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Osman, Khairul Nizam and Masih, Mansur

INCEIF, Malaysia, Business School, Universiti Kuala Lumpur,  
Kuala Lumpur, Malaysia

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# Granger-causality of selective Dow Jones Islamic and sustainability regional equity indices

Khairul Nizam Osman<sup>1</sup> and Mansur Masih<sup>2</sup>

**Abstract:** Most of the earlier studies on index effects and co-movement of stock markets focused mainly on conventional equity markets. In contrast to previous studies, this research investigated the co-movement of Dow Jones Islamic Market sustainability and its peers Dow Jones Islamic and sustainability regional Europe and US equity markets. The standard time series techniques are applied. The results revealed: (i) Dow Jones Islamic Market Sustainability index is co-integrated with its peers regionals, implying there are potentials for less gain in abnormal profits in the long run, (ii) U.S. regional (Sustainability and Islamic equity) market has more influence on Dow Jones Islamic Market Sustainability than its peers in Europe due to market capitalization factor rather than characteristics' index (iii) the study tends to suggest that portfolio diversification (risk and return) on ethical index is still largely dependent on well-balanced sectoral allocation to minimize exposure to systematic risks. Our empirical analysis however, has unveiled evidence of a negative risk-return relationship in the selected Dow Jones Islamic and Sustainability equity markets.

**Key words:** Shariah screening; Islamic stock market integration, VECM, VDC

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<sup>1</sup> INCEIF, Lorong Universiti A, 59100 Kuala Lumpur, Malaysia.

<sup>2</sup> **Corresponding author**, Senior Professor, UniKL Business School, 50300, Kuala Lumpur, Malaysia.

Email: [mansurmasih@unikl.edu.my](mailto:mansurmasih@unikl.edu.my)

## 1.0 INTRODUCTION

Islamic finance has developed significantly over the years to become a noticeable part of the international financial system. The value of Islamic financial assets worldwide increased from USD 150 billion in the mid-1990s to about USD 1.6 trillion by end-2012, led by the Islamic banking sector and the global sukuk market. And, in 2013, it is estimated to have reached the high figure of USD 1.9 trillion<sup>1</sup>. This growth represents a major achievement, as well as new challenges for investors, regulators and also Islamic financial institutions themselves.

With the recent troubles in the global economy, finance industry has been looking at Islamic contracts as the possible means of preventing such meltdowns from ever materializing again. Another area that has received more in-depth media coverage is the field of sustainability. Recent changes in the world of investment have made asset owners and managers increasingly aware of the potential risk and value impact of environmental, social, and governance (ESG) factors, on an investment profile. There are arguments in financial literature in favor of both areas as safer approaches, and less vulnerable to questionable financial transactions, which may have led to the global recession beginning in 2008. These arguments have been substantiated by some empirical findings that suggest some Islamic financial institutions and companies focused on sustainability have been more resilient to financial crisis. For instance, Hasan and Dridi (2010), report that Islamic banks have been more resilient than conventional banks during recent global financial crisis. Some studies also suggest that companies with a strong commitment to sustainability have outperformed their industry averages by 17%<sup>2</sup>.

But are Islamic finance and sustainability finance compatible? What's really involved in incorporating sustainability criteria and Islamic principles into investment decisions? Can they make a material difference to investment performance? We start answering these questions by highlighting similarities and differences between these two. Islamic finance and socially responsible investing (SRI) approaches have a lot in common with respect to the screening process, and criteria used for stock selection. Sustainability, on the other hand, goes above and beyond SRI by considering positive screens, promoting investment in companies with best practices. According to World Economic Forum Report (2011) "Sustainable investing is an investment approach that integrates long-term environmental, social and governance (ESG) criteria into investment and ownership decision-making with the objective of generating

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<sup>1</sup> Mauro, Filippo et al. (2013)

<sup>2</sup> Daniel Mahler, A.T. Kearney, Inc. Report, titled Green Winners: The Performance of Sustainability-focused Companies in the Financial Crisis, 2009.

superior risk-adjusted financial returns”<sup>3</sup>. As the financial crisis receded into a period of uncertainty in past 10 years, recognition that sustainability, corporate governance and transparency are important factors in portfolio management has emerged. This is a fundamental shift away from the ideological and political corner of SRI to the real performance of sustainability.

Some researches assert that Islamic finance holistic and dynamic perception of SRI is more effective in taking into consideration the reality and ever-changing circumstances of societies in contrast to Western humanistic theories. They conclude that corporations operation on a piety-based business paradigm acknowledge their social responsibility to their workers, managers, other corporations, customers, and society as a whole more significantly (Dusuki and Abdullah, 2007). However, regardless of their similarities, and theoretical arguments in support of one or another, sustainability and Shariah-compliant investments are assessed on the basis of long-term trends in yield, profitability, and efficiency in use of limited financial resources.

In January 2006, Dow Jones Indexes launched the world’s first Dow Jones Islamic Market Sustainability Index. This index merges Islamic investing principles and sustainability criteria by combining the methodology of Dow Jones Islamic Market Indexes<sup>4</sup> and Dow Jones Sustainability Indexes. To be included in the index, companies must be components of both the Dow Jones Islamic Market Index and the Dow Jones Sustainability World Index. Linking Sharia compliant investment performance to sustainability is, perhaps, the most effective way to highlight the importance of Environmental, Social and Governance (ESG) governing factors to Islamic finance. The time series data provided by Dow Jones Indexes is an invaluable resource to help us investigate several financial theories, literature and whether incorporating sustainability filters in Islamic finance is the best practice for investors in the long term.

This paper is a progress report on the nature of ethical (SRI) stock markets comovement that have recently gained ground in international finance literature. This increase of interests and motivations can be explained by various reasons, but the most relevant of all include the Islamic international portfolio diversification issues and the recurrence of financial crises that occurred in both developed and emerging countries during the 2000’s decade. We have used time series technique and data on Dow Jones Islamic Market Sustainability index and four other Dow Jones Islamic and Sustainability regional indices (Dow Jones Islamic Europe, Dow Jones Islamic US, Dow Jones Sustainability Europe and Dow Jones Sustainability US) indices and to investigate if there is any significant quantitative analysis between the comovement of these indexes in the long-term. We also investigate whether there

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<sup>3</sup> Transition Towards Sustainable Investing, World Economic Forum White paper, 2011.

<sup>4</sup> DJIM Indices were introduced in 1999 as the benchmarks to represent Shariah-compliant portfolios.

is any significant explanation on index effect following any changes or shocks from within Dow Jones Islamic Market Sustainability index in the addition and deletion events (if only the statistical results are promising) for future investigation.

Firstly, the *index effect*, or the tendency for addition to or removal from a stock market index to cause changes in the prices or trading volumes of the underlying stocks, has been well documented for the stock market as a whole. The literature that investigates the index effect has grown simultaneously with the number and importance of index funds, institutional and individual investors who resolve to passive investing and index arbitrageurs. The advent of passive strategies and the perception that active managers do not beat the market led to the creation of the first index funds back in 1970s<sup>5</sup>. Today, these funds have evolved into more liquid forms, usually referred to as exchange-traded vehicles (ETFs), the objective of which is to follow a particular benchmark. Institutions and private investors are more interested in indexing than ever before, because it offers lower management fees with negligible tracking errors.

Secondly, researchers studying the structure of asset returns have uncovered numerous patterns of comovement. There is a strong factor in the returns of small-cap stock, for example, the returns of value stocks, closed-end funds, stocks in the same industry, and bonds of the same rating and maturity. There is common movement within national markets and cross international markets. Common factors such as these have attracted considerable attention because of the possible role assets' loadings on them play in explaining average rate of return. However, little work has been done on understanding way the common factors arise in the first place. Why do certain groups of assets commove while others do not? In this paper, we study the explanations of portfolio diversification theories on the basis of co-movement among selected five Dow Jones Islamic and Sustainability stock markets. Accordingly, the comovement effects would be vital for investors; portfolio managers and policy makers in a sense if those indices are found to be closely linked or co-integrated then there is no long run benefit of diversification for international investors. Moreover, the dependencies among comovement in these closely linked equity markets would anticipate an inherent risk of index effects and contagious that a shocks in one market may spill over to other markets.

Thirdly, Islamic screening criteria reduce the number of available shares to invest. It is claimed by critics that the reduction of the investment universe through screening will reduce the performance. Similar counter arguments have been raised regarding sustainability criteria (Freidman, 1996). It would be interesting to investigate how this constraint could further effect on Dow Jones

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<sup>5</sup> The First Index Mutual Fund: A History of Vanguard Index Trust and the Vanguard Index Strategy (<http://www.vanguard.com>)

Islamic Market Sustainability portfolios due to double screening filters at the parents level (Dow Jones Islamic Market World and Dow Jones Sustainability World). There are only 91 constituents as of end October 2013 in Dow Jones Islamic Market Sustainability index.

Finally, academic research on the performance of Shariah-compliant with sustainability screenings investments is rare<sup>6</sup>, and to the best of our knowledge, no similar study on the impacts of the Dow Jones Islamic Market Sustainability index co-movement and revisions has been conducted before.

The rest of this study is organized as follows: Section II is allocated to a short literature review and the theoretical and conceptual underpinnings of research background. We outline research methodology, econometrics modeling and empirical findings (interpretation) in Section III. Section IV articulates our conclusions, and we describe the limits of our study section V.

### 1.1 The Issue Motivating This Paper

Our paper joins the above theoretical and literature overviews by focusing on the selected Dow Jones Islamic and Sustainability indices market index effects and co-movements. We empirically investigate the co-movement issue in the context of European and US regionals markets since i.) Both rank among the most constituents in country allocation in Dow Jones Islamic Market Sustainability index ii.) Both are also the mature markets within the universe of developed countries and iii.) They actually attract a particular attention from social responsible investors (Muslims and non-Muslims) in their portfolio investments decision-making.

We contribute to the related literature in several aspects. First, instead of understanding the characteristics of Dow Jones Islamic Market Sustainability index effects, we attempt to build modeling the co-movement of our interest index (Dow Jones Islamic Market Sustainability) with other regionals indices in Europe and US by quantifying the returns, correlations and capture the causality linkages from any changes/shocks (index effects) within the five selected Dow Jones Islamic and Sustainability. Secondly, we are interested in providing some insights for investors and portfolio managers on portfolio construction and risk management analysis as *diagram 1.0* below which would help them for key investment themes analysis on identifying the nature (influences) or the bellwether index on each screenings approach (Islamic and Sustainability), the performing sectors and regions to overweight and underweight in Dow Jones Islamic Market Sustainability index.

**Diagram 1.0 Portfolio Construction and Risk Management**




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<sup>6</sup> To the best of author's knowledge, only Dow Jones Indexes, an index provider that combines both Islamic investing principles and sustainability criteria.

vs. <b>DJ Sustainability Europe</b>	vs. <b>DJ Islamic Europe</b>
<b>COUNTRY ALLOCATION</b> US regional vs. Europe regional	<b>SECTOR ALLOCATION</b> Overweight vs. Underweight Diversification Volatility Management

Besides comparing their returns, we also examine the long-term relationship between these indices. If these indices were found to be co-integrated or having long run equilibrium this means that any of them can predict the movement of the other. Therefore, since it is established that conventional indices tend to move together as markets in general do, can the same be said about the Islamic and Sustainability indices. In addition, the short run dynamics between the indices is investigated to find the direction of the causality.

## 2.0 LITERATURE REVIEW

*2.1 Previous findings from the index effect theories and hypotheses that can explain them*

The addition to (or deletion from) events the index may be triggered by the firm meeting (or not meeting anymore) the relevant inclusion criteria or by a variety of different corporate events (delisting, bankruptcy, takeover and other). An important dimension that contributes to the magnitude of the index effect is the way that index re-compositions are announced in the market and consequently, the level of anticipation of the relevant changes. Despite the efficient market hypothesis (Fama, 1970) predicting that index re-compositions should not have any effect in stock prices, significant price and volume changes connected to such events (mainly for the S&P 500 index) have been observed in numerous studies. Consequently, a number of other theories have emerged to justify these results. The hypotheses proposed, refer to whether the effects on company stock price and volume performance are temporary or permanent, the new information component that, arguably, comes along with each announcement of addition or deletion and the investor behavior after the event.

The first theory relies on the *price pressure* assumption, which supports temporary price and volume effects as a result of index re-compositions. Harris and Gurel (1986) reported a significant price increase of 3.13% on the date of an S&P 500 inclusion, which was almost fully reversed after two weeks, while Arnott and Vincent (1986) reported a 2.91% price increase on the date of addition and a 1.44% price drop on the date of deletion.

The second theory relies on the *imperfect substitutes* assumption. According to this hypothesis, prices will change to eliminate any excess demand or supply in the market with no reversal, while trading activity will also change

temporarily until the new level of equilibrium is reached. Shleifer (1986) and Morck and Yang (2002) examined the index effect and were in favor of this hypothesis. Tests for the *imperfect substitutes* theory require the assumption that the events are information-free.

The third theory refers to the assumption of *new information content*. According to this hypothesis, index re-compositions are not information-free events; therefore the price effects on firm performance after the event period should be permanent. Jain (1987) also supported that the index effect has an information content, by reporting a 3.07% price increase for S&P 500 additions and a -1.16% for deletions, providing evidence that index inclusion was very valuable in terms of the future investment appeal of a company.

The fourth theory relies on *liquidity* effects, which are mainly attributed to the increase of index funds. According to the *liquidity cost* theory, inclusion in an index is an event that promises a permanent increase in the stock's liquidity and therefore, prices and trading volumes shall both increase permanently to reflect this new advantage of the included stock. Edmister, Graham and Pirie (1994, 1996) were the first supporters of this hypothesis, finding permanent price effects after inclusion that did not reverse over time. In 2003, Hegde and McDermott provided evidence of a positive relation between stock prices and changes in liquidity, although it was uncertain whether the increase in firm value is attributed to better investment opportunities or to a potential decrease of the firm's discount rate upon inclusion.

The last theory that attempts to explain the index effect relies on Merton's theory (1987) about *market segmentation* and *investor recognition*. According to this hypothesis, investors know of only a subset of all stocks (in this case, only the index member stocks), hold only the stocks that they are aware of, and demand a premium (shadow cost) for the non-systematic risk that they bear. Chen, Noronha and Singal (2004) argue for the first time that inclusion in an index increases the overall investor awareness of the particular asset. As the stock becomes part of their portfolio universe, it is subject to stronger buying pressures and its required rate of return is permanently decreased. Since investors cannot be made unaware of a deleted stock, the price effects will not be symmetrically negative in the case of deletions from the index.

## *2.2 Previous findings from the theories comovement and hypotheses that can explain them*

To start with, a pattern of positive correlation is defined as co-movement, but positive correlation is an unclear term and defines many types of relationships (Barberis, et al, 2002). To be more precise, co-movement describes a phenomenon of an asset price moving with another asset price. The joint movement that is mutual among all assets or movement that all assets have in common is called moving with.

Most investigations that have focused on the equity markets of the developed countries reveal relationships between the stock markets of the world and the



comovements among them. Comovement between markets has been of significant interests to practitioners and academics. The research conducted to examine the interdependence between stock indices across various stock markets over different time periods indicate a lack of consistency and the results vary based on the sample period chosen, the frequency of observations (monthly, daily or weekly) and the choice of market.

According to a wide variety of research findings and market reports, most of the world's global markets have become more closely correlated with the passage of time. According to Xydias, (2010), the average weekly correlation among the 45 markets in the MSCI All Country World Index climbed to 0.7 in 2010. The closer than number is to 1.0, the more the markets are moving together. The coefficient was 0.3 recently as 1997. This correlation is frustrating financial professionals who hope to provide above-average returns and investors who want geographic diversity to balance their risks. In the depths of the 2007 to 2008 financial crisis, virtually all developed and emerging markets dropped in unison.

Camilleri and Galea (2009), found that emerging market indices exhibit positive correlations with those of developed markets in a ten year period from 1998 to 1997. The indices they selected for their study were the S&P (United States), FTSE 100 (United Kingdom), DAX (Germany), Nikkei (Japan), Bovespa (Brazil), Shanghai SE Composite (China), Bolsa (Mexico) and RTS Russia). The developed market indices they chose represent the strongest developed economies while the emerging market indices cover the strongest of the emerging markets.

### *2.3 Empirical Literature*

Although studies examining whether there exists a socially responsible index effect are limited in both number and scope and although the literature on the index effect relating to mainstream indices is large, it is not clear whether the key findings therein also apply to socially responsible indices, which are typically both smaller in terms of assets following them and more specialized. It is perhaps also the case that investors may be more challenged in anticipating the future composition of social indices because of the fundamental additional criteria that the firm must meet in order to be deemed socially responsible and enter the index, on top of meeting the other conditions of listing (based usually on firm size and the representativeness of the sector in which the firm operates).

To our knowledge, at the time of writing, the extant literature only numbers three studies. Becchetti, Ciciretti and Hasan (2009) employ the Domini 400 (now MSCI KLD 400 social index) for their analysis and find that stock deletions from the index produce negative short-term cumulative abnormal returns between 2% and 3% while no robust, statistically significant link can be detected when looking at additions to the index. These findings are echoed by Doh, Howton, Howton and Siegel (2010), who also examine short-term

reconstitution effects and find that while additions to the Calvert social index do not incite positive market reactions, deletions lead to a significant average decline in equity prices of more than 1.5%. On the other hand, Chow, Durand and Koh (2009) concentrate on the KLD 400 index but examine long-term price effects, and find strong evidence for positive buy-and-hold abnormal returns of additions, while the respective results for deletions are somewhat mixed.

The global economic crisis made a great attack on stock markets and rang alarm bells to investors. Most of the scholars are interested in investigating the co-movements, interrelationship and interdependency of world's major stock indices after solid crisis.

For example, Singh (2010) found that both Chinese and Indian market are correlated with all the selected developed markets, namely U.S., U.K., Japan and Hong Kong, after the subprime mortgage crisis in 2008, based on the analysis of Granger causality. Rodriguez (2007) highlighted a particular approach of financial contagion based on models dependence with switching-parameter copulas. Technically, the empirical analysis is based on daily returns from five East Asian stock indices during the Asian crisis and from four Latin American stock indices during the Mexican crisis. The results demonstrated the existence of changing dependence during periods of financial turmoil. An investigation also was made on BRICA countries (Brazil, China, Russia, India and Argentina). This investigation finds that China and India have co-movement relationship with the US market after the 2008 subprime crisis on the basis of daily indices from January 2002 to February 2009, by Aktan, et al.

#### *2.4 Theoretical and Conceptual Underpinnings*

Given the above findings from previous literature, we anticipate that in the case of Dow Jones Islamic Market Sustainability and regional indices, we postulate that our time series technique would not be able to identify exclusively any potential effects on index performance that attributed to the price pressure, imperfect substitute and liquidity cost theories. We argue instead, that forecast variance error result can produce strong signaling effects concerning on the variable that is explained mostly by its own past from changes in Dow Jones Islamic Market Sustainability, as compared to other variables, is supposed to be more sensitive to index effects event in Dow Jones Islamic Market Sustainability.

Based on Dow Jones Islamic Market Sustainability index characteristics, we test the null hypothesis that *“any changes (index effects) in Dow Jones Islamic Market Index has more significant impacted on Europe regional (both DJ Sustainability and Islamic) than its peers in the U.S. regional due to more European companies than U.S. companies in the Dow Jones Islamic Market Sustainability index's characteristics”*.

We posit that the information content hypothesis is the best candidate for explaining comovement and index effects. Furthermore, we believe that the performance between added and deleted firms in our study, could be consistent with the recognition hypothesis, since the nature of information

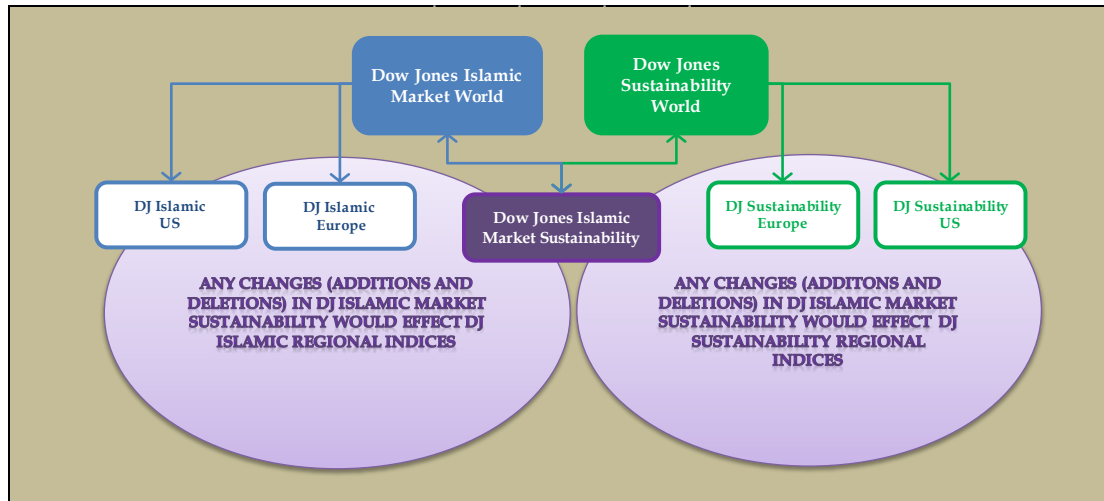
revealed in the Dow Jones Islamic Market sustainability index's characteristics is likely to the information content theory and the impact of the deleted firms at a higher degree than the added firms because a stock's deletion from a social index can be interpreted as a strong, highly visible signal produced by an independent institution that the firm has been involved in some kind of a social or environmental transgression, it is plausible to find that the financial effects are greater than those of additions to the index (which is a signal for the firm being a strong social performer). We argue that investors tend to react more intensely to negative rather positive new information. Similarly, it has been shown in the literature of financial economics that *"losses and disadvantages have greater impact on preferences than gains and advantages"* (Tversky and Kahneman, 1991 p. 1039), a sort of *loss aversion utility theory*, which is also in line with our study. But again, we leave this argument into the future investigation.

### **Dow Jones Islamic Market Sustainability Index Portfolio Diversification**

As far as the portfolio diversification is concerned, we already acknowledge that, according to the basic lessons drawn from both the mean-variance framework of Markowitz (1958) and the Capital Asset Pricing Model (CAPM) developed by Sharpe (1964) and Lintner (1965), investors, either individual or institutional, can reduce the volatility of their Dow Jones Islamic Market sustainability portfolios through allocating their investments in various classes of financial instruments, sectors and other categories of assets that would move in different ways in response to the same event.

In other words, diversification benefits can be achieved because a portfolio's performance depends not only on the return and risk characteristics of the assets being held in the portfolio, but also on the correlation (or co-movement henceforth) of these assets. The lower is the correlation between assets; the higher are the diversification gains. Based on the same rules, diversifying the portfolios is beneficial to investors only if stock markets in different countries (Europe and U.S.) do not move together. Thus, the portfolio diversification issue naturally raises the question of investigating the relationship between Dow Jones Islamic Market Sustainability and other regionals stock markets. The ongoing process of globalization, and the resulting cross-border capital flows, also contributes to further expand the literature on stock market co-movements.

### **Diagram 1.1 Theoretical Dow Jones Islamic Market Sustainability**



We anticipate that when there is a constant change; combination of two forces from both Dow Jones Islamic and Sustainability indices are required for the existence of Dow Jones Islamic Market Sustainability (DJISMS). Only a stock that complies both screenings approaches can be included in the index. In contrast, a stock that only comply sharia-compliant but not sustainability or *vice versa* would be not crowned as an eligible constituent in Dow Jones Islamic Sustainability index.

Therefore, we would have two-type of a constituent-x as not compliant ( $x^1$  and  $x^2$ ) in every additions and deletions event due to different review re-composition frequency on both parents' indices.

If  $x =$

$x^1$  - Shariah-compliant, but not sustainability compliant (Quarterly)

then - **not eligible**

$x^2$  - Sustainability compliant, but not shariah-complaint. (Annually)

then - **not eligible**

$x^3$ -Shairah-complinat and Sustainability compliant

then- **eligible constituent**

Therefore, a success cross-paired analysis (*eligible constituent*) would only happen when  $x = x^3$ .

### 3.0 RESEARCH METHODOLOGY, ECONOMETRIC MODELLING AND

## INTERPRETATION

This overview should provide the reader with an understanding of how time series technique works and where it should and how the technique is used in our study. In particular, we employ cointegration test, error correction modeling and variance decomposition to find empirical or statistical evidences of the nature of relations, influences and characteristics between Dow Jones Islamic and Sustainability regional equity markets (the US and Europe) on our interest index, Dow Jones Islamic Market Sustainability as introduced in the introductory paragraphs. This study is favored over the traditional regression method for the following reasons.

Firstly, time series techniques all have the common characteristic that they are endogenous techniques. This means a time series technique looks at only the patterns of the history of actual data (or the series of index price through time in our case – thus, the term time series). If these patterns can be identified and projected into the future, then we have our forecast. Therefore, this rather esoteric term of endogenous means time series techniques look inside (that is, endo) the actual series of demand through time to find the underlying patterns of sales. This is in contrast to regression analysis, which is an exogenous technique and regression analysis examines factors external (or exo) to the actual price pattern to look for a relationship between these external factors (like additions and deletions events changes) and correlated indices price patterns. If time series techniques only look at the patterns that are part of the actual history of data (price); that is, are endogenous to the price history, then what are these patterns? The answer is that no matter what time series technique we are talking about, they all examine one or more of only four basic time series patterns: level, trend, seasonality, and noise.

*Trend* is a continuing pattern of price of index increase or decrease, and that pattern can be a straight line or a curve. Of course, any investor wants a positive trend that is increasing at an increasing rate, but this is not always the case. If the index prices are decreasing (either at a constant rate, an increasing rate, or a decreasing rate), we need to know this for forecasting purposes.

*Seasonality* is a repeating pattern of data increases and decreases that occurs within a one-year period or less (“seasonal patterns” of longer than one year are typically referred to as “cycles,” but can be forecast using the same time series techniques). Examples of seasonality are high sales every summer for air conditioners, high sales of agricultural chemicals in the spring, and high sales of toys in the fall (Christmas season). The point is that the pattern of high price in certain periods of the year and low price in other periods repeats itself every year. When broken out of the time series, the seasonality line can be seen as a regular pattern of index price increases and decreases around the zero line at the bottom of the graph.

*Noise* is random fluctuation – that part of the index price history that time series techniques cannot explain. This does not mean the fluctuation could not be explained by regression analysis or some qualitative technique; it means the

pattern has not happened consistently in the past, so the time series technique cannot pick it up and forecast it. In fact, one test of how well we are doing at forecasting with time series is whether the noise pattern looks random. If it does not have a random pattern it means there are still trend and/or seasonal patterns in the time series that we have not yet identified.

Secondly, many economists consensus that most financial variable which also includes equity markets indices are non-stationary variable. Thus, ordinary regression on the selected variables will render the results misleading due to statistical tests (t-ratios and F statistics are not statistically valid when applied to non-stationary variables. If we performed regression on the differenced form on our variables, the long-term trend as discussed earlier is effectively removed. Thus, regression would only captures short term, cyclical or seasonality patterns. In sum, the regression only test short term not long term (theoretical) relationships.

Thirdly, we differ than regression from presumption bias on endogeneity and exogeneity variables, as researchers in regression make pre-determination based on the priori theories. In fact, time series techniques (through VECM and VDCs tests) will determine which variables are in fact endogenous and exogenous and relative (endogeneity and exogeneity) from the cointegrating vector. In other words, with regression, causality is presumed whereas in cointegration, it is empirically proven with the data.

All data used in this study are secondary and collected from Datastream. This study used five Dow Jones Islamic and Sustainability equity indices (of Islamic Market sustainability, the Europe and the United States. Total 406 weekly price observations of each index have been used in this study starting from January 27, 2006. The study used selected Dow Jones Islamic and Sustainability in the Europe and the U.S. regional equity indices as the two are biggest country allocation regionals in Dow Jones Islamic Market Sustainability index's characteristics and the selection was taken to maintain homogeneity in data. In addition, these indices are selected based on the importance of the markets; for example, European and the US indices cover both Islamic and Sustainability equity markets in all economies in European and the U.S. regions. The study period also covers the 2008 global financial crisis and ongoing 2009 the European sovereign debt crisis; in particular Europe is still mired in economic stagnation as deflation draws closer in present outlook.

**Figure 3.1 The closing prices of all the indices for the whole period.**

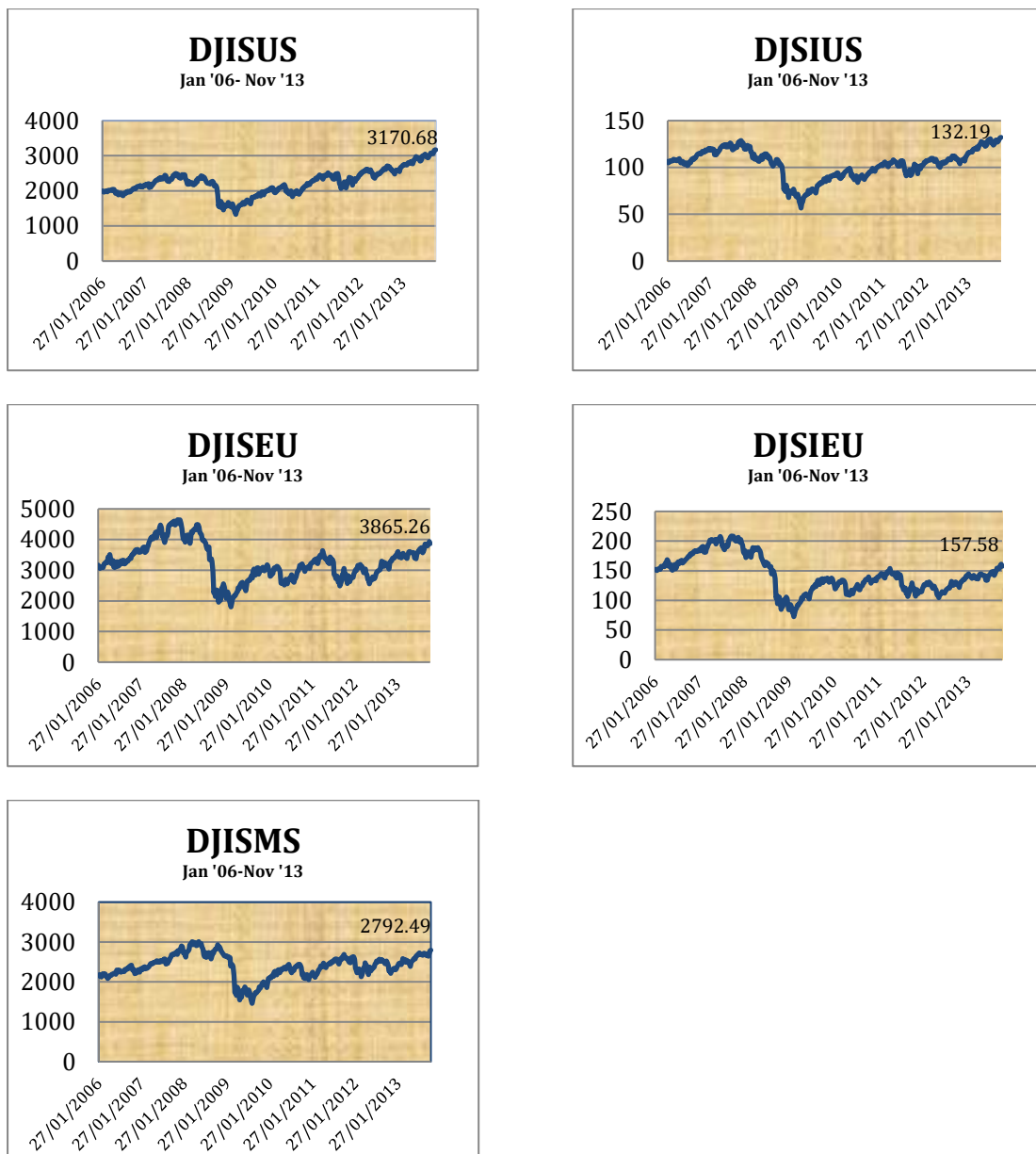
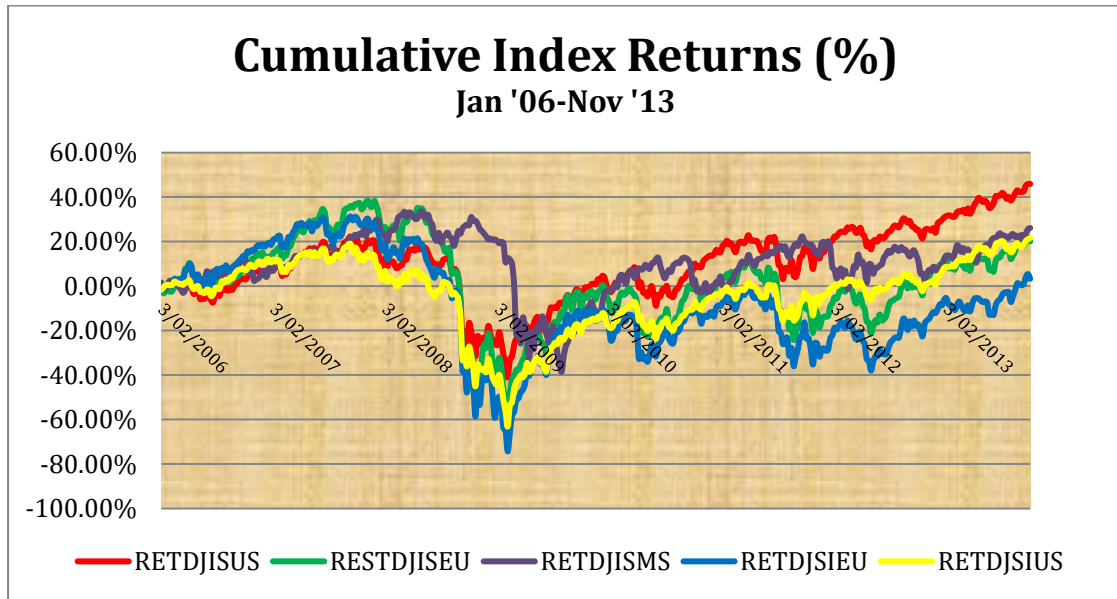


Figure 3.1 shows the closing prices of all the indices for the overall period of the study. It is clear that all these indices moved together during the financial crisis in U.S. in mid though (2008-2009) but diverge after 2010 and forward.



**Table 3.2 Descriptive statistics for all indices**

	RET <sub>DJISUS</sub>	RET <sub>TDJISEU</sub>	RET <sub>DJISMS</sub>	RET <sub>DJISIEU</sub>	RET <sub>DJISIUS</sub>
Mean (Return)	0.1%	0.0%	0.1%	0.0%	0.1%
Annualized Mean (Return)	5.9%	2.6%	3.4%	0.4%	2.8%
Std. Dev	2.7%	3.8%	2.9%	3.7%	2.6%
Annualized Std. Dev	19.2%	27.1%	21.2%	26.7%	18.8%

Table 3.2 shows that all returns are positive. In addition, the lowest return in the whole period is DJ Sustainability Europe. The highest return is for DJ Islamic US index followed by the second highest which is the DJ Islamic Market Sustainability, DJ Sustainability U.S., DJ Islamic Europe and finally DJ Sustainability Europe. This indicates that the U.S. stock markets were doing extremely well in the whole period in general. Risk of these indices are measured by the standard deviation, as reported in the above the DJ Islamic Europe has the highest standard deviation which means it was the riskiest among all other indices. The lowest standard deviation is for DJ Sustainability US indicating that is it the least risky index in the group. The risk and return relationship which suggest that the higher the risk an investor is willing to take the higher the compensation an investor should get or higher the returns. But the results are contradicting to the risk and return relationship.

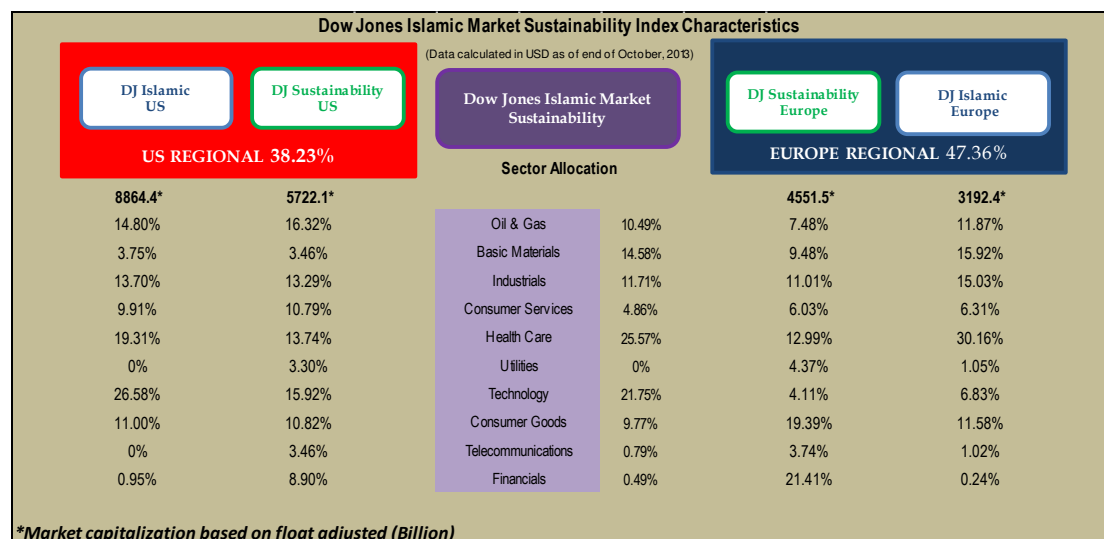
Apparently, recent market observations postulate that the **low-volatility anomaly** phenomenon or portfolios of low-volatility stocks have produced higher risk-adjusted returns than portfolios with high-volatility stocks in most markets studied. It is considered an anomaly because it contradicts what the Capital Asset Pricing Model (CAPM) would predict about the relationship between risk and return. Baker, Bradley and Wurgler (2011) assert that the low-volatility anomaly arises partly from investor psychology and the behavior of large institutional managers. In with Mitton and Vorkink (2007), they argue that volatile individual stocks have positive return skew-i.e., unlimited upside



but a known downside limited to the stock price. Investors therefore, view buying a low-priced volatile stock as if they were buying a lottery ticket, with volatility serving as a proxy for the potential payoff. As Barberis and Hung (2007) show, volatile stocks tend to be overvalued because of this lottery preference and, hence, perform poorly relative to low-volatility stocks over the long run.

This observation appealing to our mind as why the Dow Jones Islamic Market Sustainability index contributed to much higher standard deviation than both the U.S. indices despite this index is the most stringent in its screenings approach. We anticipate the explanation based on the below diagram as follows:

**Diagram 3.3 All Dow Jones Islamic and Sustainability Index Characteristics**



**a. Financial crisis and economic recovering speed**

Dow Jones Islamic Market Sustainability’s characteristic is clearly skewed toward European regional (47.36%) compared to 38.23% in the U.S. As our study period also covers the 2008 global financial crisis and ongoing the European sovereign debt crisis; we anticipate that in particular Europe is still mired in economic stagnation as deflation draws closer in present outlook while U.S is recovering much faster from 2008 financial crisis. Despite the global recovery is emerging, but it has two speeds: That of the stimulus-fed U.S. and that of the ongoing austerity-starved Eurozone especially in Southern European. According to Angel Gurría, OECD Secretary-General, Paris, November 2013, The Economic Outlook from the Organisation for Economic Cooperation and Development, paints a picture of pain for some economies as major nations struggle to emerge from recession and unemployment in Europe soars to record levels. The crisis in European regional has been prolonged to recover since 2009 and significantly impacting European constituents returns performances from abnormal volatility in the Dow Jones Islamic Market Sustainability index.

### **b. Commodity price plunged on weighed sectors**

Despite Health Care and Technology are the major sectors allocation in Dow Jones Islamic Market Sustainability index, the other combined sectors like Basic Materials, Industrials, Consumer goods and Oil & Gas contributed the most important sources of commodities demand, driven by the manufacturing hubs of European countries like Germany and Italy. According to Nissanke and Huellen (2012) the continued price volatility across commodities have been undoubtedly a major source of instability to the world economy and made all the more difficult to ride through the financial crisis of 2007-2009 and to secure a robust recovery worldwide since then. Thus, we believe that the highly unstable commodity prices over the past decade have also had profound impacts on the course of economic development of both commodity exporting and importing countries (European and the U.S.) which has also darkened the outlook as commodity prices significantly and turned outright bearish on the affected sectors in the index.

**Table 3.3 Variables used in the study**

<b>Variable</b>	<b>Explanation</b>
LDJISUS	Logarithmic Price of DJ Islamic US
LDJSIUS	Logarithmic Price of DJ Sustainability US
LDJISEU	Logarithmic Price of DJ Islamic Europe
LDJISMS	Logarithmic Price of DJ Islamic Market Sustainability
LDJSIEU	Logarithmic Price of DJ Sustainability Europe

Traditionally, multivariate regression analysis has been widely used to examine the relationship between variables, which has serious limitations because of non-stationarity nature of most of the macroeconomic and financial variables. With the non-stationary variables traditional regression provides either spurious relationship (if the original “level” form of the variables was non-stationary) or a short run relationship (if the variables were “differenced” to make the original variables stationary) (Masih, Al-Sahlawi, & Mello, 2010). This study, because of the damaging shortcomings of multivariate regression analysis, employs the Johansen multivariate cointegration approach to examine the cointegration among the Islamic equity index prices with a view to checking the long run theoretical relationship of the Islamic indices.

After checking cointegration, this study applies vector error correction model (VECM) to determine the speed of the short-run adjustment towards long term equilibrium by the size of the error correction coefficient. VECM also helps to identify the endogenous and exogenous indices. Endogenous equity index is a dependent variable, the movement of which depends on the changes in the exogenous equity indices, which are independent variables. In addition, this study uses the impulse response and error variance decomposition technique

to examine the relative exogeneity/endogeneity of the selected Islamic equity indices. Furthermore, this study employs persistence profile (PF) test to find out the time horizon required for the cointegrating relation to move back to equilibrium point following an economy wide shock.

### 3.1 TESTING STATIONARITY OF VARIABLES

We begin our empirical testing by determining the stationarity of the all variables<sup>7</sup>. In order to proceed with the testing of cointegration later, ideally, our variables should be I (1), in that in their original level form, they are non-stationary and in their first differenced form, they are stationary. Taking the difference of their log forms creates the differenced form for each variable used. For example,  $DDJISMS = LDJISMS - LDJISMS_{t-1}$ . We then conducted the Augmented Dickey-Fuller (ADF) test on each variable (in both level and differenced form). The table below summarizes the results.

Variable	Test Statistic	Critical Value	Implication
<b>Variables in Level Form</b>			
LDJISUS	-1.6997 (SBC)	-3.4228	Variable is non-stationary
	-1.5775 (AIC)	-3.4228	Variable is non-stationary
LDJISEU	-1.8673	-3.4228	Variable is non-stationary
LDJISMS	-2.1213(SBC)	-3.4228	Variable is non-stationary
	-2.1240(AIC)	-3.4228	Variable is non-stationary
LDJSIUS	-1.2991 (SBC)	-3.4228	Variable is non-stationary
	-1.3225 (AIC)	-3.4228	Variable is non-stationary
LDJSIEU	-1.6859 (SBC)	-3.4228	Variable is non-stationary
	-1.6919 (AIC)	-3.4228	Variable is non-stationary
<b>Variables in Differenced Form</b>			
DDJISUS	-21.2071 (SBC)	-2.869	Variable is stationary
	-8.9205 (AIC)	-2.869	Variable is stationary
DDJSIUS	-21.3803 (SBC)	-2.869	Variable is stationary
	-7.2187 (AIC)	-2.869	Variable is stationary
DDJISEU	-20.8927	-2.869	Variable is stationary
DDJISMS	-21.8535 (SBC)	-2.869	Variable is stationary
	-7.1798 (AIC)	-2.869	Variable is stationary
DDJSIEU	-21.6089 (SBC)	-2.869	Variable is stationary
	-13.5163 (AIC)	-2.869	Variable is stationary

Based on the AIC and SBC criteria, the conclusion that can be made is that *all the variables we are using for this analysis are I(1)*, thus we may proceed with testing of cointegration<sup>8</sup>. Note that in determining which test statistic to

<sup>7</sup> A variable is stationary when its mean, variance and covariance are constant over time.

<sup>8</sup> The null hypothesis for the ADF test is that the variable is non-stationary. In all cases of the variable in level form, the test statistic is lower than the critical value and hence we cannot reject the null. Conversely, in all cases of the variable in differenced form, the test statistic is higher than the critical value and thus we can reject the null and

compare with the 95% critical value for the ADF statistic, we have selected the ADF regression order based on the highest computed value for AIC and SBC. In some instances, AIC and SBC give different orders and in that case, we have taken different orders and compared both (for example, this applies to the variable LDJSIUS, LDJISMS, LDJSIUS and LDJSIEU see the table above). In all cases, the implications are consistent.

### 3.2 DETERMINATION OF ORDER OF THE VAR MODEL

Secondly, we determine the order of the vector auto regression (VAR), that is, the number of lags to be used. As per the table below, results show that AIC recommends order of 1 whereas SBC favors zero lag. <sup>9</sup>.

	Choice Criteria	
	AIC	SBC
Optimal order	1	0

Given this apparent conflict between recommendation of AIC and SBC, we address this in serial correlation statistical test for each variable and obtained the following results.

Variable	Chi-Sq p-value	Implications (at 10%)
DDJISUS	0.899	No serial correlation
DDJISEU	0.822	No serial correlation
DDJSIEU	0.984	No serial correlation
DDJSIUS	0.681	No serial correlation
DDJISMS	0.223	No serial correlation

From the statistical results, there is no autocorrelation in 5 variables. Thus, if we adopted a lower order, we may encounter the effects of serial correlation. The disadvantage of taking a higher order is that we risk over-parameterization. However, in our case, given that we have a relatively long time series (406 observations), this is a lesser concern. Considering the trade-off of lower and higher orders, we decided to choose the *higher VAR order of 2* instead of 1 so we may get robust statistical result on short term and long-term component on each variable at VECM (section 3.5).

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conclude that the variable is stationary (in its differenced form).

<sup>9</sup> Based on highest computed values for AIC and SBC, after stipulating an arbitrary relatively high VAR order of 6.

### 3.3 TESTING COINTEGRATION

In our earlier tests (3.1 and 3.2), we tested the unit roots of all the variables and found that they could be taken as I(1) on the basis of ADF and PP tests. We also found that the optimal order of the VAR could be taken as two on the basis of AIC and SBC criteria. We applied the standard Johansen co-integration test (*Table 1*) and found them to have one co-integrating vector at 95% significance level on the basis of maximal Eigen value and trace statistics. An evidence of co-integration implies that the relationship among the variables is not spurious or by chance<sup>10</sup>, i.e. there is a theoretical relationship among the variables and that they are in equilibrium in the long run. (*See Appendix 3*)<sup>11</sup>

**Table 1. Johansen ML results for co-integrating vectors -DJ Islamic US, DJ Islamic US, DJ Sustainability Europe, DJ Sustainability US and DJ Islamic Market Sustainability, (2006–2013)**

Ho	H1	Statistic	95% Crit.	90% Crit.
Maximum Eigen value statistics				
r=0	r≥1	44.8959	37.86	35.04
r≤1	r≥2	21.0511	31.79	29.13
Trace Statistic				
r=0	r≥1	97.4933	87.17	82.88
r≤1	r≥2	52.5974	63.00	59.16

**Notes:** The statistics refer to Johansen's log-likelihood maximal Eigen value and trace test statistics based on co-integration with unrestricted intercepts and restricted trends in the VAR. From the above results, we select one co-integrating vector based on the Eigen value and trace statistics at 95% level. The underlying VAR model is of order 2 and is computed using 406 weekly observations.

We are convinced to believe that there is one co-integrating vector as our intuition parallels to the theoretical concept behind the Dow Jones Islamic Market Sustainability index construction and the important observation of contemporary equity markets indicate that global stock markets are typically towards "co-integrated" in which indicates that the performance of one market tends to have an effect on other markets, in some way or other, to varying degrees co-movement. More precisely, co-movement depicts a phenomenon of an asset price moving with another asset price. Moving with is the movement that is shared by all assets or movement that all assets have in common<sup>12</sup>. According to Hoque (2007) growing globalization among economies of the

<sup>10</sup> This co-integration can also be proven by virtue of the fact that in the VECM (the change in the variable is significantly related with the error correction term  $et-1$ ).

<sup>11</sup> In the case of Maximal Eigenvalue and Trace, the test statistic for null of  $r = 0$  is greater than the 95% critical value whereas for other null hypotheses, statistic is less than the critical values. For AIC, SBC and HQC, the number of co-integrating vectors is obtained by locating the highest numbers.

<sup>12</sup> Baur, D., 2004. What is co-movement. European Commission, Joint Research Center, Ispra (VA), Italy

world has increased attention of academics and investors to the subject of co-movement among the stock markets around the globe. Thus, from economic interpretation 5 Dow Jones indices are theoretically related and they tend to move together, in the long term.

The above theoretical of co-integration and the study of co-movement are valuable to different role players. As International portfolio investments can influence the exchange rate and could lead to appreciation of local currency so co-movement among markets has considerable value for multinational companies in making financial policies. Additionally, foreign portfolio investments are subject to sudden withdrawals and hence these have the potential for destabilizing an economy thus increasing international portfolio investment has important implications for macroeconomic policies as well.

Further more, according to portfolio diversification theories<sup>13</sup> if stock markets are interlinked then there is no long run benefit of diversification for international investor and vice versa. Therefore, it is vital for global portfolio managers and international investors to examine the dependencies among international equity markets. This is to say that, while in short term, an investor can improve returns (relative to risk) by geographically diversifying his equity investment, this strategy would not yield that investor consistently abnormal returns over the long run. This is because these co-integrated markets would eventually realign themselves into a long-term (theoretical) relationship with one another.

In relation to our case, the co-integration in our selected Dow Jones equity markets also means that Dow Jones Islamic Market Sustainability index's characteristics contain very essential information (country allocation and sectors performances) of other regional indices in the Europe and US regions. For portfolio managers and investors who are seeking international diversification by investing in Dow Jones Islamic Market sustainability index may consider "indexing" as a cost-effective and logical step toward achieving their future goals. According to indexing rules, a fund manager attempts to replicate in his portfolio the result of the investment target by holding all, or in the case of very large indices, a representative sample of stocks. Although indexing is generally considered a passive investment strategy, index fund managers must actively minimize the tracking errors<sup>14</sup> of their portfolio as a result of changes in the composition of the indices that they follow<sup>15</sup>.

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<sup>13</sup> Markowitz (1952) and Lintner (1965)

<sup>14</sup> Tracking error is defined as the annualized standard deviation of the difference in returns between an index fund and its target index.

<sup>15</sup> The composition of an index can change due to various factors such as mergers or acquisitions, bankruptcy, restructuring, lack of representation, additions and deletions events. Changes can also occur when firms are dropped from an index due to poor performance and loss of status (shariah-compliance or sustainability compliance) in

Finally, to study co-movement among stock markets would be useful for policy makers in a sense if stock markets are found to be closely linked then there is a danger that shocks in one market may spill over to other markets thus require closer cooperation among the authorities of these countries, whose equity markets are closely linked.

### 3.4 LONG RUN STRUCTURAL MODELLING (LRSM)

Next, we attempt to quantify this apparent theoretical relationship among the indices. We do this in order to compare our statistical findings with theoretical (or intuitive) expectations. Relying on the Long Run Structural Modeling (LRSM) and normalizing our variable (index) of interest, the DJ Islamic Market Sustainability Index, we initially obtained the results in the following table . Calculating the t-ratios manually, we found only one variable (index) to be significant -DJ Sustainability US.

**Table 1.2**

Variable	Coefficient	Standard Error	t-ratio	Implication
LDJISUS	2.1589	1.3682	1.5779	Variable is insignificant
LDJSIUS	-2.2713	1.0472	2.1689	<b>Variable is significant</b>
LDJISEU	-1.3905	0.7918	1.7561	Variable is insignificant
LDJISMS	1	*NONE*)	-	-
LDJSIEU	1.2732	0.82568	1.542	Variable is insignificant

These initial results puzzled to us and we were curious to why DJ Islamic US, DJ Sustainability Europe and DJ Islamic US indices were found to be insignificant. Driven by that curiosity, we decided to verify the significance of the variables by subjecting the estimates to over-identifying restrictions. We did this for only insignificant variables (making one over-identifying restriction at a time) and the second results confirmed earlier findings that LDJISUS, LDJISEU and LDJSIEU were insignificant and LDJSIUS remains significant. Detailed is in the table below. Thus, our decision is based on two important facts (intuitively) as below:

- a. DJ Islamic Europe, DJ Sustainability Europe, DJ Islamic US and DJ Sustainability US represent the subset regionals of Europe and US from their both parents in DJ Islamic Market World and DJ Sustainability World.

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the industry. Alternatively, they may be added to an index due to their superior performance and elevated status in their industry.

b. DJ Islamic Europe, DJ Sustainability Europe, DJ Islamic US and DJ Sustainability US have significant influences and impacts in the components of Dow Jones Islamic Market Sustainability index characteristics. All indices are essential for cross-paired to be included as an eligible constituent in the Dow Jones Islamic Market Sustainability. The readers should acknowledge that the theoretical of DJ Islamic Market Sustainability index construction is governed by both screenings on both parent indices which requires any eligible constituent must pass sharia-compliant and sustainability compliant at the parent indices (DJ Islamic Market World and DJ Sustainability World)<sup>16</sup> prior to inclusion. As a result, we proceeded with exact-identification for the remainder of the time series technique in VECM, VDCs and IRF that all variables are significant in our study.

From the above analysis, we arrive at the following co-integrating equation (numbers in parentheses are standard deviations) follows the 1<sup>st</sup> exact-identifying:

LDJISMS	+2.1589	LDJISUS	-1.3905	LDJISEU	-2.2713	LDJSIUS	+1.2732	LDJSIEU
		(-1.3682)		(-0.7918)		(-1.0472)		(-0.8257)

### 3.5 VECTOR ERROR CORRECTION MODEL (VECM)

From our analysis thus far, we have established that at least five indices are co-integrated to a significant degree - i. DJ Islamic Europe, DJ Sustainability Europe, DJ Islamic US and DJ Sustainability US. However, the co-integrating equation reveals nothing about causality, that is, which index is the leading variable and which is the laggard variable. Information on direction of Granger-causation can be particularly useful for investors. By knowing which variable is exogenous and endogenous, investors can better forecast or predict expected results of their investment. Typically, an investor would be interested to know which index is the exogenous variable because then the investor would closely monitor the performance of that index as it would have significant bearing on the expected movement of other indices in which the investor has invested. In our study, the exogenous index would be the index of interest to the investor.

In light of this, the next part of our analysis involves the Vector Error Correction Model (VECM). Here, in addition to decomposing the change in each variable to short-term and long-term components, we are able to ascertain which

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<sup>16</sup> Please see detail on Dow Jones Islamic Market Sustainability Index Fact Sheet "Key features"1.)The Islamic investment screens are designed to exclude companies with financial ratios or lines of business that are typically viewed as incompatible with Shari'ah investment guidelines. 2.) To meet the sustainability requirements, companies must be in the top 10% of their industries based on a sustainable business practice model established by RobecoSAM that accounts for economic, environmental and social factors.



variables are in fact exogenous and which are endogenous. The principle in action here is that of Granger-causality, a form of temporal causality where we determine the extent to which the change in one variable is caused by another variable in a previous period.

By examining the error correction term,  $e_{t-1}$ , for each variable, and checking whether it is significant, we found that all variables are endogenous, as depicted in the table below.

Variable	ECM(-1) t-ratio p-value	Implications
LDJISUS	0.004	Variable is endogenous
LDJSIUS	0.000	Variable is endogenous
LDJISEU	0.013	Variable is endogenous
LDJISMS	0.000	Variable is endogenous
LDJSIEU	0.002	Variable is endogenous

Again, this statistical diagnosis resulted a dilemma that perplexing the authors on why selected variables in our co-integrating vector are all endogenous (weak exogenous link). We attempt to find the explanation by revisiting our earlier theoretical hypothesis as follows:

- a. Based on earlier diagram 1.1 Theoretical Dow Jones Islamic Market Sustainability Index Construction, DJ Islamic US, DJ Islamic Europe, DJ Sustainability US, DJ Sustainability Europe and DJ Islamic Market Sustainability index are the subset indices of their parents Dow Jones Islamic Market World and Dow Jones Sustainability World. Therefore, all subset indices are subjected to the respective parents indices composition reviewed<sup>17</sup>; Dow Jones Islamic Market World (quarterly in March, June, September and December) and Dow Jones Sustainability World (annually). In other words, all five indices are rather the followers (endogenous), which subjected to the leaders indices (exogenous) composition reviewed.
- b. We assume our building model based on general-equilibrium model<sup>18</sup> in which all the key variables such as (DJ Islamic US, DJ Islamic Europe, DJ Sustainability US, DJ Sustainability Europe and DJ Islamic Market Sustainability) are endogenous; a model in which all prices are endogenous in the vector model where selected variables determine and effect the changes in those vector model.

In addition, the VECM produces a statistic that may be of interest to investors.

<sup>17</sup> The index is also reviewed ongoing basis to account for extraordinary corporate actions such as mergers, takeovers, spin-offs, initial public offerings (IPOs), delistings and bankruptcies.

<sup>18</sup> Which is contrast to partial-equilibrium model. According to Dean Croushore, an exogenous variable is a variable that is determined outside the model or taken to be given by the model. Detail please refer to (Money and Banking: A Policy-Oriented Approach, p.227, 2007)

The coefficient of  $et-1$  tells us how long it will take to get back to long term equilibrium if that variable is shocked. The coefficient represents proportion of imbalance corrected in each period. For instance, in the case of the Dow Jones Islamic Market Sustainability index, the coefficient is 0.062. This implies that, when there is a shock applied to this index, it would take, on average, 5.1 weeks for the index to get back into equilibrium with the other indices.

### 3.6 VARIANCE DECOMPOSITION (VDC)

Although the error correction model tends to indicate the all variables are endogenous, we had to apply the two VDCs (Orthogonalized VDCs and Generalized variance decomposition) techniques to discern the relative degree of endogeneity of the variables. In other words, which is the most laggard variable compared to others, or, the least laggard? As the VECM is not able to assist us in this regard, we turn our attention to variance decomposition (VDC). The relative endogeneity of a variable can be determined by the proportion of the variance explained by its own past. The variable that is explained mostly by its own shocks (and not by others) is deemed to be the least endogenous of all.

First, we started out applying Orthogonalized VDCs and obtained the following results. In our table 4, the result for forecast horizon 52 as follows from the least endogenous to the most endogenous: **DJISUS (78.85%)**, **DJISMS (48.43%)**, **DJISEU (16.83%)**, **DJSIUS (6.92%)**, and **DJSIEU (0.95%)**

**Table 4. Percentage of forecast variance explained by innovations in: Orthogonalized variance decompositions**

Horizons	$\Delta$ LDJISUS	$\Delta$ LDJISEU	$\Delta$ LDJISMS	$\Delta$ LDJSIUS	$\Delta$ LDJSIEU
Relative variance in $\Delta$ LDJISUS					
13	92.19%	0.09%	4.15%	0.11%	3.45%
26	86.66%	0.05%	8.54%	0.19%	4.58%
39	82.20%	0.04%	12.07%	0.37%	5.32%
52	<b>78.85%</b>	0.04%	14.72%	0.56%	5.83%
Relative variance in $\Delta$ LDJISEU					
13	74.56%	19.69%	2.91%	0.10%	2.74%
26	70.96%	18.43%	6.67%	0.17%	3.77%
39	67.83%	17.51%	9.83%	0.35%	4.48%
52	65.43%	<b>16.83%</b>	12.24%	0.53%	4.97%
Relative variance in $\Delta$ LDJISMS					
13	0.47%	1.80%	94.16%	0.60%	2.97%
26	1.33%	4.32%	80.84%	2.48%	11.03%
39	3.34%	6.78%	63.07%	6.25%	20.56%
52	5.39%	8.39%	<b>48.43%</b>	9.92%	27.86%
Relative variance in $\Delta$ LDJSIUS					
13	84.85%	0.09%	6.52%	4.61%	3.93%
26	76.14%	0.05%	12.83%	5.73%	5.25%
39	69.96%	0.06%	17.47%	6.45%	6.06%
52	65.70%	0.08%	20.72%	<b>6.92%</b>	6.58%
Relative variance in $\Delta$ LDJSIEU					
13	77.41%	14.54%	5.96%	1.61%	0.47%

26	71.52%	13.37%	12.04%	2.61%	0.46%
39	66.80%	12.53%	16.65%	3.33%	0.70%
52	63.36%	11.92%	19.94%	3.83%	<b>0.95%</b>

Next, we proceed to Generalized variance decomposition for robustness; in terms of more realistic statistical assumption compared to Orthogonalized result. We need to recognize two important limitations of Orthogonalized VDCs. Firstly it assumes that when a particular variable is shocked, all other variables are “switched off”. Secondly and more importantly, Orthogonalized VDCs do not produce a unique solution. The generated numbers are dependent upon the ordering of variables in the VAR. Typically, the first variable would report the highest percentage and thus would likely to be specified as the most exogenous/least endogenous variable.

Thus, we decided to rely on Generalized VDCs, which are invariant to the ordering of variables. In interpreting the numbers generated by the Generalized VDCs, we need to perform additional computations. This is because the numbers do not add up to 1.0 as in the case of orthogonalized VDCs. For a given variable, at a specified horizon, we total up the numbers of the given row and we then divide the number for that variable (representing magnitude of variance explained by its own past) by the computed total. In this way, the numbers in a row will now add up to 1.0 or 100%.

**Table 5. Percentage of forecast variance explained by innovations in: Generalized variance decompositions**

Horizons	$\Delta$ LDJISUS	$\Delta$ LDJISEU	$\Delta$ LDJISMS	$\Delta$ LDJSIUS	$\Delta$ LDJSIEU
Relative variance in $\Delta$ LDJISUS					
13	30.0%	20.6%	2.1%	28.2%	19.0%
26	29.1%	20.4%	3.9%	27.9%	18.7%
39	28.4%	20.1%	5.4%	27.6%	18.5%
52	27.8%	20.0%	6.5%	27.4%	18.3%
Relative variance in $\Delta$ LDJISEU					
13	23.2%	29.0%	1.2%	21.3%	25.4%
26	22.8%	28.4%	2.6%	21.5%	24.8%
39	22.4%	27.9%	3.7%	21.5%	24.4%
52	22.1%	27.6%	4.7%	21.5%	24.1%
Relative variance in $\Delta$ LDJISMS					
13	0.5%	0.5%	97.4%	1.0%	0.5%
26	1.5%	3.8%	90.6%	2.5%	1.6%
39	4.0%	9.3%	75.8%	6.6%	4.4%
52	6.6%	14.4%	60.5%	11.1%	7.4%
Relative variance in $\Delta$ LDJSIUS					
13	28.2%	19.4%	3.1%	30.1%	19.2%
26	27.0%	19.1%	5.8%	29.4%	18.7%
39	26.1%	18.8%	7.9%	28.9%	18.3%
52	25.4%	18.5%	9.6%	28.5%	18.0%
Relative variance in $\Delta$ LDJSIEU					
13	22.6%	26.2%	2.2%	22.7%	26.4%
26	22.0%	25.5%	4.3%	22.7%	25.5%

39	21.5%	24.9%	6.1%	22.6%	24.9%
52	21.1%	24.5%	7.4%	22.5%	24.4%
	Short-term horizon				
	Long-term horizon				

From the above results, we can make the following key observations. At the end of the forecast horizon (52), the contributions of own shocks towards explaining the forecast error variance of each variable are as follows: **DJ Islamic Market Sustainability variable (60.5%), DJ Sustainability US (28.5%), DJ Islamic US (27.8%), DJ Islamic Europe (27.6%) and DJ Sustainability Europe (24.4%)**.

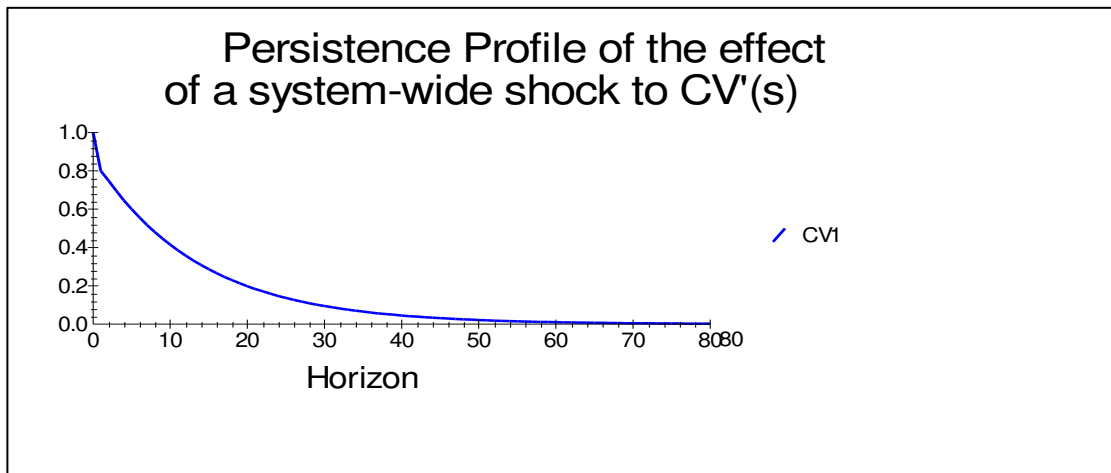
The variable that is explained mostly by its own shocks and depends relatively less to other variables is DJISMS which is the leading variable. These results tend to indicate that Dow Jones Islamic Market Sustainability index is the most exogenous (to be exact the least endogenous as in our case) of all. These out-of-sample variance forecast results given by the generalized variance decompositions contradicts to our initial theoretical. Thus, we reject the null hypothesis “ *any changes (index effects) in Dow Jones Islamic Market Index has more significant impacted on U.S. regional (both DJ Sustainability and Islamic) than its peers in the Europe regional due to higher market capitalizations despite the European companies are more than U.S. companies in the Dow Jones Islamic Market Sustainability index’s characteristics*”.

### 3.7 IMPULSE RESPONSE FUNCTIONS (IRF)

The impulse response functions (IRFs) essentially produce the same information as the VDCs, except that they can be presented in graphical form. Thus, we have included the various graphs of IRFs in *Appendix 7A to 7J*.

### 3.8 PERSISTENCE PROFILE

The persistence profile illustrates the situation when the entire co-integrating equation is shocked, and indicates the time it would take for the relationship to get back to equilibrium. Here the effect of a system-wide shock on the long-run relations is the focus (instead of variable-specific shocks as in the case of IRFs). The chart below shows the persistence profile for the co-integrating equation of this study.

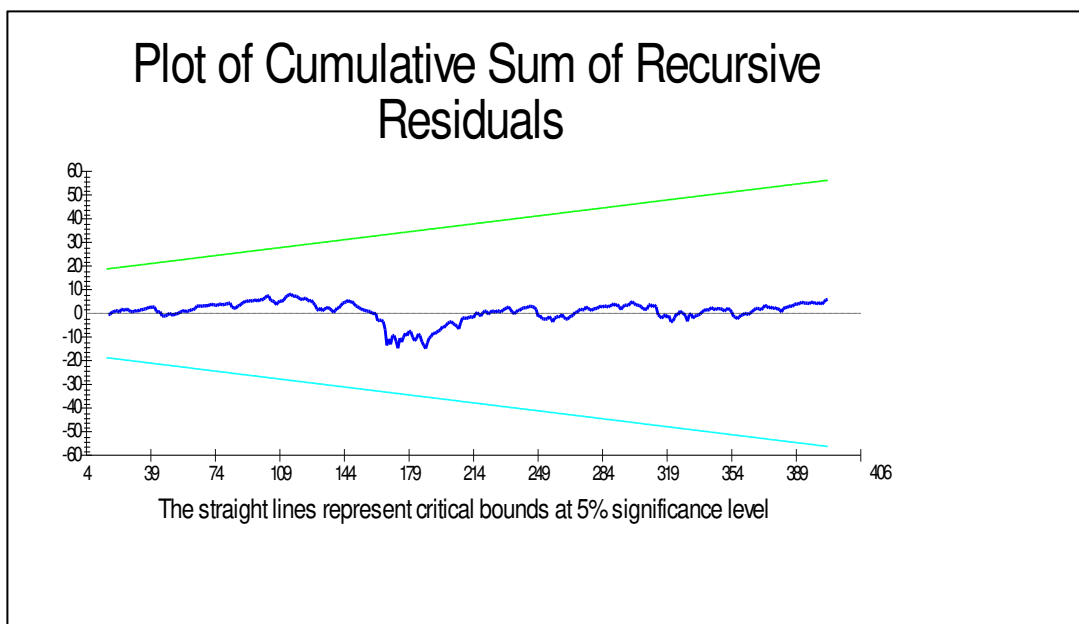


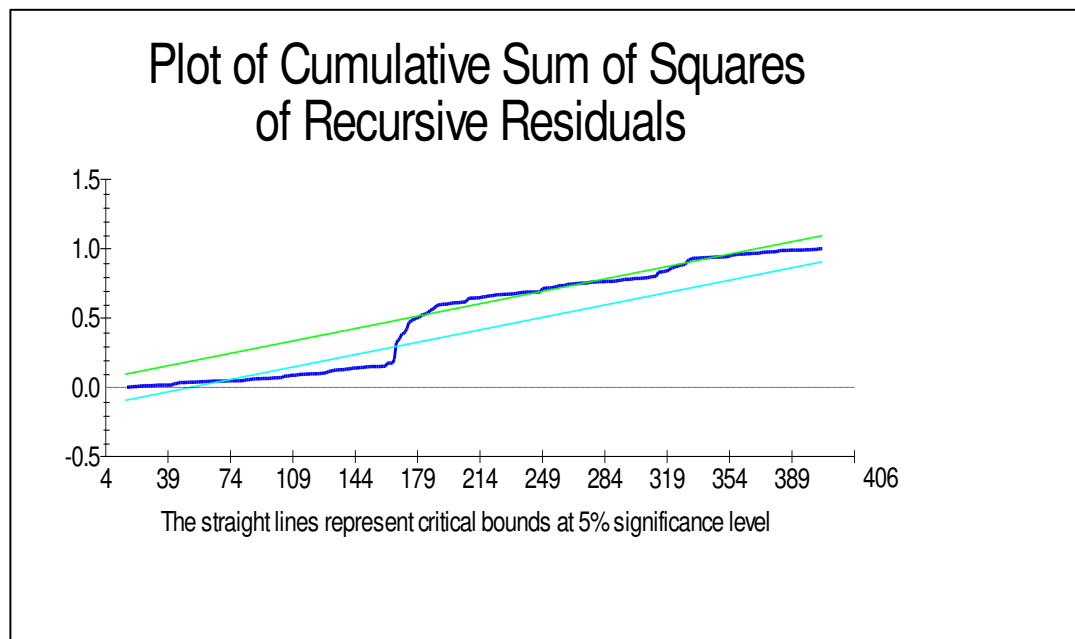
The chart indicates that it would take approximately 60 weeks for the co-integrating relationship to return to equilibrium following a system-wide shock.

### 3.9 CUSUM/CUSUM SQUARES

We also checked the stability of the coefficients by the CUSUM and CUSUM SQUARE tests (Fig. 1), which indicate the plot in CUSUM squares has crossed out/in at several time horizons and not stable (structural break). This results point out that the CUSUM-squared test is likely to be more insensitive to noise effects and changes in variance and needs to be investigated further in the future to find the relevant explanations on specific events.

**Figure. (a) Plot of cumulative sum of recursive Residuals and (b) plot of cumulative sum of squares of recursive Residuals**





#### 4. CONCLUSIONS

This study empirically investigates the comovement of Dow Jones Islamic Market Sustainability equity market with four selected Dow Jones Islamic and Sustainability stock markets (Europe and U.S.). Since the main focus of this study is to understand the Dow Jones Islamic Market Sustainability index's characteristics, to identify its influences in index effects and its possible direction of causality of the changes/shocks happens within or towards other Dow Jones Sustainability and Islamic in Europe and the US regionals, with humble we conclude by revisiting four (4) hypothesis based on below diagram portfolio construction and risk management analysis<sup>19</sup> and making further explanations or implication on overall observations.

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#### **Portfolio Construction and Risk Management**

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<sup>19</sup> Adhering to DJ Islamic Market Sustainability fund's investment objective, the Investment Management Team, portfolio managers and investors constructs the DJ Islamic Market Sustainability portfolios based on 4 respective hypothesis to benchmark the key investment themes to identify which screening approach, sectors and or regions to overweight and underweight. To execute their strategies, the teams and investors will draw this diagram from eligible constituents Dow Jones Islamic Market Sustainability index that meet combination of rigorous financial and sustainability analysis.

<b>SUSTAINABILITY APPROACH</b> DJ Sustainability US vs. DJ Sustainability Europe	<b>SHARIAH-COMPLIANT APPROACH</b> DJ Islamic US vs. DJ Islamic Europe
<b>COUNTRY ALLOCATION</b> US regional vs. Europe regional	<b>SECTOR ALLOCATION</b> Overweight vs. Underweight Diversification Volatility Management

### Sustainability Approach

Based on Relative variance between  $\Delta$  LDJSIUS and  $\Delta$  LDJSIEU on DJISMS, DJSIUS contributes (9.6%) more changes than DJSIEU (7.4%) on Dow Islamic Market Sustainability in the long term (horizon 52).

### Shariah-compliant Approach

Based on Relative variance between  $\Delta$  LDJISUS and  $\Delta$  LDJISEU, Dow Jones Islamic U.S. contributes 6.5% more changes than Dow Jones Islamic Europe 4.7% on Dow Jones Islamic Market Sustainability in the long term (horizon 52).

### Country Allocation

Based on the above sustainability and shariah-compliant approaches, U.S. regional is more influenced than Europe regional in Dow Jones Islamic Market Sustainability index despite the index's country allocation constitutes more Europe (46.36%) than the U.S. (38.23%). Thus, it applies that even though there are more European companies than the US companies from a universe of companies that meet both combination of rigorous financial (shairah-complaint) and sustainability analysis, we anticipated that the market capitalization factor plays very important in influencing the sensitivity of any changes (shocks) in Dow Jones Islamic Market Sustainability. Our results in forecast error variance on short and long horizon (13,26,39 and 52) are stable and the relative endogeneity do not changed among the variables.

### Sectoral Allocation

Based on table *Diagram 3.3 All Dow Jones Islamic and Sustainability Index Characteristics*, we compared all five indices sector allocation characteristics and conclude that the European regional is concentrated significantly (overweighed) in Health Care sector (25.57%) and U.S. regional in technology (21.75%) in Dow Jones Islamic Market Sustainability index. Moreover, financial sector is the least significant contributed (underweighted) in Dow Jones Islamic Market Sustainability. We also anticipated that even though the Health Care sector is more weighted than Technology sector in our interest index, it appears



that most of U.S technology companies are relatively much higher shares in terms of market capitalizations compared to European health care companies. We further examine the theoretical of market capitalization formula and its relations to all sectors. As market capitalization is a measure of a business entity's value, it uses a company's stock price and the number of shares issued in the markets to determine a value. Thus, factors that effects market cap include sharp changes the value of shares, either upward or downward, in addition to a change in the number of issued shares of stock. We further examined the reasons for this kind of change. However, is tied to the stock price. If there is high demand in a stock from investors, the market cap is likely to move higher, while weaker demand will hurt a company's value. Therefore, investor perception is a strong influence on market cap. If investors respond to a piece of bad news in fear that it will have a damaging, long-term impact on a business, the stock could be punished and lose value. The truth may be that the negative event was a one-time occurrence, but the investor already sold the stock. As a result, the market cap of a company will be affected downward. But we puzzle why technology appears the most in market capitalization than Health Care sector. Again, we noticed that most technology companies are relatively received better perceptions from investors due to its attractiveness as *"The top five US cash kings are Apple, Microsoft, Google, Cisco and Pfizer...the technology sector continues to lead among industries, accounting for some \$515 billion, or 56%, of total non-financial corporate cash."*<sup>20</sup>

In sum, both Dow Jones Islamic and Sustainability in U.S. indices are skewed towards much higher market capitalizations than its peers in European indices. In the event of prolonged European Sovereign debt crisis, many European companies have struggled (more volatile) and registered to lower returns due to low stock prices from poor demands (poor investors 'perception).

All the above information and analysis are useful to portfolio managers and investors to make further decision-making in portfolio construction in several perspectives. Firstly, any changes (shocks) in Dow Jones Islamic Market Sustainability postulates to have significant effects and comovement on other Dow Jones Islamic and Sustainability regional indices.

Firstly, the findings of this study have several implications for the investors and policy makers in general and portfolio managers in particular of Islamic equity markets. Since the markets are co-integrated, the opportunity to gain abnormal profits tends to be less in the long run, which could be less attractive to the portfolio managers and investors. However, there could be a short-term gain from the arbitrage activities in this Dow Jones Islamic Market Sustainability index even though the abnormal gains from portfolio diversification would tend to disappear in the long term. Thus, introducing a fund index (passive) for Dow Jones Islamic Market sustainability index would help investors to spread the inherent risk of volatile stocks by diversifying all

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<sup>20</sup> Global Credit Research (30 Sep 2013) (<https://www.moodys.com>)



stock (91 constituents<sup>21</sup>) instead of investing in just a few. So, by owning many securities reduces volatility by decreasing the impact of large price swings above or below the average return in a single security.

Secondly, our study period also covers the 2008 global financial crisis and 2009 the European sovereign debt crisis; in particular Europe is still mired in economic stagnation as deflation draws closer in present outlook. Despite we are positive that investing in Dow Jones Islamic Market sustainability would contribute to low riskiness (low exposures) in financial sector that heavily impacted most financials stocks' returns during the crisis, we anticipate that other sectors like Basic Materials, Industrials, Oil & Gas and Consumer Goods are still significantly affected from systemic risks like commodity price swings and national macroeconomic policy. In our case, Europe regional contributed significantly in much higher volatility with low returns compared to U.S. regional. Thus, investors should be very much cautious to invest in the Islamic and Sustainability equities from Europe regional due to higher volatility and contagion effect but allocate more weights on U.S. constituents especially in technology sectors.

## **5. LIMITATIONS AND SUGGESTIONS FOR FUTURE RESEARCH**

The following are some conceivable limitations of this study and hence presents opportunities for future research. The choice of indices is somewhat arbitrary due to the time constraint and quantitative modeling ability of the author, only five variables have been used to make analysis. Many other available indices could have been considered and may have produced additional or even different results. While this study looked at only the selected Islamic and Sustainability equity indices, future research should try to look at a more comprehensive picture of index effects and comovement pattern as follows:

- a. By taking into additional indices like Dow Jones Islamic and Sustainability in Asia Pacific and North America (Canada) regional together. In addition, both parents indices (Dow Jones Islamic Market World and Dow Jones Sustainability World) should be included in

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<sup>21</sup> There are only 91 component number (constituents) in Dow Jones Islamic Market Sustainability factsheet (Data calculated as of end October, 2013)

- future studies in order to identify the exogeneity linked these indices on our endogenous indices.
- b. To consider evaluating all aspects from financial analysis and sector behavioral of each constituents in Dow Jones Islamic Market Sustainability.
  - c. For robustness, we recommend for using difference quantitative technique or more advance financial techniques. We acknowledge that each modeling technique has its own limitations, biasness and unrealistic assumptions in order to make sharp predictions- In particular, the prediction in economics is not as precise as natural science (see, e.g., Granger 2001, for an assessment of macroeconomic forecasting practice).
  - d. The impact of inflation within the individual markets has also been left out, partially to avoid veering too far from the core of the study. Economies with high inflation will likely seem to have over-performed as companies faced with inflation will merely increase their selling prices to keep pace and their share prices will in turn rise to reflect this pricing power. It is because of this ability by companies to raise prices that stocks are widely considered to be a good hedge against inflation.
  - e. In addition, some major theories also should be considered in the future like the work on co-movement around index changes was done by Barberis et al (2002) in explaining for co-movement subsequent to index changes. Barberis analyzed the S&P 500 index additions discriminated between the three co-movement views, namely category view, habitat view and finally the information diffusion or fundamental view.

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