Portfolio diversification opportunities for U.S. Islamic investors with its trading partners when the world catches a cold: A Multivariate-GARCH and wavelet approach

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1 October 2020

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Abstract

The goal of this study is to analyse the co-movements and the portfolio diversification between the Islamic index of U.S. and its top trading partners, namely Canada, China, Mexico, Japan and Germany, using Morgan Stanley Capital International (MSCI) daily returns data from January 2013 to August 2020. We employed three main techniques: multivariate-GARCH-DCC, CWT and MODWT to analyse whether these markets have any diversification opportunities. Our findings reveal that, first, we observed that the U.S. Islamic index and its trading partners showed increased integration after U.S. implemented its first China-specific tariffs in 2018 and were closely integrated during the Covid-19 pandemic in 2020. Second, CWT results show that investors would gain diversification benefits in China and Mexico under specific investment horizons. Third, the results of MODWT shows Japan Islamic index provide short term diversification opportunity and Mexico Islamic index for longer term investments.

Keywords: Islamic stocks, trade war, Covid-19, portfolio diversification, MGARCH-DCC, Wavelets

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1. Introduction

"When the U.S. sneezes, the world catches a cold" was phrase made popular during the U.S. subprime crisis between 2007 and 2010 that impacted the world financial system. Using the same phrase in the case of China i.e. "When China sneezes, the world catches a cold", would bring a different meaning as the world's economy has recently been crippled by a pandemic caused by a newly discovered strain of coronavirus first reported in Wuhan, China. In between these major events, the two countries have been involved in a trade war that impacted trades around the world. As of the year 2020, the world's top exporting country is China followed by the U.S. The top importer is topped by U.S. followed by China. Therefore, these 2 countries are the dominant force in the world's economy and its influence on trade would have high impact on other countries especially its trading partners. Not surprisingly, these 2 countries trade a lot with each other as well since year 2013 (U.S. Census Bureau – July, 2020).

The 2008-2009 financial crisis started in the U.S. and no doubt affected the world's financial system, even Islamic markets despite being different, are not spared. Many studies have looked into Islamic finance since then as a potential diversifier that may offer immunity from future crisis. The world is now aware of the potential crisis from housing bubble, but in what form will future financial crisis appear in? Could it be due to trade war and government policies from the largest countries in the world that would impact the rest of the world? The possibility could be as high or low as other factors and understanding its impact early could enable policymakers to be better prepared in anticipation of future crisis. Unlike Oskar Schindler, a businessman who thrived during the 2nd world war period due to contracts in providing supplies to the military, any kind of war in the current interconnected world would have far more complicated outcomes. And due to the cooperation of countries in trade to benefit from comparative advantages, any economic and political instability would slow all trades especially those linked to the larger producers in the world.

One major event that happened after the 2008 global financial crisis is when Donald Trump was elected as the 45th President of the United States on the 20th January 2017. Not long after, a trade talk with China ensued and exactly one year after his appointment, Trump imposed tariffs on China made goods and raw materials (July 2018) which China retaliated with the same on U.S. products. New tariffs were subsequently being imposed by the U.S. with China reacting in the same manner and went on until end of 2019, before the start of

global pandemic known as the Covid-19. Eventually, both countries entered into a Phase One deal which would suspend planned tariffs in October 2019. The International Monetary Fund expects this trade war to slow the global growth in 2019 to a rate similar to 2008-09 financial crisis, with the current pandemic causing more uncertainties for the remaining of year 2020.

In the first half of year 2020, productivity all over the world has slowed down due to travel restrictions to prevent the spread of a deadly virus that until the present day, has no cure. This caused a slowdown in investments as most investors prefer to hold cash during uncertain times or buy gold for value preservation. The common phrase, "cash is king" would mean that investors will only start investing again when the market is recovering and buying of undervalued assets due to fire sale. At the same time, U.S. is preparing for its coming Presidential election and its current president Donald Trump would be seeking re-election to lead the country for a 2nd term. Neumann and Geary (2019) found that all modern U.S. Presidents except for Trump associated Islam with the notion of violence as a target but not enablers. Donald Trump was noted in his statements being a very patriotic person but portrayed Islam in a negative manner (Khan et al., 2019). This strategy may have won him the election and is explained by Sunar (2017), hence, Islamophobia and China-phobia would be on the rise as he attempts to make American great again. While these can be observed in the news and reports, its impact and outlook from an Islamic investor is lacking especially when stark difference of Presidential views on Islam is taken into consideration. If Islamic financial market is a possible alternative to conventional finance after the 2008 global crisis, what benefits could it offer now? The teaser title "when the world catches a cold" is aimed at capturing this sentiment under the presence of new leadership, policies and trade sanctions impact on all the considered markets which coincides with the global pandemic and other political events that occurred during the period under study. We seek to find empirical evidence that can potentially enable Islamic investors to embrace the strengths of Shari'ah compliant markets rather than compare or question the performance of Islamic funds with conventional ones. This research intends to seek answer to the questions that would interest Islamic investors on where to diversify their assets and how to allocate them at different investment horizons.

The results of this paper are relevant and valuable for both investors and financial analysts and give new insights about the dependence relationships between Islamic stock market return of the largest economies in the world and their trading partners. The knowledge of financial co-movement among Islamic stock markets affected by trade policies is

important for portfolio diversification and risk management. More precisely, the most important finding of our paper is that the co-movement between Islamic stock market return of U.S. and China with their trading partners vary across different period of time. The findings may be useful to policy makers to help predict to what degree trade policies can be a good way to stabilize Islamic financial markets across different market conditions.

2. Literature Review

The Islamic economy and equity market may be small and insignificant if compared with those in developed countries, however Islamic investors do not lack funds. Islamic investors currently own the top 2 richest football clubs in the English Premier League. With 3 out of the top 6 richest football clubs in England having owners from Islamic countries, it is fair to say that Islamic investors are looking beyond conventional investments for diversification. Parker (2016) noted that the Islamic finance industry has grown on average 18% annually between 2008 and 2014, hence it gives greater incentives to look into the Shari'ah compliant equities that are mostly listed in Shari'ah indices all over the world. Inspired by the use of recently developed techniques and research on portfolio diversification with major trading partners for Islamic investors, Rizvi and Arshad (2014); Rahim and Masih (2016); Joyo and Lefen (2019) have provided a fundamentally strong starting point for further research in Islamic equities and indices.

In the Islamic stock markets, multiple studies have been done using latest techniques. Among them are by Najeeb et al. (2015) looked at potential cross border diversification for Islamic investors in Malaysia and concluded that developed markets, European markets and MENA are better for diversification. Another study which the decision of using Morgan Stanley Capital International indices for this study is based on Bahloul et al. (2017) which looked at macroeconomic impact on Islamic indices under different regimes. Morgan Stanley Capital International index is included to capture a broad market-wise portfolio diversification from the South East Asian region, instead of just Vietnam on its own. Rahim and Masih (2016) employed similar methods of MGARCH-DCC and Wavelet to study diversification opportunities for Malaysian Islamic investors to diversify with Shari'ah indices of the country's major trading partners. Jaffar et al. (2018) innovatively used Malaysian Ace Index to represent venture capital (PLS investments) which are the fundamentals of Islamic investments and found portfolio optimisation opportunities for investors in other Islamic stock indices in Malaysia. A more recent study by Trabelsi et al. (2020) uses Markov regime-switching model for the performance analysis of Islamic portfolios, utilising MSCI Islamic stock index as well.

The methods used in these studies are not unpopular and has been used in other articles looking at diversification opportunities in markets other than Malaysia and Shari'ah indices. For example, Kearney and Poti (2006) used MGARCH-DCC to study determinants

of volatility of equity returns in major Euro-zone indices. Paramati et al. (2015) found long-run relationship between Australia and its major trading partners allowing potential diversification for portfolio managers. Gjika and Horvath (2013) used asymmetric DCC model in their study which identified correlations of stock markets in central Europe. Alternatively, markov switching method has been utilised by several studies to capture the different regimes under the period of study for Islamic assets ie. Aloui et al. (2015); Chkili (2017); Bahloul et al. (2017); Jaffar et al. (2018).

Generally, gold is considered a safe haven for investors due to its low correlation properties but will not generate any income. Alternative assets such as cryptocurrencies and Bitcoin on the other hand is a potential diversifier for Islamic investors (Lim and Masih, 2017; Rehman et al., 2020) but does not fulfil the requirements of money from the Islamic perspective (Siswantoro et al., 2020). As such, it is expected having Islamic indices of major trading partners as an alternative for portfolio diversification would be useful to businesses dealing with U.S. Studies have also shown that during volatile regimes such as the 2008-2009 global financial crisis, integration among markets increases and diversification benefits would reduce.

A recent study by Shehzad et al. (2019) found that China and U.S. stock markets are linked in a way where spillovers of volatility during the financial crises were significant. The current uncertainties arising from U.S. – China trade war leading to policy uncertainties in the long-run would affect trade partners. As policy uncertainty is found to have consequences on financial stress and economic activity that are more pronounced during crisis period (Tiwari et al., 2020). While U.S. and China have recently gained the world's attention, the existing literatures has so far overlooked the potential role of Islamic equity markets as a form of diversification for Islamic investors in this major world economic powerhouses. This paper intends to fill the literature gap by looking into potential diversification in Islamic investment assets of U.S.'s trading partners with a particular interest in China which has been highlighted by several studies including a recent one by Trabelsi et al. (2020).

3. Research Objectives and Contributions

Regarding the importance of asset allocation under new leadership and economic policy changes with on-going global pandemic having possible impact to the Islamic capital market, this study undertakes the following objectives under the three issues discussed:

1. Can the U.S. Islamic stock market investors gain portfolio diversification benefit by investing in trading partners?

2. Which major trading partner should U.S. Islamic investors invest in and how to fulfil the objective to unravel the international portfolio diversification benefits given different investment horizons or stock holding periods?

3. How would diversification benefits through U.S. trading partners change given different investor stockholding periods (e.g., two to four days, four to eight days, eight to sixteen days, etc.)?

The results from each of the research questions are expected to have significant impact on investors and fund managers in their decisions concerning portfolio allocations and investment horizons with the presence of economic uncertainties and global pandemic. More importantly, the results will help in addressing the newly emerging issue of whether trading partners of a developed country is stable enough to provide portfolio diversification and whether these benefits change given different investment holding periods.

4. Methodology

The study implements the multivariate GARCH DCC (MGARCH-DCC) proposed by Pesaran and Pesaran (2007) to study the relationship between Islamic index of U.S. and its top trading partners in terms of risk diversification alongside wavelet tools namely wavelet coherency to capture the correlation between two time series (i.e., CWT and MODWT).

Multivariate GARCH – Dynamic Conditional Correlation (MGARCH-DCC)

MGARCH-DCC approach allows the researcher to observe and analyse the precise timings of shift in conditional correlations and volatilities replacing the traditional approach of using historical covariance mix. The advantage of DCC in relation to other time varying methods such as Kalman filters and Flexible Least Squares is that it accounts for changes in both the mean and variances of the time series. Hence, DCC allows for changes both in the first moment (mean) and the second moment (variance). Estimation of MGARCH-DCC involves two step processes to simplify the estimation of time varying correlations. In first stage, univariate volatility parameters are estimated by using GARCH model. In stage two, the standardized residuals from first stage are used as inputs for estimating a time varying correlation matrix. The following equation is used for our test:

$$V(r_{it}|\Omega_{t-1}) = \sigma^2_{i,t-1} = \bar{\sigma}^2_i(1 - \lambda_{1i} - \lambda_{2i}) + \lambda_{1i}\sigma^2_{i,t-2} + \lambda_{2i}r^2_{i,t-1}$$

Where $\bar{\sigma}^2_i$ is the unconditional variance of the *i*th asset return.
λ_{1i}+λ_{2i} are asset specific volatility parameters (individual asset return volatilities).
We proceed to test whether the computed volatility is mean-reverting by estimating
$(1 - \lambda_{1i}\text{-}\lambda_{2i})$. Some diagnostic tests were conducted to substantiate the validity of our models. Further explanation on this model can in found in Pesaran and Pesaran (2007).

The DCC modeling enable us to identify changes (when they occur and how) in the interdependence between variables of a time series. Therefore, it allows us to identify possible diversification benefits provided by trade partners in a dynamic environment. MGARCH DCC models have proven to be reliable estimators of portfolio estimators and have been used by Fantazzini (2009), Chevallier (2012) and Aas and Berg (2013) in investigating Value at Risk, time-varying correlations and multivariate dependence structures.

Wavelet

The wavelet approach allows us to identify stock market interactions that are challenging to be tested out using any other modern econometric time-series models. As we know, markets consist of traders operating in different time horizons and therefore these traders can behave differently depending on non-similar time resolutions (daily, monthly, and weekly). These are the few advantages of using wavelet approach. First of all, wavelets can be used to overcome the problems due to non-stationarity of the series signals. Secondly, wavelet can be a very useful technique for analysing financial relations especially when there is a distinction between short and long-run relations. Wavelets are localized in both time and scale (frequency band) and can be used to decompose any observed variable on scale by scale (different frequency bands) basis in order to analyze the dynamics of co-movement across different time horizons without losing any information. The main advantage of the cross-wavelet coherency-phase analysis is its ability to analyze transient dynamics for the association between two time series.

i) Continuous Wavelet Transform (CWT)

For the wavelet decomposition, this study follow the studies of Grinsted et al. (2004) and Aguiar-Conraria and Soares (2011) which apply wavelet coherency in the form of continuous wavelet transform (CWT) on the return series in order to capture co-movement in time-frequency space. The continuous wavelet transform of a time series x_t with respect to ψ is a function of two variables given by the following convolution:

$$W_x(\tau,s) = \int_{-\infty}^{+\infty} x(t)\bar{\psi}_{\tau,s}(t)dt = \frac{1}{\sqrt{s}}\int_{-\infty}^{+\infty} x(t)\bar{\psi}\left(\frac{t-\tau}{s}\right)dt,$$

where the bar denotes the complex conjugate, τ is the time position or translation parameter controlling its location, s is the scale or dilation parameter that controls the width of the wavelet, and $1/\sqrt{s}$ is a normalization factor to make sure that the wavelet transforms are comparable across scales and time series.

ii) Maximum Overlap Discrete Wavelet Transform (MODWT)

Maximum Overlap Discrete Wavelet Transform (MODWT) is used with its advantage on the flexibility of the length of data which means not requiring the integral power of 2, as

well as the time invariant property. The wavelet family symlet 8 is chosen in order to get the least asymmetry property, which is more appropriate for financial series. The transformed return series *r(t)* is represented as a linear combination of wavelet functions as follows:

$$r(t) = \sum_k s_{J,k}\phi_{J,k}(t) + \sum_k d_{J,k}\psi_{J,k}(t) + \sum_k d_{J-1,k}\psi_{J-1,k}(t) + \ldots + \sum_k d_{1,k}\psi_{1,k}(t),$$

where:

j is the number of scale crystals (intervals or frequencies);

k is the number of coefficients in the specified component;

$\phi_{j,k(t)}$ and $\psi_{j,k(t)}$ are the father and mother orthogonal wavelet pair that are given respectively by:

$$\phi_{J,k}(t) = 2^{-J/2}\phi\left(t - \frac{2^J k}{2^J}\right)$$

$$\psi_{J,k}(t) = 2^{-j/2}\psi\left(t - \frac{2^j k}{2^j}\right)$$

Father wavelets represent the low-frequency (smooth) parts of the series, whereas mother wavelets represent the high-frequency (detailed) parts of the series. $s_{j,k}$ and $d_{j,k}$ are wavelet coefficients that are approximated by the following integrals:

$$\int \phi_{J,k}(t)f(t)dt \approx s_{J,k}$$

$$\int \psi_{J,k}(t)f(t)dt \approx d_{J,k}$$

$s_{J,k}$ are called the 'smooth' coefficients that represent the underlying smooth behavior of the series, while $d_{j,k}$ are called the 'detail' coefficients that represent the scale deviations from the smooth process. These coefficients are the measures of the contribution of the corresponding wavelet function to the total series. After decomposing the return series into j crystals, the crystals d_j are recomposed into a time domain. The entire excess return series is replicated in multi-resolution decomposition as follows:

$$\hat{r}^J = D_1 + \cdots + D_J + S_J$$

Dj is the recomposed series in the time domain from the crystal d_j and S_J is the recomposition of the residue. The reconstituted return series $\hat{r}^J$ contain the separate components of the original series at each frequency *j*. *Dj* represent the contribution of frequency *j* to the original series. After obtaining the recomposed series for each frequency, the study follows Ramsey and Lampart (1998) in estimating beta in different time scales. The coefficient $\beta^j{}_i$ the key variable the study are trying to examine, which change depending on the timescale *j*. The study can estimate wavelet covariance $\tilde{}\gamma_{XY}(\lambda_j)$ and wavelet variance, $\tilde{}\sigma_X(\lambda_j)$ and $\tilde{}\sigma_Y(\lambda j)$. For correlation, the wavelet correlation coefficient, $\rho_{XY}(\lambda j)$, provides a standardized measure of the relationship between the two time-series subjected to multiple timescales. The unbiased estimator of the wavelet correlation for timescale *j* is defined by

$$\tilde{\rho}_{XY}(\lambda_j) = \frac{\tilde{\gamma}_{XY}(\lambda_j)}{\tilde{\sigma}_X(\lambda_j)\tilde{\sigma}_Y(\lambda_j)}$$

where, $\tilde{}\sigma_X(\lambda_j)$ and $\tilde{}\sigma_Y(\lambda j)$ are the unbiased estimators of the wavelet variances while $\tilde{}\gamma_{XY}(\lambda_j)$ is the unbiased estimators of the wavelet covariance. The study follows Gençay et al. (2002) for a simple wavelet-based approach to testing for significant difference. In particular, the study will test whether wavelet correlation coefficients on a scale-by-scale basis between trade partners Islamic index returns with the Islamic index of U.S. are significantly different. The significant change is identified by observing approximate confidence intervals between U.S.'s index returns and its trade partner's stock index pairs. The null hypothesis of no statistically significant difference can be rejected when 95% approximate confidence intervals are non-overlapping.

Symbol	***Definition***
US	MSCI Islamic USA index
CANADA	MSCI Islamic Canada index
CHINA	MSCI Islamic China index
MEXICO	MSCI Islamic Mexico index
JAPAN	MSCI Islamic Japan index
GERMANY	MSCI Islamic Germany index

Table 1: Selected indices for research

5. Results and Discussions

Past article Trabelsi et al. (2020) have used MSCI Islamic stock indices as a proxy for country specific Islamic stock index returns. This study will apply the same index by MSCI Islamic as a proxy for U.S. Islamic stocks (U.S.) along with MSCI Islamic Canada (CANADA), MSCI Islamic China (CHINA), MSCI Islamic Mexico (MEXICO), MSCI Islamic Japan (JAPAN) and MSCI Islamic Germany (GERMANY).

We collected daily closing price data for all 6 indices from January 2013 – August 2020. Though data is available from a much earlier date, it is from year 2013 onwards that the market has taken time to recover from the financial crises and just after U.S. 57th Presidential election. In addition, regime change arising from the recent pandemic and political matters would be of our attention hence, the period before and after President Trump's era would be covered. All stock market indices are obtained from Thomson-Reuters DataStream database. Returns from all 6 indices are calculated as differences of the logarithmic daily closing prices of indexes, {ln(pt)—ln(pt-1)}, where p is an index value.

The descriptive statistics in Table 2 below shows that the volatility of returns represented by the standard deviation is the highest for the Mexico's index and lowest for the U.S. returns. This standards deviation shows absolute time independent volatility of the return. At the same time, mean is also highest for U.S. We also observed that all returns are negatively skewed, portraying an asymmetric return. Notice that kurtosis value of all indices except China are above 3 indicating a fat-tail distribution and are not normally distributed.

	US	CANADA	CHINA	MEXICO	JAPAN	GERMANY
Maximum	0.0873	0.1126	0.0600	0.0935	0.0709	0.0902
Minimum	-0.1183	-0.1302	-0.0697	-0.0993	-0.0669	-0.1411
Mean	0.0003	-0.0001	0.0002	-0.0004	0.0002	0.0001
Std. dev.	0.0105	0.0127	0.0136	0.0152	0.0116	0.0125
Skewness	-0.9207	-1.0872	-0.0884	-0.3993	-0.2360	-0.9374
Kurtosis - 3	21.0153	16.7418	2.5412	4.9787	4.3170	11.9779
Coef of variation	36.8285	-129.34	85.6284	-41.9481	46.7343	126.4592

Table 2: Descriptive statistics of the data

The purpose of this research is to conduct an exploratory study on whether there exists incentive for U.S. Islamic asset managers and mutual funds to invest part of their

portfolio in the country's trading partners. While there are multiple Islamic indices in the U.S., the Morgan Stanley Composite Index will be used as its proxy to be consistent with other indices used in this study. The empirical analysis starts by identifying the relationship between Islamic stock markets returns in the U.S. and its top trading partner's for possibilities of diversifying an investment portfolio.

Should U.S. Islamic Stock Market Investors Invest in Trading Partners to Gain Portfolio Diversification Benefits?

We run an M-GARCH-DCC analysis on the U.S. and all 5 stock index returns. Figures 1 and 2 illustrate the results. Prior to that, the results from Gaussian DCC Model and the t-DCC model is compared to determine the best model. The volatility parameters observed in the Gaussian DCC Model (Table 3) is highly significant with its high t-ratio and shows volatility decay with its λ 1i, i = 1,2,3,4,5,6 close to 1. Estimated unconditional volatilities and correlations are reported in Table 4.

Parameter	Estimate	Standard Error	T-Ratio	Probability
lambda1_US	0.79794	0.020623	38.6914	[.000]
lambda1_CANADA	0.89876	0.010378	86.6058	[.000]
lambda1_CHINA	0.91521	0.017578	52.0659	[.000]
lambda1_MEXICO	0.86553	0.025484	33.9629	[.000]
lambda1_JAPAN	0.84416	0.026007	32.3722	[.000]
lambda1_GERMANY	0.90341	0.014151	63.8391	[.000]
lambda2_US	0.13534	0.012844	10.5368	[.000]
lambda2_CANADA	0.081257	0.0075262	10.7967	[.000]
lambda2_CHINA	0.051798	0.0087081	5.9483	[.000]
lambda2_MEXICO	0.095449	0.014745	6.4731	[.000]
lambda2_JAPAN	0.11583	0.016769	6.9074	[.000]
lambda2_GERMANY	0.061324	0.0079445	7.7190	[.000]
delta1	0.97958	0.0034708	282.2317	[.000]
delta2	0.0079325	0.0010884	7.2882	[.000]
Maximized Log-Likelihood	38225.7			

Table 3: Maximum likelihood estimates of the Gaussian DCC model on stock indices daily returns.

	US	CANADA	CHINA	MEXICO	JAPAN	GERMANY
US	**0.010569**	0.67767	0.40154	0.44131	0.083357	0.54192
CANADA	0.67767	**0.012773**	0.35795	0.49240	0.14491	0.54197
CHINA	0.40154	0.35795	**0.013663**	0.32240	0.28850	0.40929
MEXICO	0.44131	0.49240	0.32240	**0.015212**	0.17317	0.47753
JAPAN	0.083357	0.14491	0.28850	0.17317	**0.011636**	0.18004
GERMANY	0.54192	0.54197	0.40929	0.47753	0.18004	**0.012515**

Table 4: Unconditional correlation and volatilities.

Parameter	Estimate	Standard Error	T-Ratio	Probability
lambda1_US	0.86095	0.018856	45.6599	[.000]
lambda1_CANADA	0.92677	.0093546	99.0719	[.000]
lambda1_CHINA	0.93738	.014707	63.7377	[.000]
lambda1_MEXICO	0.93931	.012861	73.0376	[.000]
lambda1_JAPAN	0.88082	.024167	36.4479	[.000]
lambda1_GERMANY	0.94250	.011067	85.1595	[.000]
lambda2_US	0.099154	.012153	8.1585	[.000]
lambda2_CANADA	0.056487	.0067281	8.3957	[.000]
lambda2_CHINA	0.039698	.0076445	5.1930	[.000]
lambda2_MEXICO	0.044810	.0081985	5.4656	[.000]
lambda2_JAPAN	0.092082	.016399	5.6153	[.000]
lambda2_GERMANY	0.038966	.0068504	5.6881	[.000]
delta1	0.98514	.0027121	363.2383	[.000]
delta2	0.0074618	.0010285	7.2550	[.001]
df	7.9087	.44338	17.8372	[.000]
Maximized Log-Likelihood	38555.7			

Table 5: Maximum likelihood estimates of the t-DCC model on stock indices daily returns.

Next, the t-DCC model result in Table 5 shows significant signs of gradual volatility decay as well but to determine the most appropriate model will depend on:

1. maximized log-likelihood value of 38,555.7 > 38,225.7

2. estimated degrees of freedom for the t-DCC is under 30

Hence, t-DCC model will be more appropriate to capture the fat-tailed nature of the returns especially high-risk assets such as stock indices (Pesaran and Pesaran, 2007). The evidence of gradual volatility decay simply means that the riskiness involved in the returns gradually cancels out following a shock in the market. The sum of lambda1_US and lambda2_US(0.86095 + 0.099154 = 0.960104) and alongside the other five remaining indices, the result of the summation is under 1 which tells us that the volatility of U.S. return along with other returns are not following the Integrated Generalized Auto Regressive Conditional Heteroskedascticity (IGARCH) or simply, shock to the volatilities are not permanent. In the event of a shock to the system, we want to know if these correlations and volatiles revert to normal. Testing the hypothesis whether volatility in returns are mean reverting would be to test the null hypothesis:

$$H_0: \lambda_1 + \lambda_2 = 1$$

The diagonal elements in Table 4 explain the unconditional volatilities of the indices while the off diagonals explain the unconditional correlations.

Referring to the table, MSCI Mexico Islamic index is the most volatile with unconditional volatility of 0.015 while the remaining stock indices having unconditional volatilities ranging from 0.010 to 0.014, that in turn signifies on overall that these returns on the other five Islamic stock indices are less volatile in comparison. The least volatile of all is MSCI USA Islamic index followed by MSCI Japan Islamic Index. As we know that the major financial crisis happened in 2008, and the time series data for this study is of early-2013 onwards, hence we believe that the Islamic and non-Islamic stocks alike have been more cautious with its leverage levels which resulted in low volatilities.

The off-diagonal elements showing the unconditional correlations as presented in Table 4, shows that correlation between MSCI USA Islamic index returns with MSCI Canada Islamic index returns to be the highest among the other returns with +0.67767. The result is as expected due to both countries are next to each other and have mutual needs.

Being geographically far from one another, it also came to no surprise that there is lower correlation between the returns of the MSCI USA Islamic index with MSCI Germany Islamic (0.5419) and MSCI China Islamic (0.4015), while its lowest correlation coming from MSCI Japan Islamic (0.0834). From here, we observed that Japan Islamic stocks will make an excellent diversification instrument as its correlation with all Islamic indices in this study are relatively low as compared to correlations of other countries. This shows that Islamic investors in U.S. along with their trading partners can look to Japan to benefit from diversifying their investments.

In Figure 1 below, we can see the charts of conditional volatilities plotted during our entire period of study. The chart shows the time-varying properties of volatilities and correlations. As we can see from the chart that U.S.'s conditional volatilities hit a peak at the start of 2020 but was fluctuating in a less volatile manner before that as compared to the other Islamic stock indices. The chart also confirms what was shown in the unconditional volatility matrix earlier that is MSCI Mexico Islamic returns exhibited the highest volatilities as compared to other indexes during most periods. However, small spikes in volatility from MSCI Japan Islamic can be seen in the late-2015 and early-2019, hence prove its low but positive correlation.

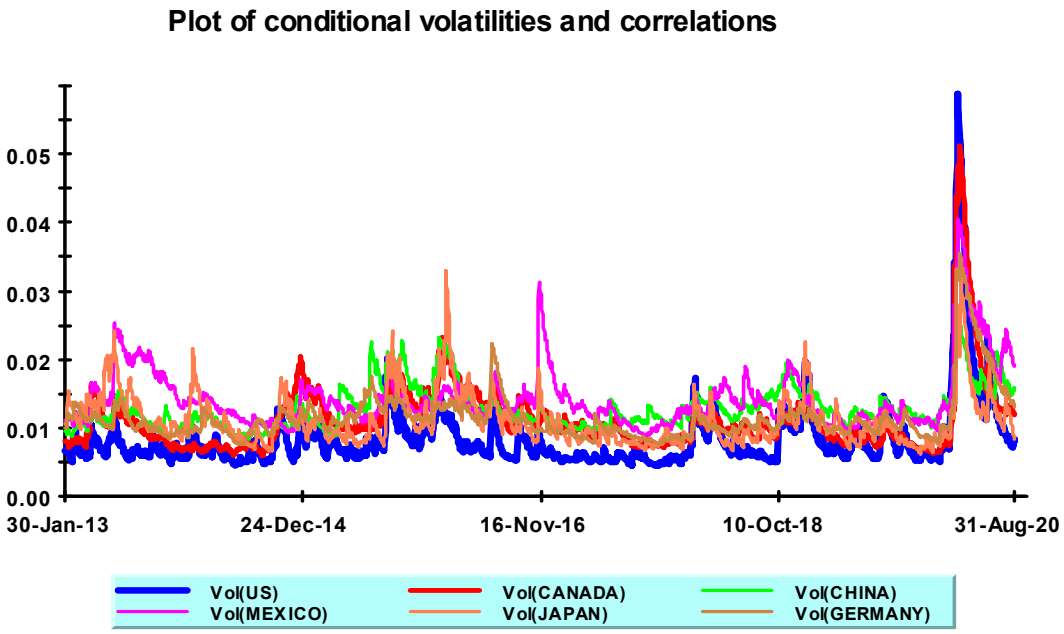

Figure 1: Conditional volatilities- US, CANADA, CHINA, MEXICO, JAPAN, GERMANY

Next, we plot the conditional correlations in Figure 2 and it consistently confirms the results of the unconditional correlations in Table 4 showing that all stock indices used in this study have an average 0.5 correlation with MSCI USA Islamic except for MSCI Japan Islamic. Note that the correlation of U.S. and China has grown in the period of study, especially an obvious increase from early-2017 up until August 2020. The chart shows that correlations of all countries with U.S. apart from Japan, is seemingly at its peak in year 2020, indicating diminishing diversification properties of U.S. trading partners during uncertain times. This would also offer some explanation on Warren Buffet's recent bet on Japanese stocks.

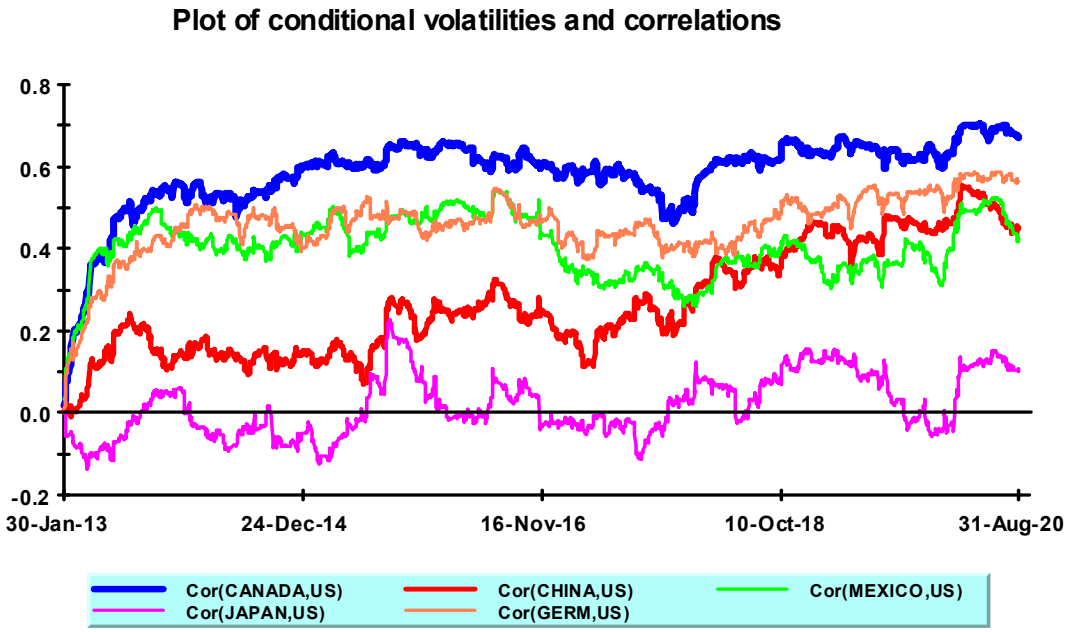

Figure 2: Conditional correlations-US, CANADA, CHINA, MEXICO, JAPAN, GERMANY

Continuous Wavelet Transform (CWT)

In this section, we perform continuous wavelet transform analysis using the wavelet coherence method to analyse the impacts on portfolio diversification benefits given the different investment horizons. The continuous wavelet transform and phase difference of MSCI USA Islamic index returns with index returns of MSCI Canada Islamic, MSCI China Islamic, MSCI Mexico Islamic, MSCI Japan Islamic and MSCI Germany Islamic are presented in Figures 3 to 7 respectively from scale 1 (2-4 days) up to scale 7 (256 days). The horizontal axis represents the time in terms of number of trading days while the vertical axis refers to the investment horizon. The values for the 5% significance level represented by the curved line were obtained from the Monte Carlo simulations and observations outside the curved line is insignificant to this study. The colour code for power or strength of correlation ranges from blue (low coherency, near zero) to red (high coherency, near one). The arrows pointing to the right mean that the indexes are in-phase but if they point to the left it means that the indices are out of phase. To the right and up means that the first series (U.S.) is lagging. To the right and down means that the first series (U.S.) is leading. To the left and up indicates that the first series (U.S.) lags, whereas

first series (U.S.) leads when the arrows are pointing towards the left and down (Madaleno and Pinho, 2012).

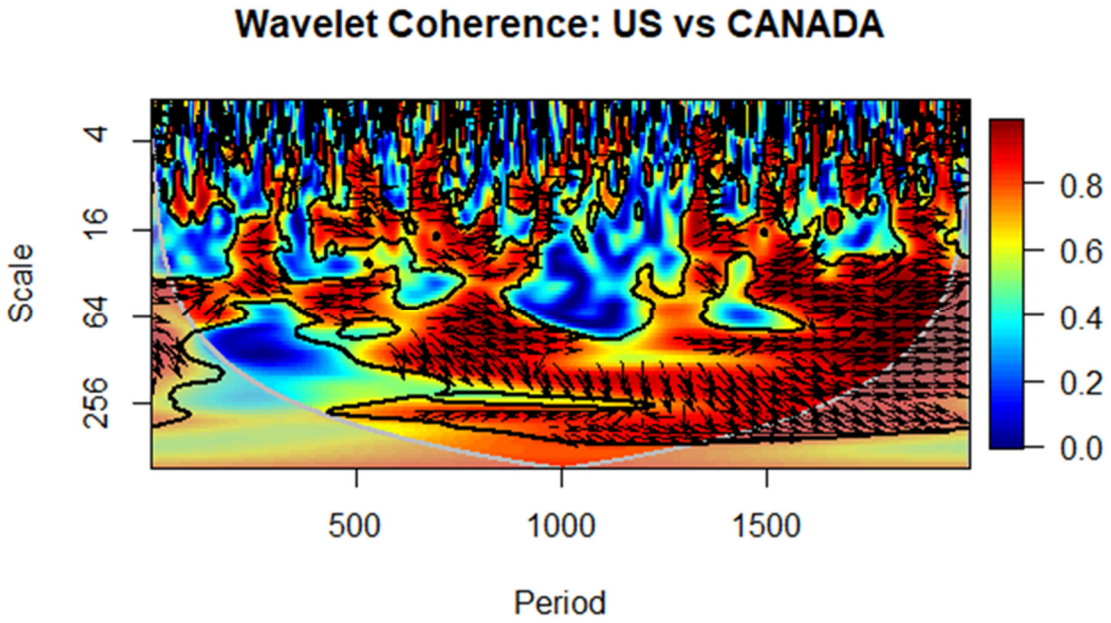

Figure 3: Continuous wavelet transform-US and CANADA

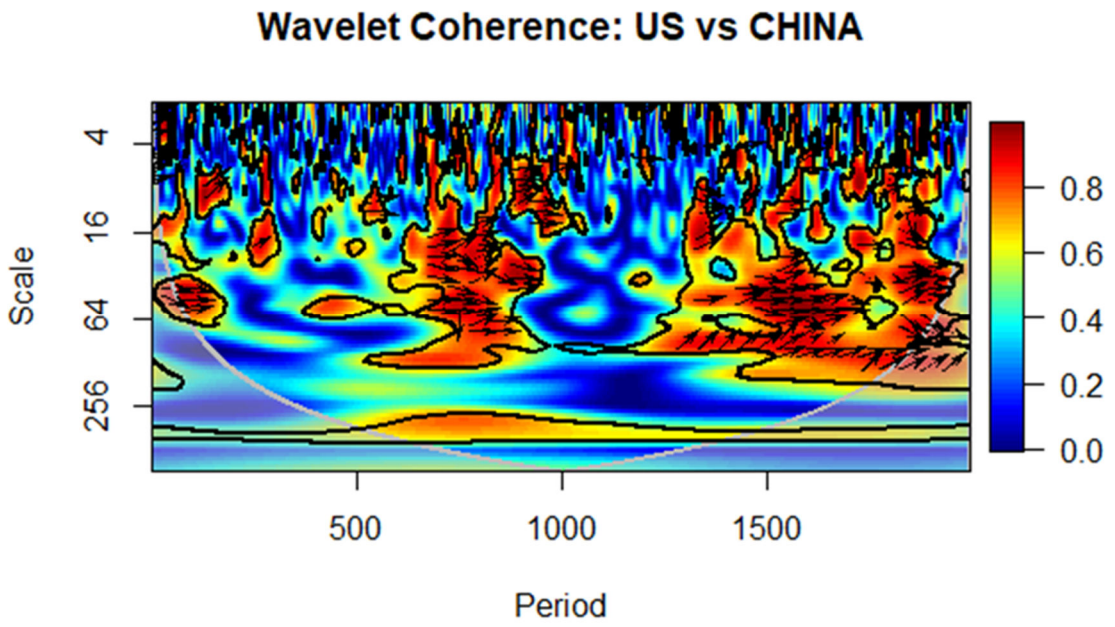

Figure 4: Continuous wavelet transform-US and CHINA

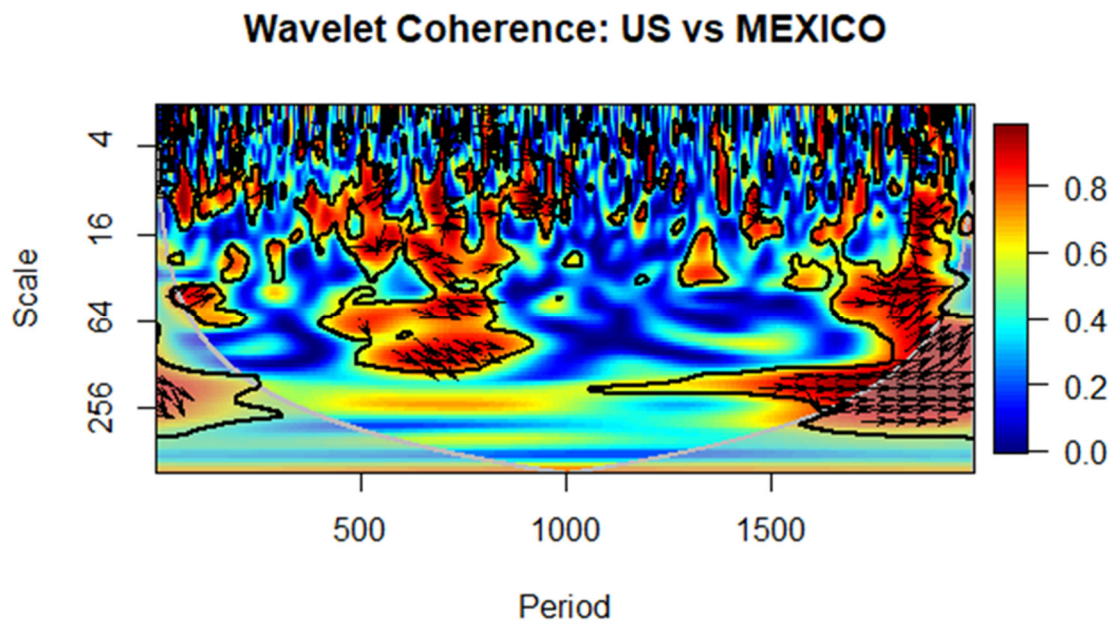

Figure 5: Continuous wavelet transform-US and MEXICO

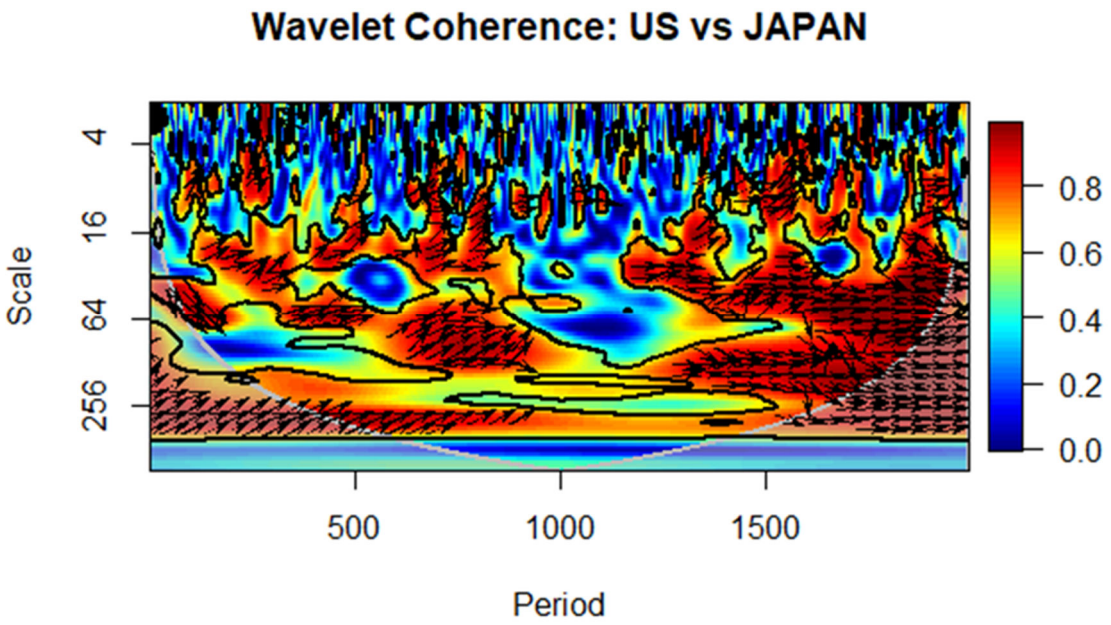

Figure 6: Continuous wavelet transform-US and JAPAN

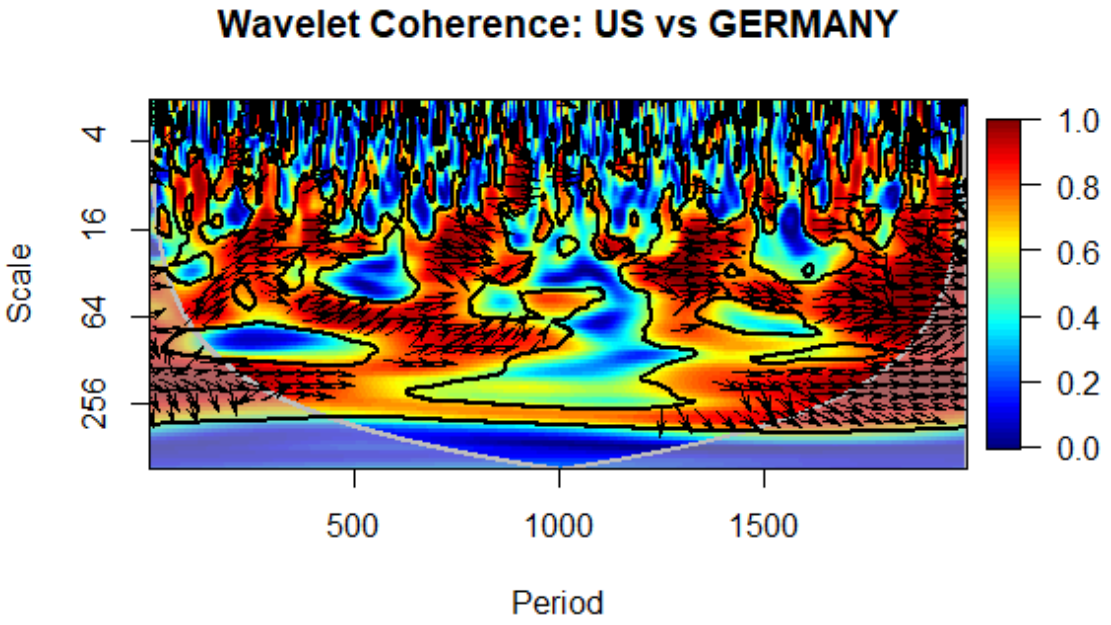

Figure 7: Continuous wavelet transform-US and GERMANY

In general, the colour of wavelet coherence result for all 5 Figures are mostly red in colour near the 2,000-period mark, which implies high coherency between U.S. and its trading partner's Islamic stock indices. With exception for short holding periods of 2-4 days which we can observe some blue signals, but not much for Canada. Significant signals are:

1. Around time period of 1,500th day and at holding period of 128-256 days

2. Time period of 750th day with holding period of 64-128 days

Whereby all indices are showing a similar result of high correlation with MSCI USA Islamic during the abovementioned period and scale. Apart from the above periods observed which showed similar and distinct correlation with MSCI USA Islamic returns, China and Mexico observe more blue signals than other countries. Moderate investment holdings of 16-64 days show high correlation for all Islamic stock indices on periods after 1,500th day of this study, which is when the global pandemic affected every country and economic activities were disrupted. This could imply that diversification benefits diminish even to Islamic stock investors who have different holding period of investments (long and short-term investors) during a global pandemic.

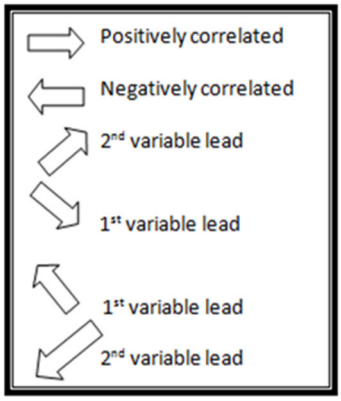

Figure 7: lead-lag arrow rubric

Robustness and Validation of Results – MODWT

Maximum Overlap Discrete Wavelet Transform (MODWT) approach is used for the robustness and validation of the results in Multivariate Generalized Autoregressive Conditional Heteroskedasticity-Dynamic Conditional Correlation (MGARCH-DCC) and Continuous Wavelet Transform (CWT). In MODWT, the result will be specified in the time scales for the returns which this study had extended the scaling into seven scales (2-4 days, 4-8 days, 8-16 days, 16-32 days, 32-64 days, 64-128 days and 128-256 days). The correlations between the MSCI USA Islamic index returns with the index returns of trading partner's Islamic indices used in this study are examined using the generated MODWT returns series as a robustness test for the results obtained in CWT and the results are shown in the Table 6 below.

MODWT Scaling	FBMSHA	DJIU	DJIDEV	DJIEM
2-4 days	-0.01121	0.001279	-0.0355	-0.00487
4-8 days	-0.00069	0.009737	0.026678	0.042746
8-16 days	0.019447	0.03197	0.044116	0.056871
16-32 days	0.077467	0.053053	0.068328	0.080226
32-64 days	0.076944	-0.00747	0.013431	-0.1171
64-128 days	0.051189	0.088108	0.194137	0.027081
128-256 days	-0.09405	0.04073	0.488453	-0.2176

Table 6: Wavelet correlations of U.S Islamic index returns with returns of the 5 indices used in this study-MODWT transformations.

There are positive and high correlations across most Islamic indices except for MSCI Mexico Islamic that exhibit lowest average positive correlation for holding period from 2-4 days up to 128-256 days. As for MSCI Japan Islamic, holding period of 2-4 days and 4-8 days show low correlations. For Canada, Japan and Germany, holding period of 16 days onwards tend to have relatively high and positive correlation with MSCI USA Islamic. Despite trading a lot with each other, U.S. and China's correlation is seemingly low at 2-4 days and 128-256 days indicating that investors should not rule out China as diversification for short and long-term investment horizon rather than medium term. As for medium term investors, it would be best to avoid all markets as its correlations with U.S. is mostly at the highest at scale of 32-64 days except for Mexico.

6. Conclusion

The study examines empirically the causal links between the U.S. return volatility and its trading partner's Islamic indices (Canada, China, Mexico, Japan and Germany) by using daily data from January 2013 to August 2020. The knowledge on the relationship between of these Islamic equity markets under specific conditions would be helpful to identify the potential use by Islamic investors or mutual fund managers for portfolio diversification. On the whole, this study is formed by combining 3 recent areas of interest: Islamic finance, economic policy changes and pandemic effect. Related literatures discussing the theoretical foundation of the relationship of indices around the world involving trade partners includes Malaysia (Karim and Majid, 2010), Australia (Paramati et al., 2016), U.S. (Daelemans et al., 2018) and Islamic indices (Najeeb et al., 2015) inspired this study in considering U.S. trade partners as a potential diversifier. The results add to the findings of existing literatures on trade partners having time varying diversification benefits that may differ across stock market indices and different economic conditions. Although there are different sources of Islamic indices from the countries included, this exploratory attempt did not include robustness testing hence the result might differ under different indices. The current study is concluded to three key findings on the basis of empirical evidence. Firstly, there is low short-term correlation of U.S. Islamic stocks with Japan and China, this implies that investors explore Asian markets to provide short term portfolio diversification benefits through Islamic stocks. Hence, investors in the U.S. that take on higher risks from exposure in Canada can benefit by tapping into the low correlation of Asian Islamic stocks. Secondly, correlation between U.S. and China is increasing over the period of study, hence the diminishing benefit of diversification. Although the correlation is increasing, the correlation of Japan is still low compared to other countries. Finally, in markets where correlation of U.S. and its trading partner's stock indices increases along with holding period horizon, this implies that the stock prices are in fact driven by long-term fundamentals. U.S. investors should look at alternative markets to diversify in the long run as diversification opportunities with the country's trade partners may only be possible in short holding periods

It is recommended for any future empirical research to extend its focus on other stock market indices and conduct a more exhaustive study that may include socially responsible index as a substitute for Islamic stock index (Abdelsalam et al., 2014). This study has shown signs that U.S. investors can benefit more from diversification with it trade partners in the short run hence a test of robustness can be pursued. Alternative assets can be included to extend this paper as a recent study by Abdulkarim et al. (2020) has found evidence of crude oil related

assets having diversification properties with Trabelsi et al. (2020) recommending emerging markets. Further study is encouraged to analyze other factors including macroeconomic variables (Bahloul et al., 2017), fundamental factors and take into account the recent U.S.-China deal to ease the trade war at the start of year 2020. It may be useful to also look into a more robust explanation from Shari'ah scholar's perspective and their views on impact of different Islamic indices in order to advocate for a more standardized and reliable use of indices. With the recent deal between U.S. and China, alongside Covid-19 pandemic, which is still on-going, it should encourage investors to seriously consider their alternatives and possibilities of diversifying investments as the next U.S. election is imminent. Should similar trade policies were to happen again in the future, investors would know where to re-allocate their investments.

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