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SUKUK-BOND DYNAMIC CO-MOVEMENT AND DRIVING FACTORS: EVIDENCE FROM DCC-GARCH AND WAVELET ANALYSIS

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ABSTRACT

The assessment of international financial markets co-movements is crucial due to the valuable information it provides to investors and policy makers that could help in making informed decisions about risk management and investment. However, there is less attention found on fixed-income returns co-movement, where most of the literature had focused on the co-movement between equity markets. This study employed two econometrics methods; the Dynamic Conditional Correlation-GARCH (DCC-GARCH); which helps in studying the time variation in the relationship over time, and Wavelet Coherence that adds frequency domain to the investigation of the dynamic relationship and to extensively examine the co-movement between global Islamic and conventional fixed-income market returns in crisis and non-crisis periods. Data on global indices were used from September 2006 to July 2016. Further, the examination had extended to investigate the impact of macroeconomic and financial uncertainty factors on the co-movement; in order to explore the determinants of the dynamic co-movement. The findings indicate that investors and policy makers should consider the variation in the co-movement on their decision-making process. Also, it suggests that sukuk provides better diversification potential to fixed-income investors as their returns exhibit the least co-movement with bond market returns. However, these benefits do not hold during high-stress periods; as the association between sukuk and other fixed-income market increases substantially during these periods. Moreover, most of the studied macroeconomic and financial uncertainty factors found to be insignificant in explaining the time variation in the fixed-income market returns co-movement with the only exception for inflation in the case of sukuk-bond co-movement.

INTRODUCTION

A debate on the difference between sukuk and bond started after the well-known scholar Mohammad Taqi Usmani scrutinizes the contemporary applications in sukuk [1]. As he revealed some practices used by issuers to ensure competitiveness with the conventional bonds that hinder the shariah compliance status of the issuance. As well Miller et al. [2] and Wilson [3], concluded that sukuk are mimicking conventional bonds; in which they are structured along with conventional rules of asset securitization. In contrast to this view, a number of researchers investigated the issue from different angles and concluded that sukuk is a unique asset class that differs from conventional bonds and shares equity and bond features. For instance, Cakir and Raei [4] and Hassan [5] contributed to the debate by investigating the impact of sukuk on the risk structure of bond portfolio. Godlewski et al. [1] compared the impact of the announcement of sukuk and bond on the shareholder wealth. Ariff et al. [6] and Safari et al. [7] examined the difference between yields to maturity and investigated the causal relationship between sukuk securities and conventional bonds. In a more recent study, Maghyereh and Awartani [8] investigated the return and volatility spillovers of sukuk and global bonds with equity. Given the evidence about the difference between sukuk and bond, and the increasing attention in international financial linkage as a result of globalization and liberalization, investigating the co-movement between global bond and sukuk markets have a keen interest for policy makers and investors.

Studying the co-movement between different financial markets have significant implications for risk management and investment decisions, as it provides valuable information for strategic asset allocation, hedging strategies, and forming policies [9]. According to the modern portfolio theory, diversification benefits can be realized when investing in securities in which their returns are less than perfectly correlated. Following the same sense, the high co-movement between two markets indicates less diversification potentials [10]. The co-movement between financial markets also uncovers information about the level of markets integration and can be used to investigate if the markets exhibit contagion effect during financial crisis periods [11]. Forbes and Rigobon [12] defined contagion as an extreme increase in cross-market linkages following a shock to one country or group of countries. Therefore, if two markets exhibit a high degree of co-movement only after a shock to one market, the market are said to experience contagion. While if the high level of co-movement did not coincide with shock to one of the markets or the increase in the co-movement was not significant, then contagion term does not apply [12]. Thus, contagion could be viewed as an extreme and abrupt change in the linkage between the markets during stress times. This phenomenon had been described as a loss of diversification benefits when most needed. Accordingly, the information provided by studying the co-movement is not only valuable to investors seeking diversification but also for policy makers in designing policies that aim to ensure the stability in the financial market.

The literature in financial market linkage can be grouped into three categories. First, studies that examined the linkage among stock market indices which are

dominant in the literature [12, 13]. Second, studies that explore the cross-market linkage and co-movement, for instance, bond-stock linkage [14, 15]. Finally, less attention found in the literature for studies that investigate the co-movement across bond markets [16]. Also, some of those papers further studied the impact of global macroeconomic and financial factors on the co-movement between asset return [14, 16, 17]. However, to best of my knowledge, the co-movement between sukuk and bond market and the factors affecting their linkage remains unexplored. Thus, this study investigates the unexplored co-movement between sukuk and bond markets and tries to identify the factors that explain the co-movement.

METHODOLOGY

This quantitative research used to investigate the relationship between sukuk and bond markets to highlight the diversification potentials for institutional bond investors in sukuk market and provide information to policymakers about how the co-movements between fixed-income market returns were affected by different market conditions.

For the first method, Multivariate GARCH (DCC-GARCH) was used to measure the dynamic co-movements between fixed-income market returns in a time domain aspect. Then, in order to provide a richer picture of the relation, the study extends the investigation into time-frequency domain by employing wavelet coherence method. The computations for DCC-GARCH and regression were done by using R software, while for wavelet coherence, MATLAB software was used.

Data

The analysis conducted on a global level by using a USD monthly data from September 2006 to July 2016 for global sukuk, global bond, and global emerging bond collected from Dow Jones Sukuk Index, J.P. Morgan GBI Aggregate index, and J.P. Morgan EMBI Global Total Return Index, respectively, totaling 131 observations. Dow Jones Sukuk Index is a market value-weighted index designed to track the performance of global U.S. Dollar-denominated investment-grade bonds that are shariah compliant and serves as a benchmark for investors who are interested in shariah compliant fixed-income investment. While J.P. Morgan GBI Aggregate Index is a comprehensive index that consists of investment grade and high yield local currency government bond across developed and emerging markets. The index covers 37 countries and launched in October 2016 with historical data back to December 2001. Finally, EMBI Global is a comprehensive emerging market index that covers a wide universe of emerging markets. The index includes USD denominated sovereign and quasi-sovereign bonds, constructed using a market capitalization weighted method, and includes fixed and floating rate instrument.

The starting point of the sample is September 2006 and was chosen in accordance with the launching day of Dow Jones Sukuk Index. Monthly frequency was used; because it is the highest frequency found for macroeconomics data. The data for these indices were obtained from the

Bloomberg database. The study sample covered over ten years of financial history that included the 2008 global financial crisis, and the 2010 European sovereign debt crisis.

For studying the impact of macroeconomic and financial uncertainty factors on the co-movement between fixed-income markets, a monthly data of advanced economies' consumer price index (CPI), industrial production index (IPI), and US three-month interbank interest rates LIBOR (IIR) were used as a proxy of inflationary environment, business cycle, and global monetary policy stance in advanced economies. Data of CPI and IPI obtained for advanced economies only; because emerging economies data were not available. The above data were retrieved from International Monetary Fund (IMF). CPI and IPI data used 2010 as a base year and a 100 as a base value. For financial uncertainty, implied volatility measures; Merrill Lynch Option Volatility Estimate MOVE Index, and Chicago Board Options Exchange CBOE volatility index VIX were used as a proxy for the global bond and stock market, respectively. These measures were widely used in the literature as a proxy for financial markets uncertainty [14, 16, 18].

RESULT AND DISCUSSION

DCC-GARCH Results

Table 1 presents the DCC-GARCH estimation results. The coefficients of α and β in the DCC equation are positive, and the sum of α and β (0.8828) is less than unity, thus indicating mean-reverting nature of the dynamic correlation process. Moreover, the significance of α and β implies of dynamic and time varying co-movement between the market's returns. The significance of DCC test indicates that the use of the model is justified. The significance of mshape indicates the appropriateness of selecting multivariate distribution over normal distribution.

Table 1. DCC-GARCH Estimation

		Sukuk	Bond	EBond
GARCH parameters (Conditional Variance)	ω_i	0.000003 (0.000061)	0.000021 (0.000017)	0.000111 (0.000066)
	a_i	0.453307 (0.328557)	0.125155 (0.081339)	0.270573 (0.200763)
	b_i	0.545693 (0.619294)	0.825787[***] (0.072750)	0.557427[**] (0.245317)
	skew	0.826423[**] (0.312251)	0.825554[***] (0.130675)	0.708260[***] (0.079245)
	shape	4.116239[***] (0.925287)	13.981099 (15.508169)	4.837489[*] (2.402581)
DCC parameters	α		0.086456[*] (0.045917)	
	β		0.796420[***] (0.079451)	
	Joint mshape		6.040361[***] (1.208907)	
DCC Test			16.85559[***]	

Remarks: Figures in parentheses are standard errors. ***, **, and* are for 1%,5% and 10% significant level respectively. DCC test is a test of non-constant correlation with null hypothesis of Constant Probability, the reported value is test statistic.

Figure 1 and Figure 2 depict the evolutions of dynamic conditional correlation between global sukuk and bond returns and global bond and emerging bond returns over the period from September 2006 to July 2016, respectively. The figures show that correlations between market returns are not constant and vary over time. Moreover, the figures demonstrate some variation in the pattern of dynamic conditional correlation across the investigated markets.
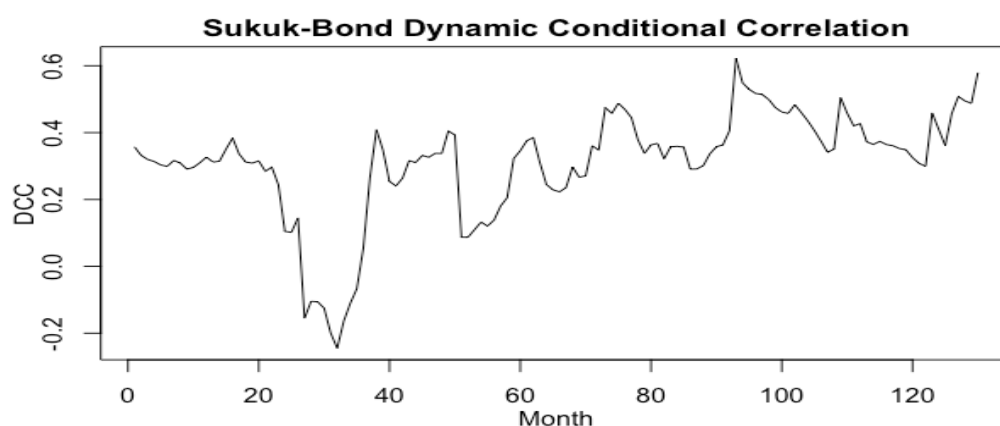

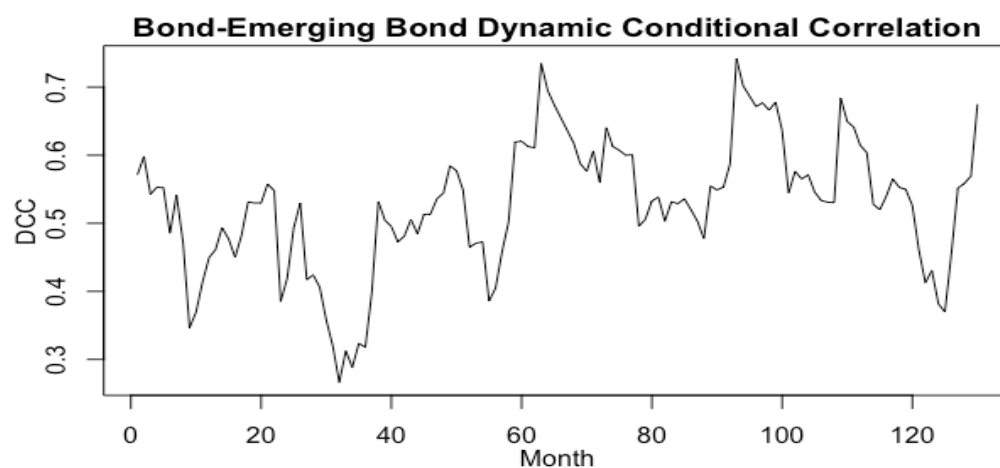**Figure 1.** Dynamic Conditional Correlation of Sukuk and Bond

Figure 2. Dynamic Conditional Correlation of Bond and Emerging Bond

On the other hand, Global bond and emerging bond returns had an average conditional correlation of 0.53 over the sample period and ranged between 0.27 and 0.74. Suggesting stronger co-movement compared to sukuk and bond case; which indicate of less diversification potentials for fixed-income institutional investors compared to the diversification potentials found in sukuk markets. The co-movement between global bond and emerging bond returns was on average strong and had been strengthened over the last six years. Similar to the pattern found in sukuk and bond co-movement, the period

before the financial crisis exhibited the lowest correlation between global bond and global emerging bond markets. While on the time of financial crisis, the correlation became stronger, where in the case of global bond and global emerging bond it returned to its level before 2008. Moreover, in respect to the European sovereign debt crisis, the co-movement showed an increasing trend that continued until today.

Figure 3 shows the dynamic co-movement between sukuk and emerging bond returns. The very strong correlation between the markets returns provided further evidence about the similarity between sukuk and emerging bond features. Where the dynamic co-movement between those markets ranged between 0.91 and 0.48 and had an average of 0.73.
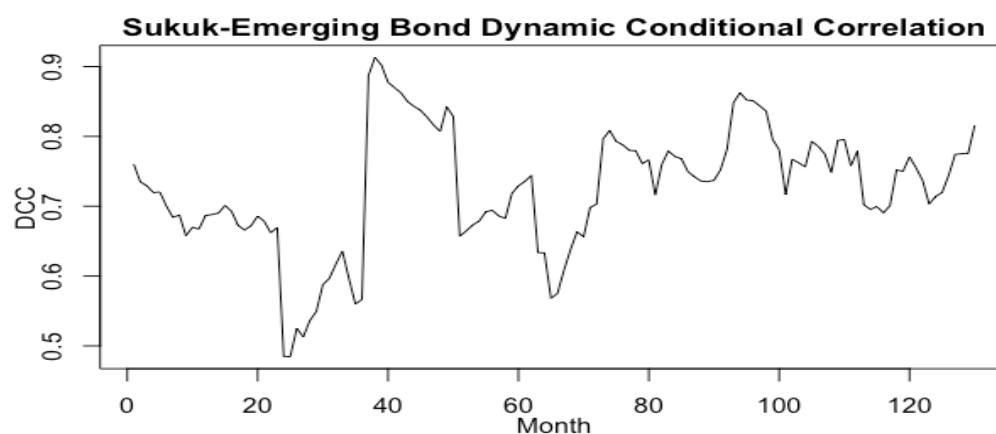

Figure 3. Dynamic Conditional Correlation of Sukuk and Emerging bond

In general, the results suggested the existence of time-varying nature of co-movement in bond and sukuk markets that investors should consider in their asset allocation strategy. Overall, the co-movement between sukuk and global bond returns were found to be less strong than the co-movement between bond and emerging bond returns suggesting better diversification potentials in sukuk markets. Moreover, policy makers and investors need to be cautious as crisis and turbulence in the markets do strengthen the co-movement between markets.

Wavelet Coherence Results

The results from wavelet coherence and wavelet phase are presented for sukuk-bond, bond-emerging bond, and sukuk-emerging bond to assess and compare the cross-market co-movement and capture the led-lag relationship (market dynamic) between the variables in the time-frequency space. A three-dimensional contour plot represents wavelet coherence; where the horizontal axis refers to time and the vertical axis refers to frequency (investment horizon) represented in days' unit, and the third dimension is the coherency which represented by colors. The contour represents wavelet squared coherency, the bold black line represents 5% significant level estimated from Monte Carlo simulations of 10,000 sets, and the coherency ranges from blue which indicate low coherency to red which means high coherency between markets returns.

Figure 4 shows the dynamic relationship between sukuk and bond over time and frequency space. The results for the phase difference show almost homogeneous relationship across frequency and time in which it indicates that sukuk and bond market returns have in-phase positive co-movement for most of the time; where the bond is leading most of the time and across frequency, and lagging only in the short investment horizon between 64 and 128 bands for the period of 2006 and between 2011 and 2012. This is not surprising as bond is well-established market compare to sukuk market. For short investment horizon (high-frequency periods), sukuk and bond shows in general low to medium coherence; which indicate high diversification potentials for short-term international institutional investors. However, for recent periods starting from 2013 the co-movement in the short horizons increases sharply and become closer to one. Moreover, for long investment horizon (low-frequency periods), the co-movement between sukuk and bond exhibits strong coherence in the band from 512 to 1024 days, while the band from 256 to 512 shows weak to low coherence in general, except for the period around the financial crisis. The frequency of more than four years (1024 days) is mostly out of the cone of influence representing insignificant statistical area however it shows low co-movement for the small area which on the cone of influence. The area corresponds to the financial crisis; late 2008 to the end of 2009, shows some turbulence in the short-term co-movement; as the co-movement changed its magnitude from low to medium and strong co-movement. While for the long term, there is no profound effect of the financial crisis as the long term co-movement is mostly strong over the sample period except for the band from 256 days to 512 days where the financial crisis had an adverse effect on the co-movement where it increases and became negative.
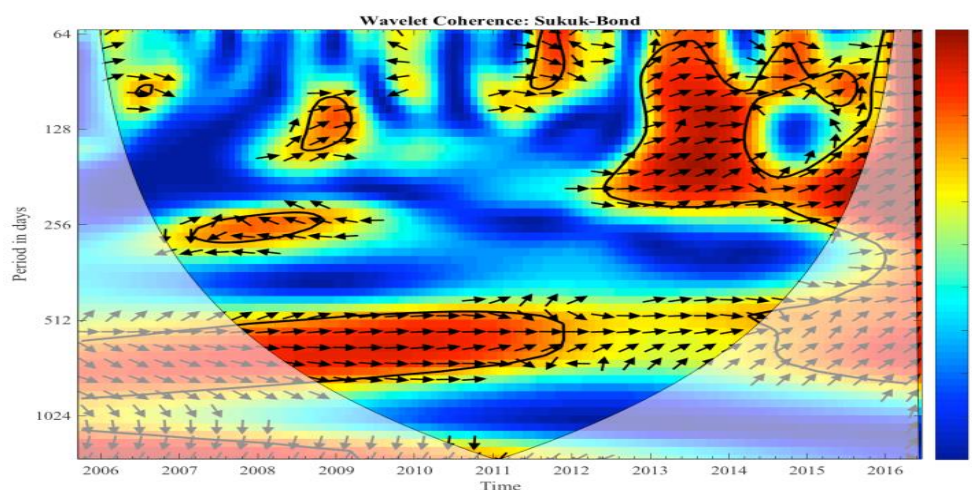

Figure 4. Sukuk-Bond wavelet coherence

Accordingly, the financial crisis shows different impact over frequency. However, for European sovereign debt crisis the impact was mainly concentrated on the short horizon as the degree of co-movement increased, and the lead-lag relationship change; where the bond lagged in this period. Moreover, a high level of co-movement also observed for short-term in 2013 which might be attributed to the turbulence in the bond market related to the

announcement of U.S. Federal Reserve about tapering the quantitative easing program [19].

Figure 5 depicts the dynamic co-movement over frequency and time between the global bond index and the emerging bond index. From the first glance, a strong coherence could be observed over frequency and time for most of the sample period. The phase difference implies that almost for all time and frequency the relationship is in-phase. Wherein, the bond is leading for almost all the time and frequencies. The effect of the financial crisis found to be moderate in the short run and much stronger in the area between 128-256 days. While the effect of the sovereign debt crisis is more profound on the short-term; as the degree of co-movement increased significantly in the short-term. Moreover, similar to the coherence results of sukuk and bond, 2013 shows strong co-movement over frequency and time, and this can be related to the announcement of Federal Reserve Chairman Ben Bernanke about reducing the US quantitative easing program.
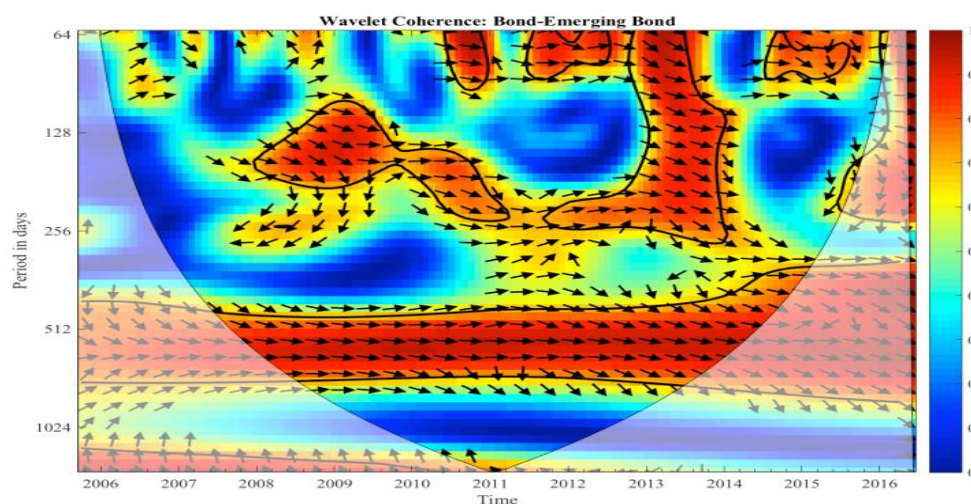

Figure 5. Bond-Emerging Bond wavelet coherence

Figure 6 presents the relationship between sukuk and emerging bond over time and frequency. In line with the DCC-GARCH results, the highest co-movement found between sukuk and emerging bond; which is expected due to the similar characteristics they share. The strongest impact of the financial crisis was observed on the sukuk-emerging bond case. As the co-movement exhibit a significant and strong increase across all frequencies that started to decay after the financial crisis. Also, in the time of the European sovereign debt crisis between 2010 and 2012 strong co-movement was observed in both long and short-term which started later in the short-term. Moreover, similar to the other cases, the sukukemerging bond had a strong co-movement in 2013 mostly in the short-term frequency. However, the strong co-movement pattern continued to the end of the sample period; which support the view of diminishing diversification potentials due to increasing linkage between financial market over time. The results from phase difference show that for most of the time Emerging bond leads the relation while there are some episodes where sukuk lead.
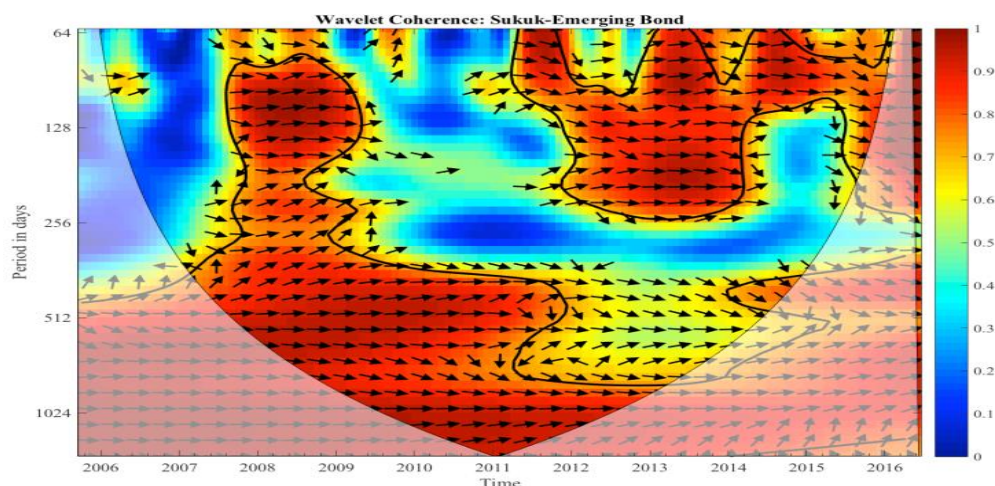
Figure 6. Sukuk-Emerging Bond wavelet coherence

In general, all the inspected markets showed an increasing trend in the short term (high frequency) co-movement at the latter part of the sample; after 2013 and strong pattern of co-movement in the long term especially in the 512-1024 band. Overall, the strongest co-movement found between sukuk and emerging bond and the least co-movement found between sukuk and bond.

Impact Of Macroeconomic And Financial Uncertainty Factors

The estimate of dynamic conditional correlation from the DCC-GARCH model regressed on the expected determinant factors by using Ordinary Least Square regression. Table 2 contains the estimation results, a regression model that links the dynamic conditional correlation of sukuk and bond and bond and emerging bond with a number of global macroeconomic factors and global financial uncertainty factors
.

Table 2. Ordinary Least Square Regression result

Sukuk-Bond	γ	VIX	MOVE	CPI	IPI	IIR
Estimate	0.33405*** (0.01539)	-0.06977 (0.06972)	-0.02226 (0.09577)	-18.12173*** (5.17059)	0.13989 (0.28966)	0.11865 (0.11454)
R-squared	0.09937					
Adjusted R-squared	0.06305					
F-statistic	2.736**					
Bond-EBond	γ	VIX	MOVE	CPI	IPI	IIR
Estimate	0.532602*** (0.009520)	-0.037658 (0.043122)	-0.006111 (0.059233)	-4.028975 (3.198037)	0.016195 (0.179154)	0.010111 (0.07084)
R-squared	0.01969					
Adjusted R-squared	-0.01984					
F-statistic	0.4981					

Figures in parentheses are standard errors. ***, **, and* are for 1%,5% and 10% significant level respectively.

For the sukuk and bond co-movement, only CPI have a statistically significant impact on the dynamic co-movement at 5% level. The sign of the CPI coefficient suggests a negative relation between inflation and co-movement. The model has low explanatory power as most of the studied variables are statistically insignificant. However, the overall fit of the model is significant evidence from significant F-statistic. On the other hand, for bond and emerging bond co-movement, none of the variables have a significant impact on the co-movement, and the model has no explanatory power.

CONCLUSION
By using data on global sukuk, bond, emerging bond from September 2006 to July 2016, the obtained results provide evidence of time-varying nature of co-movement also suggest that the co-movement is not only time-varying but also scale dependence as the co-movement varies significantly across different frequencies. Moreover, the results suggest that comovement is least found between sukuk and bond market returns suggesting that sukuk provide the most diversification potentials for fixed-income investors. However, during turbulence periods, the market returns association increases thus limiting the diversification benefits. Little evidence was found regarding the determinants of the dynamic conditional correlation as most of the studied factors were insignificant in explaining the variation of the market returns co-movement, where only inflation had a significant impact on sukuk-bond co-movement.

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