of the study confirms that business cycles affect the volatility of the Islamic stock indices; thus, we accept Hypothesis 1 and Hypothesis1 (b). On the other hand TO , oil prices and CPI also show significant relationship with the volatility of Islamic stock indices; thus Hypothesis 2, Hypothesis 3, and Hypothesis 4 also accepted.

Table 6(C) – Country Wise Results – W3 time scale

	Turkey		**Pakistan**		**Malaysia**	
Variable	Coefficient	**Prob. ***	**Coefficient**	**Prob. ***	**Coefficient**	**Prob. ***
COINTEQ01	-0.167249	0.0000	-0.191994	0.0000	-0.180911	0.0000
D(TO)	-0.434126	0.0065	-1.284137	0.0963	-0.328790	0.0007
D(TO(-1))	-0.175729	0.0885	-3.052599	0.0268	-0.237233	0.0036
D(TO(-2))	-0.651919	0.0114	-3.651563	0.0217	-0.504375	0.0004
D(TO(-3))	-0.350153	0.1104	-2.795012	0.0636	-0.816223	0.0001
D(TO(-4))	0.373807	0.1198	-1.232470	0.2591	-0.808134	0.0001
D(TO(-5))	0.211223	0.2780	-1.810211	0.1026	-0.939072	0.0001
D(TO(-6))	0.046098	0.7612	-3.406239	0.0306	-1.016433	0.0003
D(TO(-7))	-0.247553	0.1480	-2.823502	0.0562	-0.782325	0.0007
D(TO(-8))	0.051833	0.7097	-1.554523	0.1487	-0.396257	0.0037
D(TO(-9))	-0.168687	0.2775	-2.753186	0.0348	-0.184425	0.0100
D(TO(-10))	0.211546	0.1794	-2.321122	0.1066	-0.173719	0.0021
D(TO(-11))	0.697043	0.0037	0.427455	0.5963	-0.069806	0.0038
D(OP)	-0.016820	0.0000	0.021502	0.0000	0.002196	0.0001
D(OP(-1))	-0.029990	0.0000	0.036484	0.0000	-0.002378	0.0001
D(OP(-2))	-0.009084	0.0000	0.033224	0.0000	0.016892	0.0000
D(OP(-3))	-0.014061	0.0000	0.000499	0.1374	0.029151	0.0000
D(OP(-4))	-0.016371	0.0000	0.014432	0.0000	0.012173	0.0000
D(OP(-5))	0.009924	0.0000	0.021859	0.0000	0.035326	0.0000
D(OP(-6))	-0.002700	0.0003	0.012300	0.0000	0.018826	0.0000
D(OP(-7))	0.011766	0.0000	0.046739	0.0000	0.002463	0.0001
D(OP(-8))	0.024438	0.0000	0.042810	0.0000	0.026663	0.0000
D(OP(-9))	0.004173	0.0001	0.020213	0.0000	0.026486	0.0000
D(OP(-10))	0.025849	0.0000	0.059629	0.0000	0.017570	0.0000
D(OP(-11))	0.003299	0.0002	0.029765	0.0000	0.017405	0.0000
D(BD)	0.057424	0.0002	0.174283	0.0025	0.469915	0.0000
D(BD(-1))	0.000210	0.9483	0.163812	0.0024	0.156013	0.0005
D(BD(-2))	0.022193	0.0056	-0.003287	0.8681	-0.240931	0.0002
D(BD(-3))	0.014180	0.0223	-0.033328	0.1520	-0.212646	0.0002
D(BD(-4))	0.134189	0.0000	0.123877	0.0059	-0.350846	0.0001
D(BD(-5))	-0.007841	0.0952	0.393194	0.0002	-0.226878	0.0002
D(BD(-6))	-0.080255	0.0001	0.155688	0.0029	-0.205064	0.0001
D(BD(-7))	-0.065105	0.0002	-0.214173	0.0005	-0.177150	0.0001
D(BD(-8))	-0.153712	0.0000	-0.303480	0.0003	-0.061855	0.0033
D(BD(-9))	-0.052747	0.0003	-0.182260	0.0014	0.047087	0.0093
D(BD(-10))	0.013773	0.0165	0.120951	0.0062	-0.002293	0.7972

D(BD(-11))	0.177507	0.0000	0.287905	0.0002	-0.228450	0.0001
D(RBC 1)	-0.200320	0.0014	-0.115384	0.0340	-0.189705	0.0024
D(RBC 1-1))	-0.373925	0.0002	0.206698	0.0137	-0.284004	0.0015
D(RBC 1 (-2))	-0.550852	0.0000	0.727451	0.0010	-0.296958	0.0034
D(RBC 1 (-3))	-0.616930	0.0000	1.465066	0.0005	-0.304484	0.0047
D(RBC 1 (-4))	-0.576109	0.0000	2.063246	0.0005	-0.359732	0.0050
D(RBC 1 (-5))	-0.460298	0.0002	2.367894	0.0004	-0.323778	0.0044
D(RBC 1 (-6))	-0.312760	0.0007	2.640273	0.0005	-0.263092	0.0048
D(RBC 1 (-7))	-0.163630	0.0031	2.231577	0.0003	-0.141899	0.0084
D(RBC 1 (-8))	-0.023417	0.2050	1.575425	0.0002	-0.132976	0.0027
D(RBC 1 (-9))	0.044458	0.0196	0.894334	0.0001	-0.066383	0.0028
D(RBC 1 (-10))	0.059835	0.0020	0.511980	0.0000	-0.101355	0.0000
D(RBC 1 (-11))	0.089506	0.0000	0.204195	0.0000	-0.051336	0.0000
D(RBC 2)	-0.397986	0.0001	-0.246486	0.0056	-0.291928	0.0004
D(RBC 2 (-1))	-0.428671	0.0001	0.202268	0.0223	-0.279145	0.0014
D(RBC 2 (-2))	-0.423823	0.0001	1.033808	0.0007	-0.333894	0.0014
D(RBC 2 (-3))	-0.425629	0.0001	1.435635	0.0006	-0.279488	0.0051
D(RBC 2-4))	-0.478681	0.0001	1.964340	0.0007	-0.269950	0.0070
D(RBC 2 (-5))	-0.490446	0.0001	2.596492	0.0006	-0.372528	0.0029
D(RBC 2 (-6))	-0.354340	0.0002	2.638673	0.0004	-0.302774	0.0022
D(RBC 2 (-7))	-0.210759	0.0009	2.382888	0.0003	-0.229793	0.0017
D(RBC 2 (-8))	-0.010068	0.5152	1.872120	0.0002	-0.124581	0.0032
D(RBC 2 (-9))	0.059785	0.0058	1.087942	0.0001	-0.119018	0.0005
D(RBC 2 (-10))	0.132506	0.0001	0.409072	0.0001	0.073414	0.0002
D(RBC 2 (-11))	0.056578	0.0000	0.057565	0.0007	0.120982	0.0000
D(CPI)	-0.214410	0.0007	-0.130242	0.1011	-0.133803	0.0235
D(CPI(-1))	-0.162307	0.0021	-0.394676	0.0028	-0.255198	0.0044
D(CPI(-2))	-0.156443	0.0037	-0.065602	0.2696	-0.012457	0.7222
D(CPI(-3))	-0.359447	0.0002	0.050418	0.4622	0.071030	0.1254
D(CPI(-4))	-0.031222	0.1563	-0.412348	0.0060	-0.193758	0.0063
D(CPI(-5))	0.062481	0.0370	-0.192489	0.0400	0.181586	0.0063
D(CPI(-6))	-0.273205	0.0008	-1.221826	0.0002	0.239540	0.0030
D(CPI(-7))	0.044601	0.0927	-0.230805	0.0224	-0.290461	0.0016
D(CPI(-8))	-0.346549	0.0003	-0.443961	0.0021	-0.448165	0.0004
D(CPI(-9))	-0.587603	0.0001	-0.067153	0.2410	-0.269037	0.0009
D(CPI(-10))	-0.410870	0.0002	-0.102809	0.1119	0.061549	0.0397
D(CPI(-11))	-0.231638	0.0006	0.566294	0.0014	0.134309	0.0050
SB3	0.044196	0.0000	0.105685	0.0000	0.034151	0.0000
C	-0.783454	0.0005	-0.738005	0.0013	-0.803844	0.0003

Source: Authors' calculations

5. Conclusion & policy implications

The main aim of the study is to check the volatility of ISI with business cycles and macro-economic indicators, including internationalization, banking development, oil price, inflation, and unknown structural breaks. The selected Islamic countries for the current studies include Pakistan, Malaysia, and Turkey. The data collected from the Shari'ah stock markets and economic repositories of selected Islamic countries monthly.

Business cycles have formulated using the bandpass filter de-trending technique and afterwards NARDL approach on each country's industrial production index. The volatility of the ISI has generated with the help of Autoregressive conditional hetroskedicity (ARCH) and Generalized Autoregressive conditional hetroskedicity (GARCH), which is further divided into three different time scales with the help of wavelet analysis using maximum overlap discretionary wavelet transform (MOWDT) scale 3 with symmlet d8. This transformation enables the extracted residuals into three different time waves categorized as w1, w2 and w3.

After applying Panel ARDL, the extracted results considering all the countries in panel showed that business cycles played a vital role in the long run for the model w2 and w3 time scale. However, it is not significant for w1. Results for other macro-economic indicators suggest that TO is considered vital at the w1 scale. For model w2, all the variables show significant results except BD and inflation. Lastly, for w3, all the variables show significant results. This confirms that in the long term, at time scale w3, all the variables and business cycles play a vital role in explaining the volatility of the Islamic stock indices.

Countrywide results confirm that expansion and contraction of economic activities in business cycles play significant roles for all the selected countries at each time scale. However, positive business cycles at w1 and w2 create less volatility in the Islamic stock indices. For w3, the relationship is positive with the Islamic stock indices, which means expansion of time scale cause more volatility. BD in the case of turkey cause positive volatility; however, for Pakistan and Malaysia, the magnitude is negative and significant. OP and inflation also cause volatility; however, OP brings more volatility as the relationship is positive, whereas CPI creates less volatility. Structural breaks also confirm that all the Islamic stock markets of the selected Islamic countries are subject to market irregularities as the results are significant and positive in each time scale.

Overall results suggest that policymakers and relevant stakeholders of the selected sample country must consider that expansion and contraction of economic activities in the form of business cycles along with oil price, BD and CPI as key economic indicators to the Islamic stock markets. This implies that studying volatility must not base solely on earlier theories like efficient market hypothesis or random walk theory. The impact of economic expansion and contraction must considered while explaining the performance of Islamic stock indices. The volatility of ISI also confirms that the shock in price stability may affect future output and thus ISI may use as variable of economic stability for all the selected countries and specifically for Malaysia as it is highly reliant on Islamic stock markets.

The author would like to emphasis that more in-depth studies would be conducted at global level which depict more dynamic relationship between the real sector and Islamic stock indices, so that the results may be generalized more conveniently to the global scenario. For future studies multi-macroeconomic proxy may be used for business cycle as well as further wavelet techniques may applied which would enlighten the results more comprehensively.

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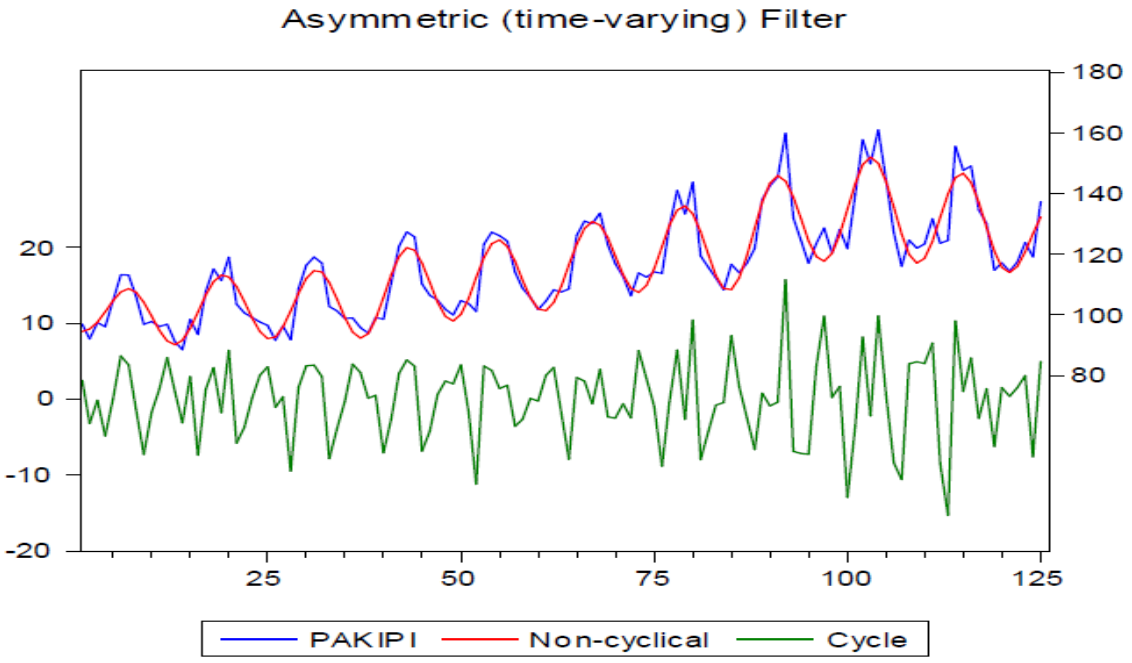
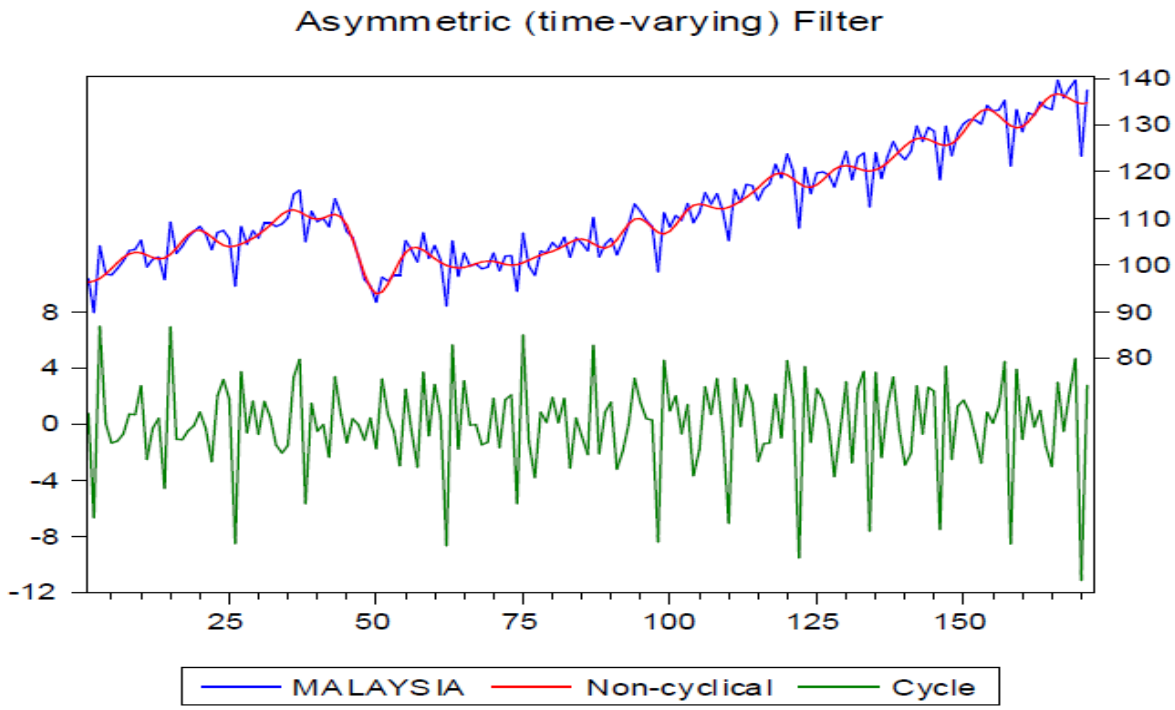
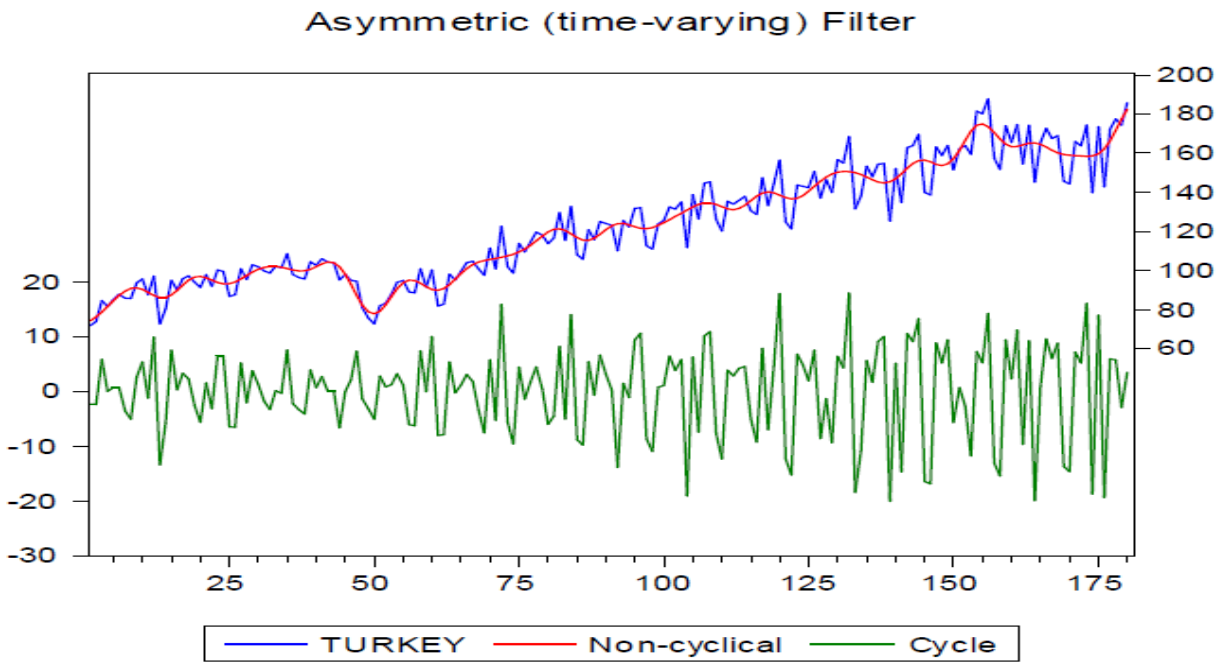
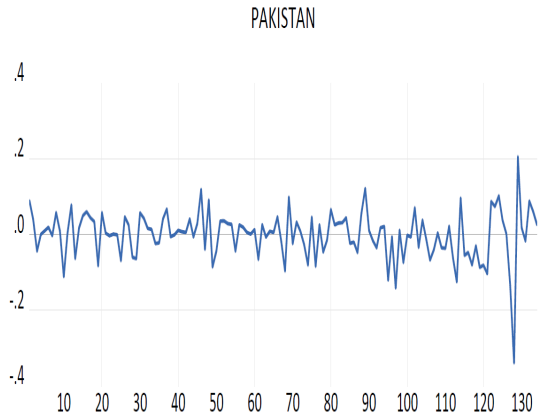
Appendix –I: Business Cycles

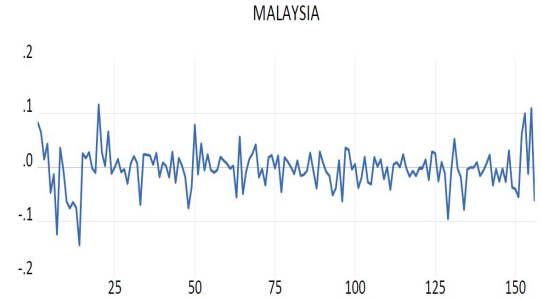






Appendix –II: Wavelet Graphs





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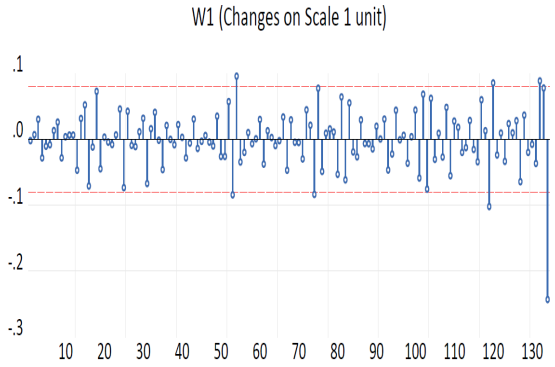

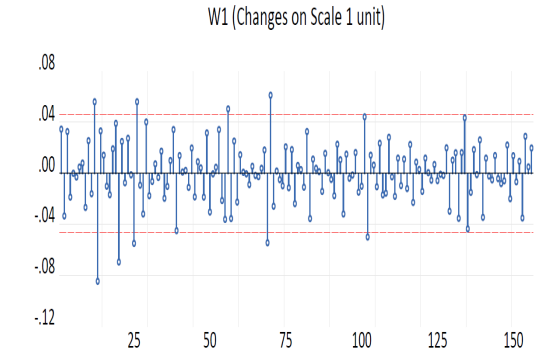

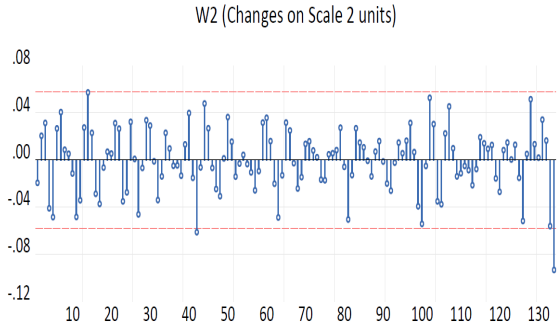

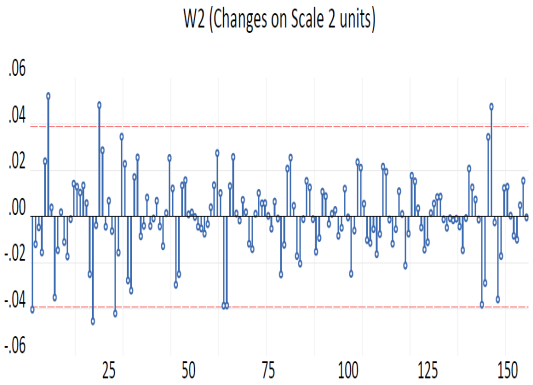

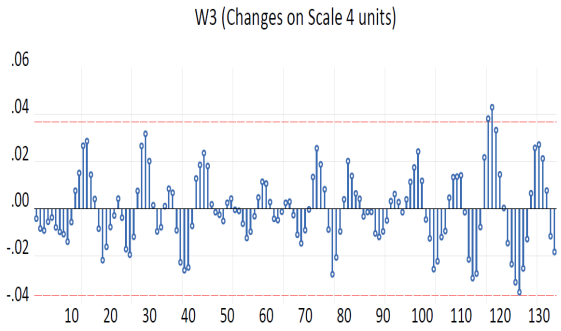
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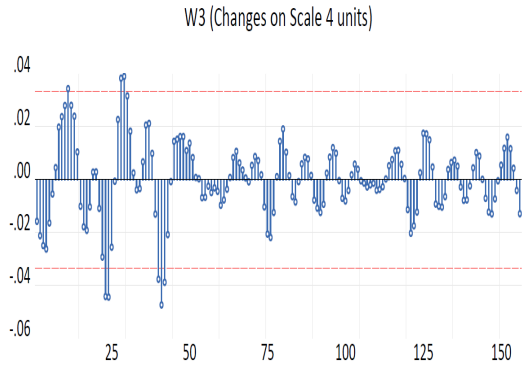
.04
.02
.00
-.02
-.04
10 20 30 40 50 60 70 80 90 100 110 120 130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.02
.00
-.02
-.04
-.06
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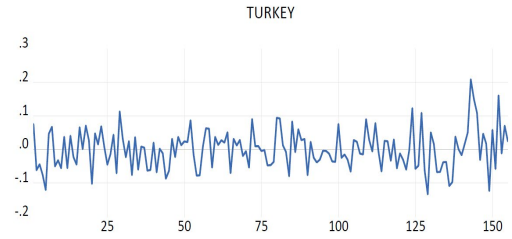
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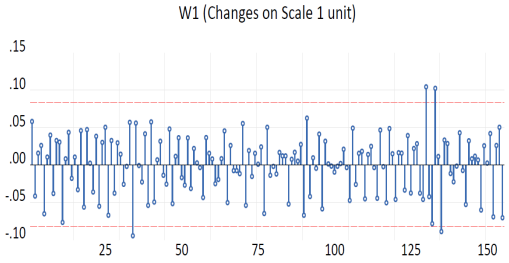
.3
.2
.1
.0
-.1
-.2
25 50 75 100 125 150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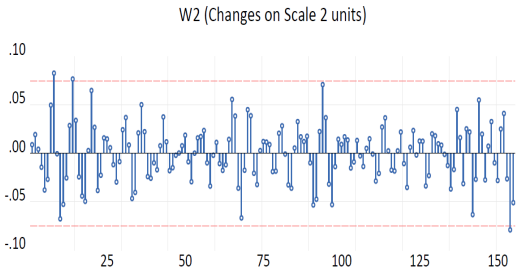
.05
.00
-.05
-.10
25 50 75 100 125 150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-.05
-.10
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