



# Comparison of the Islamic and the Conventional Stock Market in Indonesia and Developed Countries

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In the global economy, global financial shocks adversely affect the financial industry, especially stock markets. Focusing on this, the present study aims to assess how global financial shock affected the links between Indonesia and seven other selected countries (U.S.A., U.K., Japan, Kuwait, Saudi Arabia, Malaysia, and Qatar) from December 2004 to December 2012. The correlations between the Islamic and conventional stock markets tend to be higher at both high and low frequencies during a crisis period. Using the wavelet method, this study demonstrates higher correlations during a crisis period, in both the short and the long term. The co-movements for certain countries were apparent across the analysed horizon in the periods of lower frequencies (more than one year). The obtained results also reveal varying responses for both types of stock markets, particularly in the Indonesia-Malaysia nexus and the Indonesia-Saudi Arabia nexus. This indicates the solidity of the Islamic finance system against global financial shock that typically affects the conventional finance system. Nevertheless, this does not mean that the Islamic finance system is free from the impact of global financial shock, given its linkages to the U.S.A., Japan and other markets. The outcomes of the present study create significant implications for financial investors to optimise their asset allocation strategies or to diversify their global investments, as the changing correlations of the stock markets at high and low frequencies (or investment horizons) influence the portfolios with different rebalancing horizons.

**Key words:** *Global financial shock, Islamic stock market, wavelet.*



## Introduction

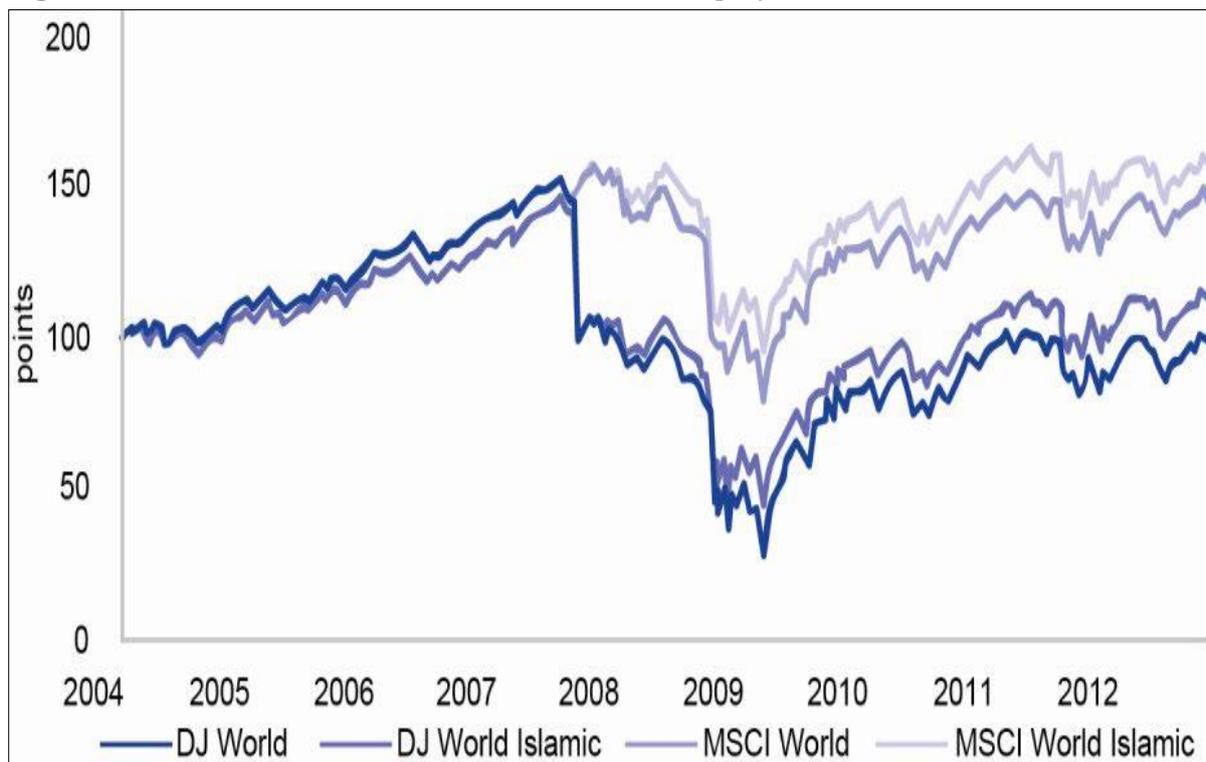
A slide in the stock market can lead to substantial monetary losses in market capitalisation and negatively affect the capital of “buy and hold” investors. For instance, the stock market slide experienced by Dow Jones Industrial Average (a drop of 11.58%) and S&P 500 (a drop of 11.08%) in October, 2008, increased the interest rate of interbank borrowings by up to 6.88%, due to lack of confidence in their financial capabilities. Concurrently, the subprime mortgage market in the same year led to widespread financial insecurities (specifically known as the contagion effects) across the global financial market. However, contagion may not take place if the markets display substantial co-movement during the stable period and continue to be strongly linked to one another during the aftershock period (Forbes and Rigobon, 2002). It is crucial for managers and policymakers to consider the global financial context in their decision-making process. Their decisions are often made based on the spill-over analysis that considers the linkages of the global stock markets (Tiwari, 2016). The International Monetary Fund (IMF) and the World Bank oversee the overall crisis and updates in order to implement effective mitigation measures to rescue susceptible and contagious financial markets. These financial authorities assess various components that can affect the movement of stock markets to identify salient crisis indicators.

The performance of Islamic equity indices is said to be significantly related to their conventional counterparts in the long term. It demonstrates similar risk-return characteristics, taken as a whole. Since 6 October 2008, the Dow Jones Index Average (DJIA) closed all five sessions and experienced a drop of 18% (> 1,874 points), whereas S&P 500 experienced a fall of more than 20%. As of 6 March 2009, DJIA experienced a steep fall from 14,164 points (9 October 2007) to 6,469 points. Meanwhile, the Financial Times Stock Exchange (FTSE) 100 Index experienced a drop in the share price of 391 points, with the highest price drop in history by London Stock Exchange ever since the collapse of the stock market in 1987. As a result, the FTSE 100 Index lost almost one third of its initial value. Japanese stocks experienced a drastic drop (> 5%), but only within the first half hour of the event during the crisis period (Winnett, 2008). Surprisingly, the global financial shock did not critically affect the Islamic stock markets.

Referring to Figure 1, there is an increasing trend in the global Islamic indices (DJWI) (by 14% since 2004) and the MSCI World Index (by 7.8% since August 2007). After the initial stage of the crisis period, the overall indices declined by 20%. In particular, the total return of DJIM World Developed Index dropped by 24.7%, while the output for the MSCI World Index dropped by 34.7%. Indonesian stock markets experienced unfavourable circumstances during the global financial crisis in 2008. Authorities were rather apprehensive of the inflationary loads of the dual food and energy shocks throughout the year. The increase in the interest rate by 1.5% (8.0% in January 2008 to 9.5% in November 2008) subsequently

affected the disposition of policymakers. According to Bank Indonesia, in its final quarter report on monetary policy, the negative implications of the global financial crisis on the economic performance of Indonesia appeared to be evident. The stock market crash reversed the acquired gains from 2005 to 2008 and its exchange rate was also significantly depreciated. And although a projected growth of between 4% and 5% was declared, the private sector anticipated growth of only 2.5% in 2009.

**Figure 1.** Selected Global Conventional and Islamic Equity Indices



**Source:** IFSB Report (2013)

Studies have mainly assessed the correlations of stock prices in the time domain using various time-series methods, such as VAR techniques (Campbell and Ammer, 1993; Laopodis, 2010), cointegration analysis (Chan et al., 1997; Hatemi-J and Roca, 2008), Granger causality tests (Panda, 2008), non-linear models (Bartram, 2002; Ballester et al., 2011), and GARCH-type models (Faff et al., 2005; Kasman et al., 2011). Several past studies focusing on the aggregate stock markets across countries, assessed the link between the interest rate and the equity market using the wavelet methods (Cifter and Ozun, 2008; Hamrita and Trifi, 2011; Andrieş et al., 2013), which revealed the time-dependent relationship between both components in the long term. The maximal overlap discrete wavelet transform (MODWT) was adopted in these past studies, given its appealing features and extensive use within economic contexts, including there being no specific requirements on sample size or on the representation of translation or shift invariance.



Unlike these past studies, considering the presence of heteroscedasticity biases, the present study presents newfound evidence on the negative implications of financial shocks on the stock markets, using a wavelet method during both the shock period and non-shock period. The recent methodological advancements visualise the estimated wavelet correlations at different investment horizons or time scales. The impacts of a global financial shock on the Islamic and conventional stock markets, specifically within the Indonesian context, were also compared in this study, whereas most previous studies have only focused on the former. Additionally, the present study aims to explore the significant implications of developing portfolio diversification strategy, given its influence on portfolio weights. Furthermore, the adoption of the wavelet method in the present study was expected to contribute essential insights on the reliability of using Pearson's correlations in making investment decisions. Moreover, assuming that the correlations exhibit a pre-specified dynamic behaviour, the wavelet method was deemed more advantageous than the conventional dynamic conditional correlation generalised autoregressive conditional heteroskedasticity (DCC-GARCH) models, as the former can decompose time-series into varying frequencies.

## Literature Review

Several studies reported significant and positive changes in the correlations of the stock markets; thus indicating the occurrence of contagion (Dewandaru et al., 2016; Kenourgios et al., 2016). These studies further assume the increase of global stock market correlations in the bear markets. For instance, Gallegati (2012) found that the U.S. subprime crisis in 2007 affected the stock markets, resulting in contagion. Uddin et al. (2014) highlighted that the variation in the nature or structure of the crisis changes the dynamics of the co-movements of Germany and other major stock markets. Additionally, Ghosh et al. (1999) identified pairwise co-integration of the U.S.A. or Japan with certain Asian-Pacific stock markets during the crisis period, whereas Sheng and Tu (2000) indicated no such co-integration in the stock markets between the U.S.A. with numerous Asian countries prior to the crisis period, except for a single co-integrating vector. A more recent study used the time-frequency approach to analyse the extent of contagion, co-movements, and rolling correlations of the stock markets in the U.K., Portugal, Italy, Ireland, Greece, Spain, and Germany (Tiwari et al., 2016). The obtained results revealed high correlations in the short term during the crisis period and the occurrence of co-movements throughout the analysed period in the long term. Besides that, the correlations of the stock markets in Portugal, Italy, Ireland, Greece, Spain, and Germany were found to be more apparent at low-frequency decomposition levels but less apparent at high-frequency decomposition levels. In another study, Mensi et al. (2016) adopted the bivariate DCC-FIAPARCH model to assess the spill-over effect of the stock markets in the U.S.A., Brazil, Russia, India, China, and South Africa, which revealed abrupt market changes in relation to the bankruptcy of Lehman Brothers, with a common break date (15 September 2008). The global financial shock appeared to substantially affect the stock markets in Brazil,



India, China and South Africa. This observation was consistent with the reported evidence by Ali and Afzal (2012) on the impact of a financial crisis on the markets in India and Pakistan.

The persistence of Islamic equities against the global financial shock, particularly in 2008, has been well-documented. Studies have revealed the negative implications of ethical and financial screening on the Islamic index performance. According to Chapra (2008), the Islamic finance principles prevent the initiation of a global financial crisis that is contributed to by excessive lending and high leverage within the conventional financial system. For instance, imposing an interest rate is prohibited in Islamic finance; thus, preventing the risk of a global financial crisis (Ahmed, 2009; Ferdian, 2010). In fact, Islamic equities are generally regarded a safe and profitable investment in a downturn. Several studies that assessed the performance of Islamic and conventional equities during the recent crisis also shared similar views. Rizvi et al. (2015), who assessed the co-movements of Islamic equity markets in the U.S.A. and the Asia Pacific (in relation to contagion behaviour), concluded that the Islamic equity markets display higher survival capability during crisis.

Accordingly, Arouri et al. (2013) assessed how a global financial crisis affects the Islamic and conventional stock markets, revealing that the Islamic stock market was not severely hit with lower systemic risks (due to the augmented portfolios) and had more significant diversification benefits. Additionally, the changing investment choices due to the U.S. crisis prompted major changes in resource allocation. Ho et al. (2014) and Ashraf and Mohammad (2014) shared similar views on the performance of the Islamic stock market during crisis. Both studies revealed that the Islamic indices displayed better performance with lower systemic risks during the bearish period. However, certain studies disputed its superior performance—for instance, Abderrezak (2008) reported insignificant difference in the performance of Islamic equity funds (IEFs) and conventional funds (1997–2002). Yusof and Majid (2006) also reported similar results for the risk-adjusted returns between both Islamic and conventional funds in Malaysia. Likewise, Beik and Wardhana (2009) found insignificant difference in the performance of both Islamic and non-Islamic indices. When it comes to the global financial shock, Charles et al. (2010) indicated that, unlike the conventional indices, the Islamic indices exhibited slightly higher volatility although both types of indices were found similarly affected. Meanwhile, Ajmi et al. (2014) found major outcomes on the connections between Islamic and global conventional equity markets and the corresponding linear and nonlinear causality, which rejected the longstanding decoupling hypothesis that assumed weak correlations between both financial markets. To date, the findings on the performance of Islamic and conventional stock markets have remained inconclusive.

Thus, the present study aims to assess how the global financial crisis (2007–2008) affected the time-variation nature of both Islamic and conventional market indices. The obtained

results were deemed significant, as this study provides newfound evidence on the impact of the crisis on the correlation structure of both Islamic and conventional stock markets and their responses against financial shock. After all, the time- and frequency-based responses of both stock markets during crisis have remained underexplored. Hence, the resultant outcomes of this study are expected to bridge the literature gap on the dynamic correlations and its applications in finance, specifically the Islamic stock markets.

## Methodology

A wavelet method, specifically the signal decomposition technique, was used for this study to analyse the linkages of the Islamic and conventional stock returns. Unlike the Fourier basis functions, wavelets are localised in frequency (through dilatations) and time (through translations). The wavelet method estimates the spectral properties of a time-series (as a function of time) and demonstrates the variation in its periodic components. The Fourier transform separates a time-series into integral sinusoids, involving various frequencies and unlimited duration. However, the wavelet method expands a time-series into shifted and scaled functions, involving limited frequencies and duration. Besides that, this method produces correlation estimates at different frequencies and time levels with lower risk of data loss, as the uncaptured information can be captured at another level.

In particular, MODWT was applied to determine the correlations of stock prices over time, originating from the multiresolution signal decomposition. MODWT is basically a modified DWT (stationary wavelet transform) that addresses the limited translation in variance of DWT (Percival and Walden, 2000). Unlike DWT, MODWT yields a more asymptotically efficient wavelet covariance estimator and presents a larger sample size in the wavelet correlation analysis (Tiwari, 2013). In particular, the price of MODWT refers to the loss of orthogonality and computational efficiency. Both wavelet ( $\tilde{W}_{j,t}$ ) and scaling ( $\tilde{V}_{j,t}$ ) coefficients at  $j$  level ( $j = 1, \dots, J$ ) are expressed as follows:

$$\tilde{W}_{j,t} = \sum_{l=0}^{L-1} \tilde{g}_l \tilde{v}_{j-1,t-1 \bmod N} \text{ and } \tilde{v}_{j,t} = \sum_{l=0}^{L-1} \tilde{h}_l \tilde{v}_{j-1,t-1 \bmod N}.$$

Where the wavelet ( $\tilde{g}_l$ ) and scaling ( $\tilde{h}_l$ ) filters are denoted as  $\tilde{g}_j = g_j/2^{j/2}$ ,  $\tilde{h}_j = h_j/2^{j/2}$ . The non-decimated wavelet coefficients denote the changes between generalised averages of data at Level  $\tau = 2^{j-1}$ .

The weekly stock market returns of eight countries were decomposed into the corresponding time-level components. The Daubechies least asymmetric (LA) wavelet filter of length,  $L = 8$ , was applied according to eight non-zero coefficients (Daubechies, 1992) with periodic



boundary conditions. Accordingly, Daubechies is a group of orthonormal wavelets from the multiresolution analysis and possess finite vanishing moments and property insures, resulting in finite non-zero coefficients in the associated filter. This consequently minimises the cases of distortions (Tiwary, 2005). The decomposition of a time-series of financial returns into orthogonal components, namely the wavelet details ( $W_1, W_2, \dots, W_J$ ) and wavelet smooth ( $S_J$ ) subsequently takes place. Basically, the use of translation invariant wavelet transform at specific levels, in this case,  $J = 5$ , generates five vectors of wavelet filter coefficients ( $w_5, w_4, w_3, w_2, \text{ and } w_1$ ) and a single vector of scaling coefficients ( $v_5$ ). As weekly data was considered in this study, the wavelet filter coefficients characterise slight deviations over time from the smooth behaviour with respect to the wavelet details of level 1 (one week), level 2 (two weeks), level 3 (four weeks), level 4 (eight weeks), and level 5 (sixteen weeks).

### ***Data Collection***

The collected weekly data<sup>1</sup> from 31 December 2004 to 31 December 2012 describes the first log difference of the weekly stock price indices of eight different countries, namely Indonesia, U.S.A., U.K., Saudi Arabia, Qatar, Malaysia, Kuwait and Japan. The unit root test served as one of the preliminary analyses of the time-series data. The use of first differences was deemed fitting since the analysis involved non-stationary series. In particular, the augmented Dickey-Fuller (ADF) test was performed to identify any unit roots within the collected data. Additionally, the collected data were categorised into three groups according to three specific periods, namely the pre-crisis period, crisis period, and post-crisis period, in order to prevent sample selection biases and determine the suitable breakpoint. The global financial crisis in 2008 was the primary focus of this study, considering its disastrous impact on the volatility of the global financial markets since the Great Depression, the failure of the U.S. subprime mortgage market in 2007, and the bankruptcy of Lehman Brothers in 2008 (Claessens et al., 2010). The onset of the crisis under study was 5 October 2007, based on the declining trend in the DJIA after achieving more than 14,000 points. The end of the global financial crisis under study was 5 June 2009, considering that the U.S. government and its federal reserve spent USD 6.8 trillion from the total amount committed (USD 13.9 trillion) in June 2009. Moreover, the New York Times identified March 2009 as the lowest point of the global financial crisis (GFC) and the year of 2011 as a fruitful period, when a large proportion of the global stock markets was at least 75% higher than they were during the GFC (Financial crisis of 2007–08, 2020). Hence, the pre-crisis period (prior to the global financial crisis) was from 31 December 2006 to 24 September 2007; the crisis period (during the global financial crisis) was from 1 October 2007 to 25 May 2009; the post-crisis period (after the bankruptcy of Lehman Brothers) was from 1 June 2009 to 26 December 2012.

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<sup>1</sup> In most cases, there are too much noise in the daily data; the symmetry in the two time intervals establish weekly data as the preferred choice of data in order to highlight as much as possible the impact of a financial crisis and quantitative easing on the stock market (Huang et al., 2016).

## Results and Discussion

The study first initiated empirical testing prior to the computation stage. In particular, the stationary of the variables under study was determined.

**Table 1:** Results of ADF unit root test

Variable	Type	Mean	Standard Deviation	Skewness	Kurtosis	ADF Unit Root	
						Unit Root	First Difference
Saudi Arabia	Islamic	3,256	0.173	0,834	-0,241	-2.4675	-5.7414
	Conventional	2,931	0.149	0,879	0,287	-2.5952	-5.9472
Indonesia	Islamic	3,387	0.275	0,189	-1,462	-1.0529	-6.4480
	Conventional	3,305	0.305	-0,471	-0,799	-3.2577	-6.6765
U.S.A.	Islamic	3,321	0.062	-0,455	0,330	-1.0681	-5.0185
	Conventional	3,067	0.066	-1,142	1,179	-9.6031	-4.7927
Malaysia	Islamic	1,552	0.137	-0,348	-1,406	-1.1588	-4.5694
	Conventional	2,817	0.092	-0,289	-1,441	-1.3811	-5.2499
U.K.	Islamic	3,305	0.072	-0,299	-0,413	-2.5169	-6.9571
	Conventional	3,087	0.026	0,600	-0,792	-2.4464	-6.2176
Japan	Islamic	3,042	0.063	0,464	0,088	-0.53438	-6.1641
	Conventional	2,828	0.134	0,294	-1,439	0.61781	-5.4967
Kuwait	Islamic	3,046	0.169	0,161	-0,135	-1.1096	-5.9388
	Conventional	2,817	0.133	0,342	-1,207	0.67637	-5.8343
Qatar	Islamic	3,162	0.113	0,065	-0,298	-2.3613	-5.2993
	Conventional	2,936	0.098	-0,051	-0,296	-1.9890	-5.1931

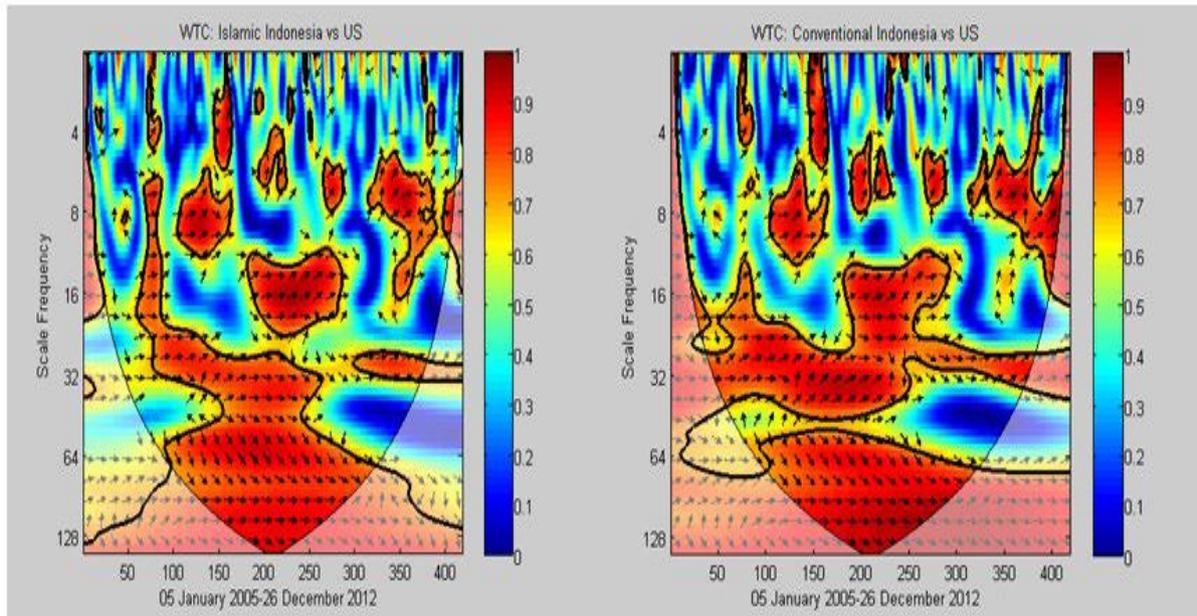
### *Wavelet Coherency (WTC) Results*

For the wavelet squared coherency analysis, two financial time-series in the time and frequency domains served as the input, and contour plots that involved time, frequency, and

wavelet squared coherency values served as the output. Referring to the following contour plots, the red spectrum represents the wavelet squared coherency whereas the horizontal and vertical axes represent the extracted time and frequency, respectively. In other words, frequencies were converted into units of time (weeks). The lower part of the plot represents lower frequencies whereas the higher part of the plot represents higher frequencies; the co-movement of financial stock returns for each country can be compared to the Indonesian market and can be determined based on the visual assessment of these plots. The thick blue contour reflects the outcomes of Monte Carlo simulations (using phase randomised surrogate series) at 0.05 level whereas the lighter shade of black line denotes the cone of influence or specifically, the region affected by the edge effects. Generally, the colour code for power changes from blue (lower power) to red (higher power). Additionally, the phase difference between two series can be determined based on the arrows—an arrow that points right indicates “in phase” (the variables experience cyclical effect) whereas an arrow that points left indicates “out of phase” (the variables experience an anti-cyclical effect) (Tiwari, 2012). With the arrow down, the first variable is leading the second and with the arrow up, the second variable is leading to the first.

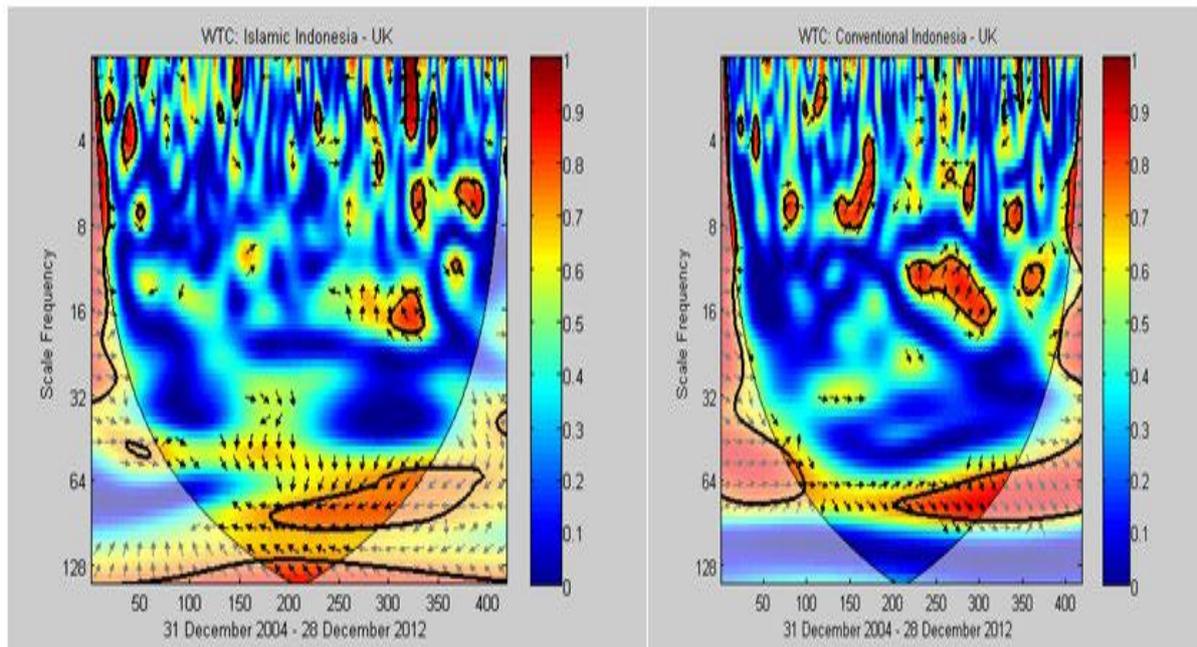
Referring to Figure 2, a large red zone can be seen in the lower part of the parabolic curve, especially in the quasi-elliptic areas during the crisis period from 5 October 2007 to 25 May 2009. This reflects the co-movement in the stock markets between the U.S.A. and Indonesia. The Indonesian stock market appeared to accommodate the anti-cyclical effect of the U.S. stock market, based on the upward arrows that point right at Levels 6-32. On the other hand, the downward arrows that point right at Levels 64-128 demonstrated the strength of the U.S. stock market during the crisis period. The variables were “in phase” where the Indonesian conventional stock market led the U.S. conventional stock market, with the latter accommodating the cyclical effect from Indonesia. In short, the Indonesian stock market displays endurance in the long run.

**Figure 2.** Wavelet Coherency Results of the U.S. and Indonesia



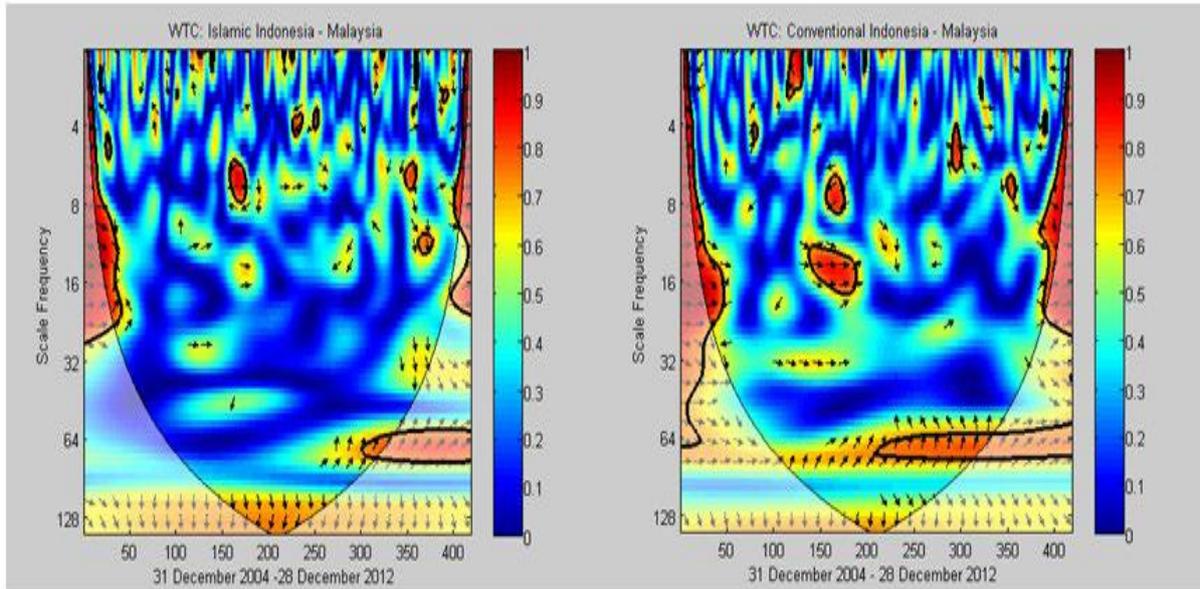
Referring to Figure 3, the U.K., as another developed country, appeared to be not severely hit by the global financial crisis, as compared to Indonesia, for both the Islamic and conventional stock markets. The direction of red zones across different periods, especially for the Islamic stock market, was rather indistinct. Unlike the U.S. stock market, the fluctuations of the U.K. and Indonesian stock markets appeared more frequent. At this point, the outcomes of the correlation between the U.S.A. and Indonesia and the correlation between the U.K. and Indonesia were not similar, particularly for their Islamic stock markets. These observations emphasise how the developed markets (developed countries) can affect the emerging markets (developing countries) differently during the crisis period.

**Figure 3.** Wavelet Coherency Results of the U.K. and Indonesia



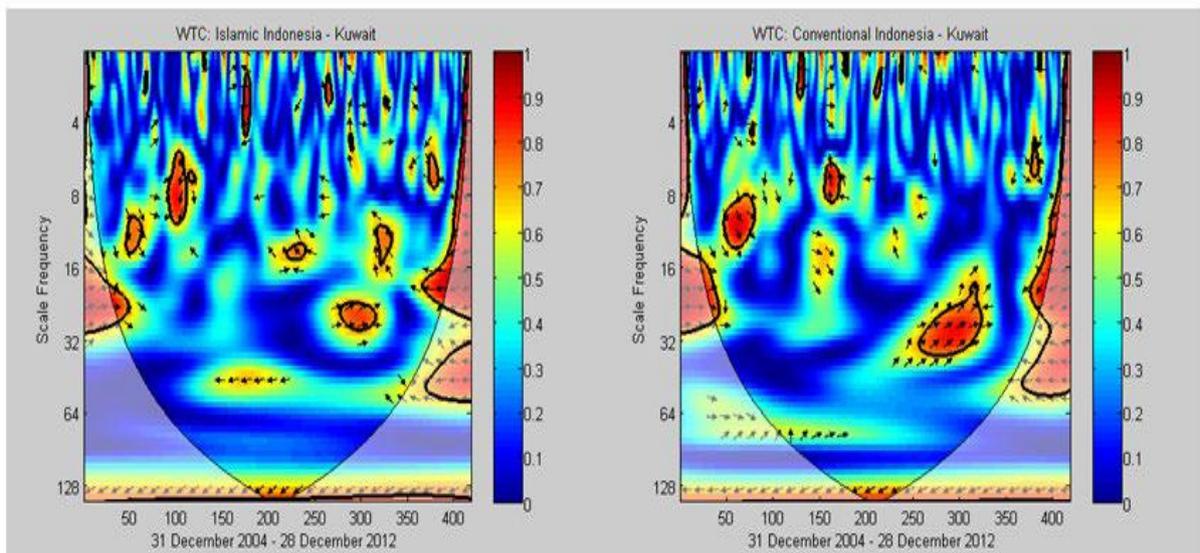
Referring to Figure 4, small red zones at all levels can be observed. Unlike the conventional stock markets, the correlation between both of these countries for the case of the Islamic stock market appeared to be indistinct and weaker. Nonetheless, the significant region of the conventional stock markets in Malaysia and Indonesia was found between 17 October 2008 and 17 August 2012 (over less than 52 weeks cycle). Furthermore, upward arrows that point right suggest that the variables were “in phase” where Indonesia is leading to Malaysia. These results demonstrate the impervious nature of the Islamic stock markets in Indonesia and Malaysia against the impact of the global financial crisis.

**Figure 4.** Wavelet Coherency Results of Malaysia and Indonesia



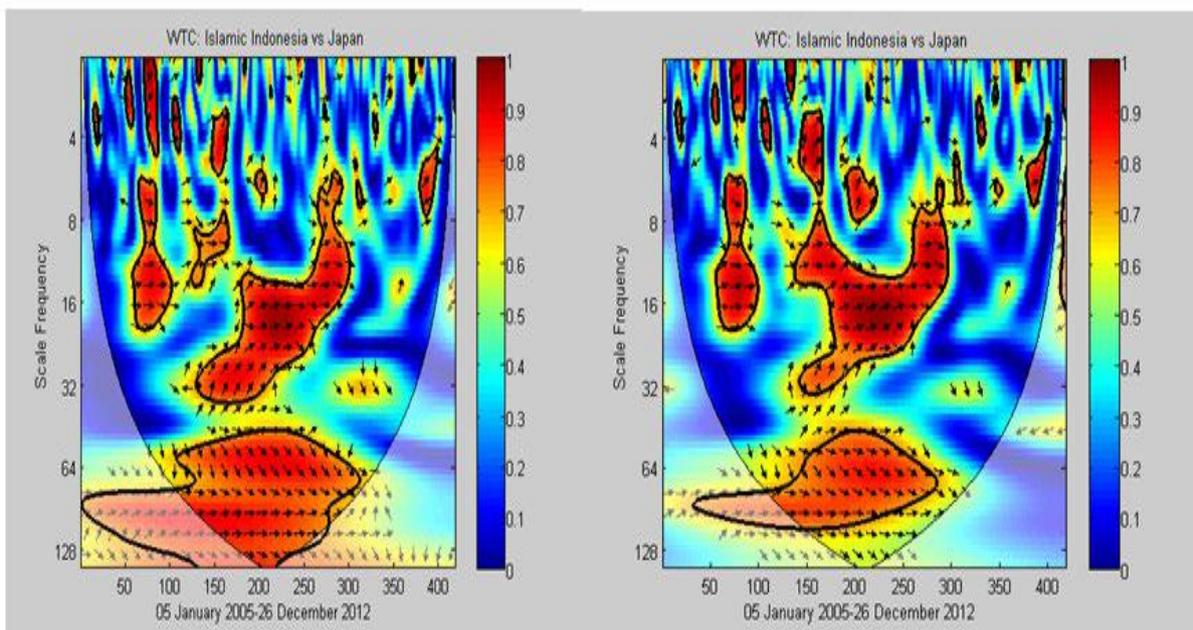
Referring to Figure 5, a clear-cut correlation between both Indonesia and Kuwait was revealed with apparent changes from 16 to 32 weeks during the post-crisis period. Furthermore, upward arrows that point right suggest that these variables were also “in phase”, where Indonesia is lagging Kuwait. However, the correlation between both countries during the crisis period was unclear where only small red zones appeared. This particular observation was rather similar to the outcomes of the correlation between Indonesia and Malaysia. Likewise, these countries appeared to be not critically affected by the impact of the global financial crisis.

**Figure 5.** Wavelet Coherency Results of Kuwait and Indonesia



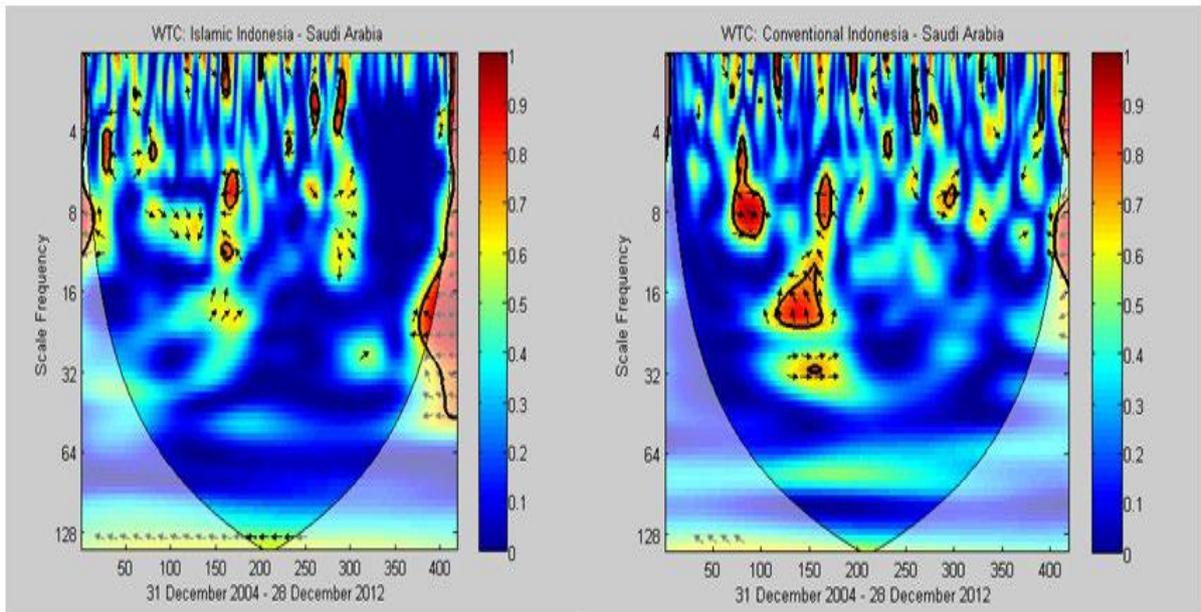
Referring to Figure 6, the obtained results demonstrate the propensity of Indonesia to follow the Japanese market movement during the crisis period, particularly at Levels 16-32 with the upward arrows that point right. In other words, the Japanese market was leading the Indonesian market during the crisis period. Additionally, the variables were found “in phase”, which suggests the presence of a cyclical effect. Basically, there was no space for profitable diversification between both countries. The outcomes during the crisis period were mainly discussed here, considering that the correlation between Indonesia and Japan was critically affected by the impact of the global financial crisis.

**Figure 6.** Wavelet Coherency Results of Japan and Indonesia



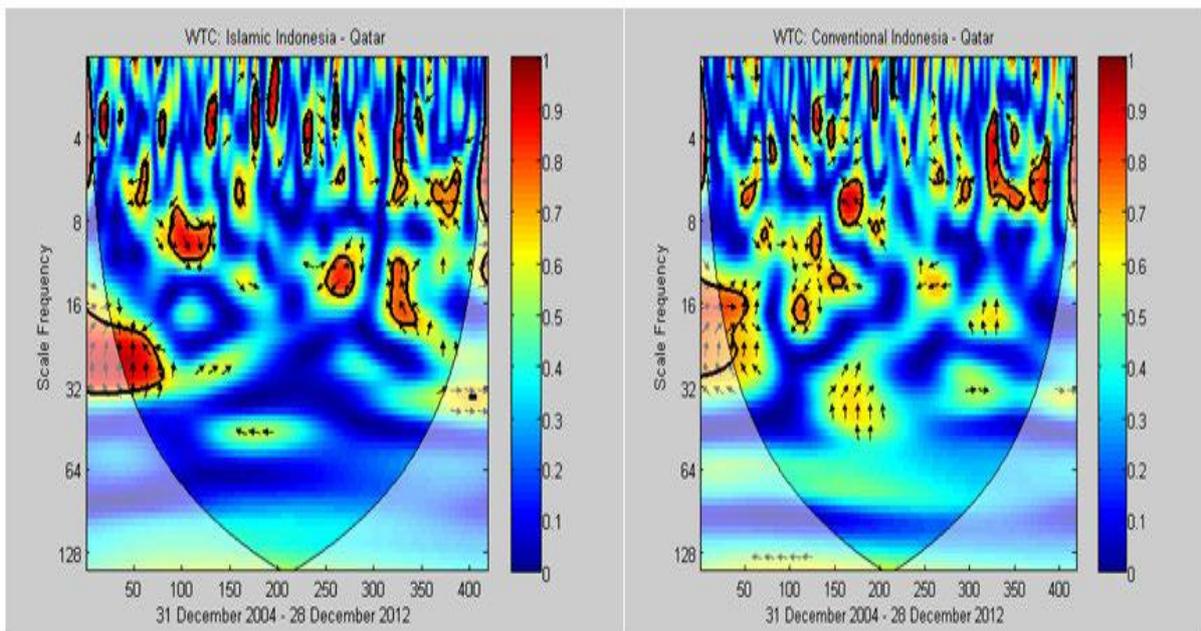
Referring to Figure 7, a clear-cut correlation between Indonesia and Saudi Arabia was apparent for the conventional stock markets, with clear changes from 10 to 24 weeks during the crisis period. Based on the upward arrows that point left, the variables were “out of phase”, thus suggesting that Indonesia is lagging Saudi Arabia. However, the obtained results for the Islamic stock markets demonstrate that these markets were not critically affected by the impact of the global financial crisis.

**Figure 7.** Wavelet Coherency Results of Saudi Arabia and Indonesia



Referring to Figure 8, the obtained results for both Islamic and conventional stock markets within the region of higher frequencies for Indonesia and Qatar revealed very small red zones in relationship for a less than 8 weeks period. As there was no clear direction for the arrows, it is evident that there was no clear movement for the variables under study. In other words, diversification may not be a profitable option for both of these countries during the crisis period.

**Figure 8.** Wavelet Coherency Results of Qatar and Indonesia





### ***Summary of WTC Results***

Focusing on the global financial shock during the global financial crisis in 2008, the wavelet correlations during the pre-crisis period, crisis period, and post-crisis period were determined to examine the variation in the correlations of Islamic and conventional stock markets in Indonesia and seven other countries (U.S.A., U.K., Japan, Malaysia, Kuwait, Qatar and Saudi Arabia). Based on the obtained results, the correlations of Islamic and conventional stock markets during the non-shock periods appeared to be stable, but global shock correlations tend to increase, with change differing with levels (or frequencies). Due to the global financial shock, the co-movements of Islamic and conventional stock markets within the regions of lower and higher frequencies tended to increase. Besides that, markets in the U.S.A., Japan and other developed countries exhibit a significant impact on the emerging markets, such as the Indonesian stock market, at smaller scales during crisis. For instance, the Indonesian stock market followed the U.S. stock market in 32 weeks—this implies that the Indonesian stock market substantially depends on the U.S. stock market.

Referring to the previous WTC figures, the frequent occurrence of phase changes within the region of higher frequencies indicate almost similar patterns of co-movements for both Islamic and conventional stocks. The analysis yielded several noteworthy findings. Firstly, the outcomes vary across countries according to the crisis date and the development state, extent of screening, and index selection of Islamic funds within the region. Secondly, the causal linkage among those countries shows that there is stronger relationship in Indonesia in which finance is more developed like the U.S.A. and Japan. The obtained results also prove the presence of varying responses for Islamic stock markets, as compared to the conventional stock markets (e.g. the Indonesia-Malaysia nexus and the Indonesia-Saudi Arabia nexus). Financial shocks may not critically affect the Islamic finance system but this does not indicate that the Islamic finance system is not exposed to global financial shocks, given its correlation to the developed markets, such as the U.S. and Japanese stock markets.

### ***T-Test Results***

At this point, a two-sample t-test with unequal variances was conducted using IBM SPSS to determine the robustness and the significance of the wavelet correlation coefficients. All decomposition levels and retain period prior to and after the crisis periods were assessed using divided sample size. For instance, assuming that  $\rho_j(X, Y)_{I1}$  and  $\rho_j(X, Y)_{I2}$  represent the wavelet correlations of two random variables of  $X$  and  $Y$  during these two periods of  $I_1$  and  $I_2$ , respectively, the null hypothesis ( $H_0$ ) was established as follows:

$$H_0: \rho_j(X, Y)_{I1} - \rho_j(X, Y)_{I2} = 0$$

where  $I_1$  denotes the shock period;  $I_2$  denotes the non-shock period.

Hence, the null hypothesis ( $H_0$ ) and the alternative hypothesis ( $H_1$ ) for the independent samples t-test can be equally expressed as follows:

**H<sub>0</sub>:**  $\mu_{Pre} - \mu_{Post} = 0$  (the mean difference equals zero)

**H<sub>1</sub>:**  $\mu_{Pre} - \mu_{Post} \neq 0$  (the mean difference does not equal zero);

where  $\mu_{Pre}$  denotes the population means for the Islamic stock market and  $\mu_{Post}$  denotes the population means for the conventional stock markets. Additionally, the values of *Pre* and *Post*, as the independent variable, were set as “1” and “2” respectively. Most importantly, this study focused on two relevant aspects: (1) Levene’s test, which is a test for the homogeneity of variances, was included in the analysis—assuming that the variance of two samples are similar,  $H_0$  is rejected if the variance of two groups are not equal; (2) t-test for equality of means was included in the analysis, where  $H_0$  is rejected if the obtained p-value is lower than 0.05 (significance level,  $\alpha = 0.05$ ); thus, concluding that the mean difference of two samples are statistically significant.

Referring to Table 2, the tabulated wavelet correlation series for the correlations of Indonesia and other selected countries at different frequencies demonstrate that wavelet correlations equity returns correlations for the Islamic U.S. and Indonesia over the period 2005–2012, are correlation of the U.S. and Indonesia markets were relatively different before and after the crisis. Hence, the correlation of Islamic stock markets between the U.S.A. and Indonesia demonstrated changes due to the global financial crisis in eight weeks.

**Table 2:** T-test results before and after the financial turbulence events for Indonesia and selected countries

Countries	Type	Scale 1	Scale 2	Scale 3	Scale 4	Scale 5
Indonesia-U.S.	Islamic	8.64*	8.24*	3.39*	-0.71*	3.06*
	Conventional	8.15*	-0.19	3.41*	0.33*	-2.51*
Indonesia-U.K.	Islamic	8.10*	-0.25	5.55*	0.553	0.48
	Conventional	0.06	-0.18	-0.05	-0.57	-1.03
Indonesia-Japan	Islamic	0.29*	-0.15	-0.07	-0.04	-1.97
	Conventional	0.33*	7.87*	-0.19	0.37	-1.79
Indonesia-Saudi	Islamic	-2.07*	0.12	0.19	-0.327	0.60
	Conventional	-1.90	0.12	0.14	-0.30	-1.82
Indonesia-Kuwait	Islamic	0.05	-0.19	-0.26	0.35	-2.55*
	Conventional	0.11	-0.20	-0.55	0.46	-2.50*
Indonesia-Malaysia	Islamic	7.76*	7.63*	0.05	-0.174	-2.30*
	Conventional	7.30*	7.65*	-0.21	-0.142	-2.08*
Indonesia-Qatar	Islamic	0.08	8.11*	0.01	0.25	-2.74*
	Conventional	8.04*	7.99*	-0.18	0.73	-2.71*

As for the correlation of Indonesia and U.K. stock markets within the region of higher frequencies, the obtained t-test results for the Islamic stock markets demonstrate statistically significant difference, which implies that the bankruptcy of Lehman Brothers and the subsequent financial crisis did affect the Islamic stock indices. The insignificant outcomes of the t-test after eight weeks reveal a similar mean between the pre-crisis period and post-crisis period, which reaffirms that the aftershock correlation did return to the pre-crisis values at Levels 4-5.

As for the co-movement for the linkages between Indonesia and Japan, the obtained t-test results reveal that the wavelet correlation significantly increased and the correlation returned to the pre-crisis values, except at Level 2 (the reverse only occurred for the conventional stock markets). The correlations of Indonesia and Japan for both stock markets during the pre-crisis period and post-crisis period were similar. However, when it comes to the region of lower frequencies, the Islamic stock markets for both countries were negatively correlated whereas the conventional stock markets for both countries were positively correlated. In other words, the Islamic stock markets did provide diversification benefits during the crisis period. As the Islamic stock index was clearly unaffected by the impact of the global financial crisis, its insulation from the crisis was deemed plausible. Islamic stocks were, in fact, more appealing to investors during the crisis period.

The contagion effect was found in the linkage between Indonesia and Saudi Arabia during the crisis period. The diverged mean between the pre-crisis period and post-crisis period at Level



W1 for the case of Islamic stock markets demonstrates the impact of the global financial crisis on the stock markets in both of these countries. Conversely, the variation in the dynamic correlations between Indonesia and Saudi Arabia stock indices were not significantly different from that of the pre-crisis period. In other words, the bankruptcy of Lehman Brothers and the subsequent financial crisis did not critically affect the Islamic stock indices for both Indonesia and Saudi Arabia.

On the other hand, the obtained t-test results for the Indonesia-Kuwait nexus reveal that the differences in the market linkages prior to and after the crisis period were insignificant. Based on this newfound evidence, the Islamic equity indices potentially offered a shield during the global financial crisis. The bankruptcy of Lehman Brothers seemed to drive investors to focus on Islamic stocks to minimise their investment risks. However, the obtained results reveal negative and significantly different coefficients in the mean equation from those of the pre-crisis period for Islamic and conventional stock indices at Level W5. In other words, global financial crisis influences the behaviour of investors when they encounter such unfavourable events. Indonesia and its neighbouring country, Malaysia, share similar cultural and economic settings. However, when it comes to the development of Islamic finance, the Islamic stock market in Malaysia displays a solid market foundation. Last but not least, the linkage between Indonesia and Qatar exhibited a higher correlation during the shock period by moving in opposite directions. As the correlations were found positive and statistically significant, the co-movement for the conventional stock markets in Indonesia and Qatar is assumed. Clearly, investors shift from the conventional stock market to a more profitable market, which was in this case, the Islamic stock market, during the shock period.

## **Conclusion**

Overall, the present study assessed the varying responses of Islamic and conventional stock markets against the global financial shock using the wavelet method. The correlations within the regions of lower and higher frequencies were found higher during the crisis period. When it comes to lower frequencies (more than one year), strong co-movements were found apparent across the entire analysed horizon. Besides that, the different levels and scales during the pre-crisis period, crisis period, and post-crisis period influence the responses of Islamic and conventional stock indices. Generally, the Islamic and conventional stock markets in Indonesia and developed countries like the U.S. and Japan exhibit different responses with the outperformance of Islamic markets. Therefore, from strategic asset allocation viewpoints, it is more profitable for investors to consider Islamic equities, given its high profitability.



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