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Stock market efficiency: A comparative analysis of Islamic and conventional stock markets

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Highlights (for review)

H I G H L I G H T S

- MF-DFA is used to examine weak form stock market efficiency
- Developed, BRICS emerging and Islamic countries stock markets are analyzed
- Efficiency ranking is compared across Islamic and conventional counterparts
- Turkish stock market is most efficient Islamic stock market, while Pakistan’s is the least efficient
- Islamic stock markets are mostly more efficient than their conventional counterparts
- Islamic stock markets are new, they nonetheless maintain robust governance and disclosure mechanisms

Stock market efficiency: A comparative analysis of Islamic and conventional stock markets

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Abstract

In this paper, we examine the comparative efficiency of 12 Islamic and conventional stock markets counterparts using multifractal de-trended fluctuation analysis (MF-DFA). The full sample results indicate that developed markets are relatively more efficient, followed by the BRICS' stock markets. The comparative efficiency analysis shows that almost all the Islamic stock markets excluding Russia, Jordan and Pakistan are more efficient than their conventional counterparts. Implying that Islamic stock markets are new, however the peculiar nature, shari'ah compliant laws and good governance and disclosure mechanisms make them more efficient. Further, our results indicate that the Islamic stock markets' adjustment to speculative activity is, in fact, higher than their conventional counterparts. The findings of the study may help regulators and policy makers to reduce economic distortions through more effective resource allocation.

Keywords: Efficiency; Stock markets; Islamic stocks; MF-DFA; global financial crisis

JEL Classifications: G1, G14, G17

1. Introduction

The efficient market hypothesis[1] (EMH) has received a great deal of recognition in the literature as a theoretical device, which furthers understanding and promotion of quality financial markets. Different studies have looked to better understand and examine the efficient market hypothesis through incorporating available information regarding stock prices. The movements of stock prices (or any financial/economic series) are commonly described as the 'random walk'. These movements of stock prices (i.e., random walk) are hard to predict as they change without any pattern or limits over the long run. Moreover, future stock returns cannot be predicted on the basis of historical price information if the stock prices follow a random walk. On the other hand, if a random walk is not followed, the stock prices would track a trend over time which can help in predicting future returns by extrapolating historical prices. Therefore, a market is said to be in a weak form of efficiency if all the past information contained in stock price movements is fully reflected in the current stock prices (Fama, 1970). Confirmation of the efficient market hypothesis has been considered a sufficient condition for a long time; however, the rejection of the random walk hypothesis does not necessarily support an inference that stock price information or stock markets are inefficient.

Stock prices follow a random walk with either a positive or a zero drift as implied by the EMH. Efficient resource allocation in an economy is impacted by an inefficient stock market because the effect of new information on the stock prices is likely to be understated or overstated (Pagan, 1996). Post EMH, researchers have claimed that it is Utopian and unrealistic to expect a completely efficient market; however, current studies, for example, Zunino et al., (2008) and

[1] For details, see Fama (1970 and 1991)

Wang et al., (2009), have shown that the stock markets are indeed evolving and becoming more efficient with the passage of time.

Furthermore, the concept of achieving pure market efficiency has been a subject of academic and professional debate for years due to several reasons. Firstly, it is expected that risk-weighted returns would be greater in inefficient stock markets. Thus, an examination of stock market efficiency is vital for individual[2] and institutional investors in both the private and public sectors. A thorough knowledge and understanding of the EMH concept is critical for corporate managers because the actual and perceived value of companies is determined by their decisions and actions. For equity market supervisors and operators, EMH is imperative as it helps decision-making in the development of equity markets. Lastly, the efficient market hypothesis is an important underlying assumption in numerous financial models. Hence, from the perspective of investors, regulators, and policy makers, the examination of EMH (i.e., whether stock prices follow a random walk or a mean reverting process) is crucial.

However, little scholarly attention has been paid to testing the EMH in Islamic stock markets. This is surprising given that Islamic stock markets are a significant new phenomenon in the world financial system, underlined by the fact the Islamic financial sector has experienced a growth rate of 15-20% per annum over the last five years (Di Mauro et al., 2013). It is also expected that the risk-return profile of Islamic and conventional products (i.e., stocks) is different because of the unique characteristics of Islamic stocks such as ethical investing, ratio screening, low tolerance towards interest based leverage and limit to the intensively structured financial

[2] Before the latest developments of the EMH concept, the individual investors may not be able to obtain the optimal benefits as a result of high information costs, transactions costs, agency costs and other real-world frictions. However, the most recent expressions of the EMH thus allow a role for individual investors in the market who may profit from their comparative advantages including specialized knowledge, lower trading costs, low agency costs or management fees and a financing structure (Ang, et al. 2011).

products such as derivatives (Saiti et al., 2014). The screening criteria of the Islamic stock indices such as debt to equity ratio (not more than 33%) limits the inclusion of industrial sectors engaged in prohibited activities (trade in alcohol, gambling etc.) and the inclusion of financial sectors (Islamic banking, modarba, musharika businesses) that only facilitate the supportive activities. Therefore, the performances of the Islamic and conventional stock markets are not theoretically expected to be similar, a conclusion that has been documented by recent studies. For example, Beck et al. (2013) concluded that conventional banks are more efficient compared to their Islamic counterparts. They are outperformed, however, by Islamic banks in terms of capitalization, asset quality and intermediation. Likewise, Ho et al. (2014) confirmed that conventional stock indices are outperformed by the Islamic stock indices over time. Saeed and Izzeldin (2014) proved that Islamic banks' efficiency and default risk association differs in comparison to conventional banks. These findings reiterate the necessity to comparatively investigate the efficiency of Islamic and conventional stock markets.

This study contributes to the existing literature by employing a cutting-edge method of de-trended fluctuation analysis (DFA) derived from econophysics to measure the degree of stock market efficiency. Previous studies, for example, Cajueiro and Tabak (2004, 2005, 2007) and Di Matteo et al. (2003, 2005), have employed monofractal techniques to rank and compare the efficiency of stock markets. However, a plethora of research argues that the time series data of financial markets exhibit multifractal behavior. Therefore, a monofractal method with a single scaling exponent is inappropriate since it may provide spurious findings (Oświe et al., 2005; Kwapień et al., 2005; Pasquini and Serva, 1999; Fisher et al., 1997; among others).

It is also worth mentioning that the multifractal nature of the time series[3] is attributable to the fat-tailed probability distributions of variations, different long-range temporal correlations, for small and large fluctuations, or both (Yang et al., 2016). In view of this aspect, econophysics approaches are well known for their ability to analyze stock markets' weak-form efficiency. Another important feature of this approach is that it considers the presence of long-range memory (multifractality) in non-stationary time series. Multifractal de-trended fluctuation analysis (MF-DFA) can also be used to examine financial market efficiency, the level of persistency, and long-range dependence. The method provides the flexibility to avoid misjudgments of correlation and to estimate the long-range correlation behavior of nonstationary time series (Zhao and He, 2016). Moreover, econophysics approaches give more accurate findings as compared to rescaled range analysis (R/S), which is prone to non-stationarity and short-term auto-correlation issues of the time series, and is therefore likely to provide spurious results of long memory parameters (Zhuang et al., 2015). The MF-DFA approach is robust against these issues and may accurately detect the long-range auto-correlations in financial markets.

Considering the evidence from previous literature and taking into account the global detection of multifractal behavior in measuring long-range dependence, the first contribution of the present study is to extend existing knowledge on the efficient market hypothesis (EMH) by an application of multifractal de-trended fluctuation analysis (MF-DFA) on Islamic stock markets. Second, the robust methodology of MF-DFA helps in quantifying the multiple scaling exponent within a time series. These multiple scaling exponents are used to calculate the ranks which are then employed to compare the stock markets in terms of their efficiency. Third, the study ranks

[3] For further details, see Shiri et al. (2012).

the four Islamic, BRICS (emerging) and three developed countries' capital markets. Our findings highlight that developed markets are relatively more, while the Islamic are less efficient. Further, we find that almost all the Islamic stock markets excluding Russia, Jordan and Pakistan are more efficient than their conventional counterparts.

The remainder of this study is organized as follows. Section 2 provides a review of the literature. Section 3 discusses the methodology. Section 4 describes the data and discusses the empirical results and draws implications. Section 5 provides concluding remarks.

2. Literature Review

Given the implications of EMH for stock market efficiency, numerous studies have targeted its different aspects, but there remains a lack of consensus on the empirical evidence. This is because the findings seem based on empirical frameworks, theoretical models and miscellaneous methods (i.e., some confirmed the efficiency of the markets while the others did not). Considering the importance of EMH, numerous studies have been conducted; however, this literature lacks consensus. For example, Narayan and Smyth (2004) tested the random walk hypothesis on the South Korean stock market and found evidence of the existence of random walk. Likewise, Narayan and Smyth (2005) investigated whether 22 of the stock markets in OECD countries follow random walk or a mean reversion process. Their study confirmed that the stock prices of these markets are characterized by a unit root process. Hence, these markets follow random walk and are in line with the hypothesis of market efficiency. Ozdemir (2008) and Gozbasi et al. (2014) tested the efficiency of the Turkish stock market. According to those results, the Turkish market follows a random walk process, which shows that the Turkish stock market is weak-form efficient.

In other studies, Marashdeh and Shrestha (2008) examined the weak-form efficiency of the United Arab Emirates' (UAE) stock market. Awad and Daraghma (2009) studied the Palestinian equity market. Oskooe and Shamsavari (2010) repeated similar work on Iranian stock prices. Alexeev and Tapon (2011) studied the Toronto Stock exchange (TSE). Hasanov and Omay (2012) examined transitioning stock markets including Bulgaria, Czech Republic, Hungary and Slovakia. Shahzad et al. (2015) investigated the South Asian (Bangladesh, India, Pakistan and Sri Lanka) financial markets. Neaime (2015) conducted research focused on the MENA region, while Rizvi and Arshad (2014) quantified East Asian (Singapore, Indonesia, Malaysia and South Korea) stock markets. These studies, among others, all documented that the markets under study were at least a weak-form of efficient.

On the other hand, many studies did not find evidence of weak-form of efficiency in their findings. These studies include, Tabak (2003) who examined the Brazil stock market and Lima and Tabak (2004) who studied the stock prices of China and Singapore. Sunde and Zivanomoyo (2008) found similar results for the Stock Exchange of Zimbabwe. Uddin and Khoda (2009) found similar results for the stock prices of Bangladesh, as did Metghalchi et al. (2015) in their analysis of the Madrid general stock index. Wang et al. (2015) reviewed several Asian stock markets and their related stock market prices, including for Hong Kong, Japan, Mainland China, Malaysia, Singapore, South Africa and Thailand. Finally, Jamaani and Roca (2015) showed similar findings of no-evidence of weak-form efficiency in the stock markets of Gulf Cooperation Council (GCC) countries, namely Bahrain, Kuwait, Oman, Qatar, Saudi Arabia and the United Arab Emirates.

Furthermore, the application of different statistical tools may provide miscellaneous findings in regard to EMH. For example, Tiwari and Kyophilavong (2014) studied the EMH for BRICS

stock markets by employing traditional unit root tests as well as wavelet based analysis. The analysis showed different results for both techniques (i.e., a wavelet based unit root test accepts the null hypothesis of the test only for Russia and rejects it for all other countries). Whereas, traditional unit root test that do not cater for structural breaks in data report opposite results (i.e., accepts the null hypothesis for all the countries while rejecting it for Russia only). The findings of the study highlight two main facts: wavelet based unit root tests give more accurate results and secondly, all the markets except Russia do not provide evidence for random walk. In another study, Chancharat and Valadkhani (2007) investigated random walk behavior of 16 countries' stock market prices. By employing the unit root tests of Zivot and Andrews (1992) and Lumsdaine and Papell (1997), they found that Zivot and Andrews' test rejects the random walk hypothesis only for two countries. However, Lumsdaine and Papell's test rejects the hypothesis for five countries.

Rizvi et al. (2014) tested the efficiency of developed stock markets and their Islamic counterparts and stated that conventional countries' markets are more efficient in comparison to Islamic markets. They also reported that the short-term efficiency of the developed markets is higher and the long-term efficiency of the same markets were moderate in comparison. The markets of the developed economies and regions were found to be more efficient than Islamic cases, with the exception of Turkey, Malaysia and Indonesia, which were continuously well positioned during all the time periods under study.

In the last decade, random walk/efficient market hypothesis has remained under discussion in finance because of its capacity for examination and its validity, especially for emerging equity markets. As the research extant in the literature to date could not reach consensus on stock market efficiency, the dilemma remains intractable. It is probable that our literature review

would provide contradictory results with regard to market efficiency because if one empirical examination on a single market provides evidence in favor of market efficiency, the other will provide against it. The reason behind this could be the assumption that the market under study is efficient in terms of development according to the most popular financial models of the 1970s and 1980s. The common examples could include the stock or bond, or option pricing models (Majumder, 2013). As expected, the above literature review provides contradicting findings on EMH. Therefore, this study not only ranks stock markets in terms of their efficiency but also comparatively investigates the efficiency of Islamic and conventional counterparts from the Islamic, BRICS emerging and developed countries.

3. Methodology

In order to examine and rank the efficiency of stock markets under study, multifractal de-trended fluctuation analysis (MFDFA) has been utilized. The MF-DFA methodology not only helps in ranking the efficiency but also assists in identifying the level of stock market inefficiency (Shahzad et al., 2017). The stationarity or random walk behavior of a time series under study is determined through a spectrum of generalized Hurst exponents provided by the method. Further, the stock markets are ranked based on their relative inefficiencies using these *q*th order (index variable) Hurst exponents. According to Kantelhardt et al. (2002), the methodology consists of the following five steps:

First of all, the corresponding profile of a correlated time series (signal) $\{x_i, i = 1,..., N\}$, is determined through integration:

$$X(i) = \sum_{k=1}^{i} [x_i - (x)], i = 1, \ldots., N \quad (1)$$

where, (x) is the mean and N is the length of the series. After determining the corresponding profile, X(i) is further divided into $N_s \equiv int(N/s)$ which is known as the non-overlapping windows of equal length 's'. In this study, the windows may not be able to capture some part of the time series as the length of the series is not a multiple of the considered time scale 's'. Therefore, to avoid the data loss, the study followed Bai and Zhu (2010), who repeated the same process starting from the opposite end and 2N's windows is obtained.

Subsequently, the local trend is examined for each sub-interval $\{v = 1, \ldots, 2N_s\}$ and each sub-interval's least square fit is determined. The de-trended time series is obtained by taking the difference between the original time series and the fits, which are as follows:

$$X_s(i) = X[(v - N_s)s + 1] - x_v(i) \text{ for } \mathrm{v} = 1, \ldots., \mathrm{N_s} \quad (2)$$

and

$$X_s(i) = X[N - (v - N_s)s + 1] - x_v(i) \text{ for } \mathrm{v} = \mathrm{N_s} + 1, \ldots.2\mathrm{N_s} \quad (3)$$

where, the polynomial fit of vth sub-interval is denoted by x_v and the variance is estimated as under:

$$F_{xx}{}^2(s, v) = \frac{1}{s}\sum_{i=1}^{s}\{X[(v-1)s + i] - x_v(i)\}^2 \text{ for } \mathrm{v} = 1, \ldots., \mathrm{N_s} \quad (4)$$

and

$$F_{xx}{}^2(s, v) = \frac{1}{s}\sum_{i=1}^{s}\{X[N - (v-1)s + i] - x_v(i)\}^2 \text{ for } \mathrm{v} = \mathrm{N_s} + 1, \ldots.2\mathrm{N_s} \quad (5)$$

Further, the variances over all sub-intervals are averaged to obtain the qth order fluctuations as under:

$$F_q(s) = \left\{\frac{1}{2N_s}\sum_{v=1}^{2N_s}[F^2(s, v)]^{q/2}\right\}^{1/q} \quad (6)$$

Here, any real value except 1 can be taken by order q. For q = 0, it is possible to estimate directly the value h(0) because of the diverging exponent. Therefore, it is needed to employ a logarithmic average procedure. For the estimation of q = 2, the ordinary DFA method is applied. Lastly, for each value of q, the log-log plot of Fq(s) against 's' is analyzed to determine the scaling behavior of the fluctuation functions. With an increase in scale s, Fq(s) increases if the time series xt is long-range power-law correlated, which is expressed in:

$$F_q(s) \sim s^{h(q)} \tag{7}$$

A family of scaling exponents h(q) is provided by the slope of the log-log of Fq(s) against 's'. The Hurst exponent H (≡ h(2)) is generalized from the scaling exponents h(q). As discussed earlier, the Hurst exponent provides the information regarding the behavior of time series over time. The $0<H<0.5$ ($0.5<H<1$) represents anti-persistence or negative correlation (persistence or positive correlation), which implies the stock markets' level of inefficiency. Further, H = 0.5 proposes that an uncorrelated Brownian motion (i.e., efficiency of stock markets) is followed by a time series.

The MF-DFA is applied to calculate the h(q), which have a direct link with the classical multifractal scaling exponent by:

$$\tau(q) = qh(q) - 1 \tag{8}$$

The singularity strength and spectrum denoted by α and $f(\alpha)$, respectively, can be estimated using the spectrum of generalized Hurst exponents h(q) which are expressed as:

$$\alpha = h(q) + qh'(q) \text{and } f(\alpha) = q[\alpha - h(q)] + 1 \tag{9}$$

In multifractal methods, different values of 'α' are used to characterize different parts of the structure, which lead to the existence of the spectrum *f*(α).

4. Data and Empirical Results

In order to analyze and rank the stock markets in terms of their efficiency, the current study uses daily returns data of 12 conventional stock markets including four Islamic countries' stock markets: Amman SE financial market price index of the Jordanian stock market; FTSE bursa Malaysia KLCI price index of the Malaysian stock market; Karachi stock exchange 100 price index of Pakistan; and BIST national 100 price index of Turkey. Five BRICS countries' stock markets are also included: BOVESPA return index of Brazil; MICEX price index of the Russian stock exchange; CNX 500 price index of the Indian National stock exchange; Shanghai stock exchange price index of China; and the FTSE/JSE ALL SHARE price index of South Africa. Finally, we analyze and rank three developed countries' stock markets including: S&P 500 composite price index of USA; FTSE 100 price index of UK; and the Nikkei 225 stock average price index of the Japanese stock exchange.

The present study also uses daily returns data of 12 Islamic stock markets to examine the comparative efficiency of Islamic and conventional stock markets. The data in US dollars for Morgan Stanley Capital International (MSCI), Islamic stock indices of four Islamic countries (Jordan, Malaysia, Pakistan and Turkey), the five BRICS countries, and the Dow Jones (DJ) Islamic stock indices of three developed countries (USA, UK and Japan), has been used. The Islamic stock indices are constructed and maintained using two types of screening criteria such as business activity and financial ratios. Moreover, they are monitored by a supervisory board

composed of Islamic scholars who advise them on matters pertaining to the compliance of the indices' eligible components. The composition of the indices is reviewed on regular basis and changes are implemented accordingly. In addition to the quarterly and annual composition reviews, the indices are monitored on an ongoing basis. A change in the index composition is necessary when an extraordinary event such as a bankruptcy, merger, or takeover has a material impact on a component. Any new issue is also evaluated in the same manner (Al-Khazali and Mirzaei, 2017).

The Islamic and developed countries' stock markets were selected for study on the basis of market capitalization and traded volume. In addition, the Islamic countries selected were the leading example based on market capitalization and traded volume from each respective region (South Asia, Southeast Asia, Middle East and North America). The selection criteria of the Islamic countries also required that a country have a Muslim majority as well as be a member of the Organization of Islamic Cooperation (OIC). Finally, BRICS stock markets have witnessed rapid growth over the last decade and hence, they have been included in the sample of the study to measure and compare the performance (efficiency) of these rapidly growing (emerging) markets with the rest of the world's stock markets.

The two key indicators i.e., market capitalization/GDP and value traded/GDP as shown in Figure-1 and 2 are calculated by averaging the each year values of market capitalization/GDP and value traded/GDP from the respective countries' group such as Islamic (Jordan, Malaysia, Pakistan and Turkey), BRICS (Brazil, Russia, India, China and South Africa) and developed (USA, UK and Japan) countries stock markets. These indicators illustrate a noticeable difference for the three sets of sample markets (i.e., developed countries' stock markets show higher average market capitalization/GDP and value traded/GDP for almost all the years). Following

developed countries, the emerging stock markets of the Islamic and BRICS countries display mixed trends i.e., the Islamic countries' stock markets exhibit higher average market capitalization/GDP, while BRICS markets possess higher average value traded/GDP. These indicators show that the developed countries' stock markets are comparatively more developed than the emerging markets of BRICS and Islamic countries and hence, they might exhibit higher stock market efficiency.

<< Insert Figure 1 & 2 about here >>

For efficiency ranking analysis, the study uses 3131 daily closing returns for each time series, while the period of data collection runs from January 1, 2003 to December 31, 2016[4]. All the data was taken from DataStream International. The selection of daily data is based on the fact that stock market prices react and adjust to new information and/or the occurrence of events (whether economic, political, industrial, or company-specific) on a daily basis. Therefore, it is vital to examine the speed and accuracy of reactions and adjustments of stock market prices to such information and/or events, which ultimately shows their responsiveness and performance (i.e., efficiency).

Additionally, to avoid results bias caused by two distinct phases experienced in the global stock markets in recent years, the sample has also been divided into two sub-periods. This should provide a more comprehensive overall understanding and mitigate any distortion of the data analysis. The phase from 2003 until 2006 is considered as the 'normal phase' during which steady economic growth was observed and no major crash (stock, financial market and economic) occurred. The period from 2007 until 2010 is categorized as a 'crisis period' mainly because of the US financial sector crises that led to the global economic slowdown.

[4] The sample period has been selected based on the availability of data on Islamic stock markets.

Empirical analysis begins with the calculation of returns series, expressed as $r_t = \ln\left({}^{P_t}/_{P_{t-1}}\right)$, where r_t is the return of the series by taking natural log, and P_t denotes the price index at time t. Then, the slopes of the generalized Hurst exponents for twenty-four stock markets (i.e., twelve conventional and twelve Islamic) are calculated, which are presented in Table 1.

Table 1 highlights that the generalized Hurst exponents h(q) of all the conventional stock markets (Panel-A), excluding Pakistan, change moderately with a variation in q that moves from −4 to 4. Similar to the findings for the conventional stock markets, a moderate change is observed in all the Islamic stock markets (Panel-B), excluding Pakistan, which initially display a more prominent change pattern, but it then moves to a pattern of moderate, gradual change. This variation in H(q) suggests that the stock markets' multifractality characteristic becomes weaker. Moreover, it highlights that the stock markets are becoming relatively more efficient with the passage of time. According to the theory mentioned in the literature review section, an equity market is said to be efficient when the random walk behavior is followed by all kinds of fluctuations. This translates into h(q)'s related to different q's are equal to 0.5. For the analysis, the study focuses on large and small fluctuations and thus it defines a stock market deficiency measure as per:

$$MDM = \frac{1}{2}(|h(-4) - 0.5| + |h(4) - 0.5|) \quad (10)$$

The large and small price fluctuations are denoted by scale exponents (i.e., h(4) and h(−4)) as shown in Figure 3. A market is said to be efficient if the value of MDM is close to zero, therefore, a large MDM value indicates a less efficient market.

<< Insert Table 1 & Figure 3 about here >>

4.1. Ranking of Markets for full sample (2003–2016)

The findings of MF-DFA ranking for the whole sample of 24 stock markets (12 conventional and 12 Islamic) are presented in Table 2. As expected, the ranking results of conventional stock markets indicate that the developed markets are relatively efficient with the Japanese and US markets holding second and fourth positions, respectively. The results for the BRICS countries' stock markets show the Brazilian stock market surprisingly located at the top of the table, while Russian and Chinese markets occupy the third and eighth positions, respectively. Findings for the Islamic countries' stock markets illustrate that the Turkish market is the most efficient market as it occupies the fifth position among conventional markets, while the Pakistani market is least efficient because it rests at the bottom of the efficiency ranking table. As the market efficiency is highly dependent on the stage of stock market development (Rizvi et al., 2014). A possible explanation for comparatively lower level of Pakistan stock market's efficiency could be its smaller size and low level of market development (as indicated by the two key stock market development indicators i.e., market capitalization/GDP and value traded/GDP). Further, the greater stock market efficiency stipulates that the adjustment of markets to speculative activity will be higher. Owing to their emerging natures, the Islamic and BRICS countries' stock markets have weaker governance and disclosure mechanisms. Hence, they are intuitively expected to have more speculative activity and less efficient relative adjustment responses.

Similar to the findings for the conventional stock markets, the Islamic stock markets of developed countries are relatively more efficient as they hold the second, third and fifth positions. The Brazilian Islamic stock market, similar to its conventional counterpart, rests at the top of the table. Findings for the Islamic countries' stock markets indicate that the Turkish market is the most efficient market as it occupies the seventh position while the Islamic stock

markets of Jordan and Pakistan are least efficient because they rest at the bottom of the efficiency ranking table. These results are in accordance to the findings of Rizvi et al. (2014).

<< Insert Table 2 about here >>

The comparative efficiency analysis of conventional and Islamic stock markets reveals some interesting insights. Almost all the Islamic stock markets excluding Russia, Jordan and Pakistan are more efficient than their conventional counterparts. The possible explanation for this finding could be the peculiar nature, shari'ah compliant laws and good governance and disclosure mechanisms make the Islamic stock markets more efficient. Moreover, the screening criteria of construction of Islamic stock indices result in more concentration on few industries such as industrial, consumer services and technological sectors (Charles et al., 2011). This can cause decrease in liquidity, increase in volatility and hence, make the Islamic stock markets less predictable. These findings also imply that the Islamic stock markets' adjustment to the speculative activity is comparatively higher than their conventional counterparts.

Finally, Table 2 indicates another interesting comparative insight with none of the developed markets holding the top position in the efficiency ranking table. The reason for this may be that these markets faced varying conditions (i.e., booms and busts) during the sample period. Therefore, the full sample study of stock market efficiency, achieved by an averaging out effect of various market conditions, may in fact provide biased findings for all the markets under study. Hence, the efficiency analysis has also been completed by dividing the sample period into two sub-samples, which is as follows.

4.2. Ranking of Markets for sub-sample – pre GFC (2003–2006)

Table-3 presents the efficiency ranking findings for the first sub-sample ranging from 2003 through 2006. The analysis for the conventional stock markets indicates that the emerging markets of BRICS economies are relatively more efficient than the developed and Islamic countries' markets because they hold the top three as well as the fourth position. In addition, Islamic countries' markets, including Turkey and Malaysia, ranked higher than the developed markets except Japan. This perhaps shows the effects of improved regulatory mechanisms, enhanced volumes and financial liberalization in the emerging BRICS markets and in Islamic countries, which ultimately lead to an increased inflow of international investors. The higher ranking of Turkey and Malaysia for this sub-sample accords with the findings of Cajueiro et al. (2009), who inferred a positive effect of financial liberalization and elimination of capital controls in the Malaysian case in his study.

In contrast to the findings for the conventional stock markets, the analysis for the Islamic stock markets shows that the developed Islamic stock markets are relatively more efficient as they hold the second, third and fourth positions, respectively. The Islamic stock markets of BRICS economies are also found to be relatively more efficient than the Islamic countries' stock markets. The overall comparative efficiency analysis of conventional and Islamic stock markets demonstrates that all the Islamic stock markets except those located in Russia and Jordan are more efficient than their conventional counterparts for this sub-sample.

<< Insert Table 3 about here >>

4.3. Ranking of Markets for 2007–2010

The efficiency ranking findings for the second sub-sample from 2007 to 2010 are presented in Table 4. The analysis shows that the financial meltdown and the global economic slowdown (slow recovery) phase show higher efficiency level results in favor of developed stock markets. The developed economies were facing problems of debt and economic slowdown but nonetheless occupy the top three rankings. The stock markets of BRICS economies are also shown to be dominating the Islamic countries' stock markets in terms of efficiency rankings, as they hold the fourth and fifth spots after the developed markets. Among Islamic countries' equity markets, Malaysia is found to be highly efficient as it rests at the sixth position. In the results for the sub-sample from 2007 to 2010, it is shown that the recent global financial crisis seems to have increased the level of efficiency of all stock markets considered. The possible explanation for this finding could be the general re-pricing of risk in financial markets caused by the global financial crisis. Investors and regulatory are more keep during turbulent markets situations and thus more closely follow the variations in asset prices. Therefore, a relatively higher level of efficiency is expected due to tight control and rapid information flow during the states of market uncertainty. The case of the emerging markets' improved efficiency might also be based on the theories proposed by Boutchkova and Megginson (2000), where the authors documented that the fast-paced GDP growth rate and privatization processes lead to increased stock market liquidity and capital formation, which are key contributors to the EMH according to finance theory.

<< Insert Table 4 about here >>

The results for the Islamic stock markets are quite similar to those attributed to the conventional markets with the developed Islamic stock markets found to be relatively more efficient than the emerging markets of BRICS and Islamic countries. The Islamic stock markets of BRICS

economies are also found comparatively more efficient as they occupy the first, fourth and sixth spots, respectively. Moreover, the Malaysian market is found to highly efficient in contrast to the remainder of the Islamic countries' stock markets, which are shown at the bottom of the table. Similar to the findings for the whole sample and first sub-sample periods, the overall comparative efficiency results of conventional and Islamic stock markets for this sub-sample reveals that all the Islamic stock markets, except Jordan, are more efficient than their conventional counterparts. This is because the risk-return profile of the Islamic and conventional products (i.e., stocks) are different due to their unique characteristics, including smaller sized firms, lower financial leverage, under-diversified markets and imposition of constraints on investing in non-compliant activities. Hence, the performances of Islamic and conventional stock markets are not, in theory, assumed to be similar, as concluded in recent studies. For example, Ho et al. (2014) confirmed that conventional stock indices are outperformed by Islamic stock indices over time. Saeed and Izzeldin (2014) proved that Islamic banks' efficiency and default risk association differs when compared to conventional banks.

5. Concluding Remarks

In this paper, we examined and compared, empirically, the comparative efficiency of 12 conventional stock markets (Jordan, Malaysia, Pakistan, Turkey, Brazil, Russian, India, China, South Africa, USA, UK and Japan) and their Islamic counterparts in those same states. Data was derived from daily stock returns data from January 1, 2003 until December 31, 2016. The study employs a novel technique of multifractal detrended fluctuation analysis (MF-DFA) to investigate and rank the efficiency of Islamic, BRICS and developed countries' stock markets as well as their Islamic counterparts.

The results for the complete sample period indicate that the developed markets are relatively more efficient, followed by the BRICS stock markets. Findings for the Islamic countries' stock markets illustrate that Turkey is the most, while Pakistan is the least, efficient market. Similarly, the Islamic stock markets of developed countries are relatively more efficient, while the Islamic countries' are the least efficient among those examined. The comparative efficiency analysis of conventional and Islamic stock markets highlights an interesting insight in that almost all the Islamic stock markets excluding Russia, Jordan and Pakistan are more efficient than their conventional counterparts.

Interestingly, the results for the first sub-sample indicate higher relative efficiency of the emerging markets of BRICS economies. In addition, Islamic countries' markets including Turkey and Malaysia ranked higher than the developed markets except Japan. This points toward the effects of improved regulatory mechanisms, enhanced volumes and financial liberalization in the emerging markets of BRICS and Islamic countries, which ultimately led to an increased inflow of international investors. Moreover, the phenomenon of emerging markets' improved efficiency might be based on the theories proposed by Boutchkova and Megginson (2000), who documented that fast-paced GDP growth rates and privatization led to increased stock market liquidity and capital formation, which, according to the finance theory, are key contributors to the EMH. In contrast to our findings for conventional stock markets, analysis of the Islamic stock markets shows that the developed Islamic stock markets are comparatively more efficient than those found in the emerging markets. The overall relative efficiency analysis of conventional and Islamic stock markets demonstrates that all the Islamic stock markets except Russia and Jordan are more efficient than their conventional counterparts for the first sub-sample.

The analysis and results for the second sub-sample shows that the financial meltdown and the global economic slowdown phase around 2007/08, in fact, illustrate a higher level of efficiency in the favor of developed stock markets. Although, the developed economies were facing the problem of debt and economic slowdown, they nonetheless still occupied the top three spots in our rankings. The stock markets of BRICS economies are also found dominating the Islamic countries' stock markets. The greater efficiency of developed stock markets specifies that the adjustment of these markets to the speculative activity is higher. Owing to their emerging nature, the Islamic and BRICS countries' stock markets have weaker governance and disclosure mechanisms. Hence, they are intuitively expected to have more speculative activity. These results also indicate that the developed countries' stock markets are more advanced. Hence, they are comparatively more efficient than the emerging markets; however, the difference is not significant. In fact, a few emerging markets were found to be comparatively more efficient, which is encouraging for their financial sector development as well the economic growth of those countries.

The results for the Islamic stock markets are quite similar to the conventional ones as the developed Islamic stock markets are found to be relatively more efficient, followed by the emerging markets of BRICS. The overall comparative efficiency results of conventional and the Islamic stock markets highlight that all the Islamic stock markets except Jordan are more efficient than their conventional counterparts. This implies that the peculiar nature, shari'ah compliant laws and good governance and disclosure mechanisms make the Islamic stock markets more efficient. Further, this indicates that the Islamic stock markets' adjustment to the speculative activity is also higher when compared to their conventional counterparts.

From a policy standpoint, an efficient market is essential because it can play an important role in an economy's development via resource allocation and capital formation, as well as providing channels to distribute wealth. Since, inefficient stock markets can be detrimental to economic growth as proved by the recent financial crises (Tiwari and Kyophilavong, 2014). Therefore, the findings may also help regulators and policy makers in reducing distortions in an economy by taking informed decisions and corrective measures. Moreover, the empirical analysis has several practical implications for regional and international market participants as the investors, speculators and arbitrageurs may use their precise knowledge regarding the efficiency of the Islamic and conventional stock markets to earn higher risk-weighted returns. Finally, the study's findings may be effectively implemented to improve asset allocation and portfolio rebalancing by the investment industry.

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Figure 1: Average market capitalization/GDP

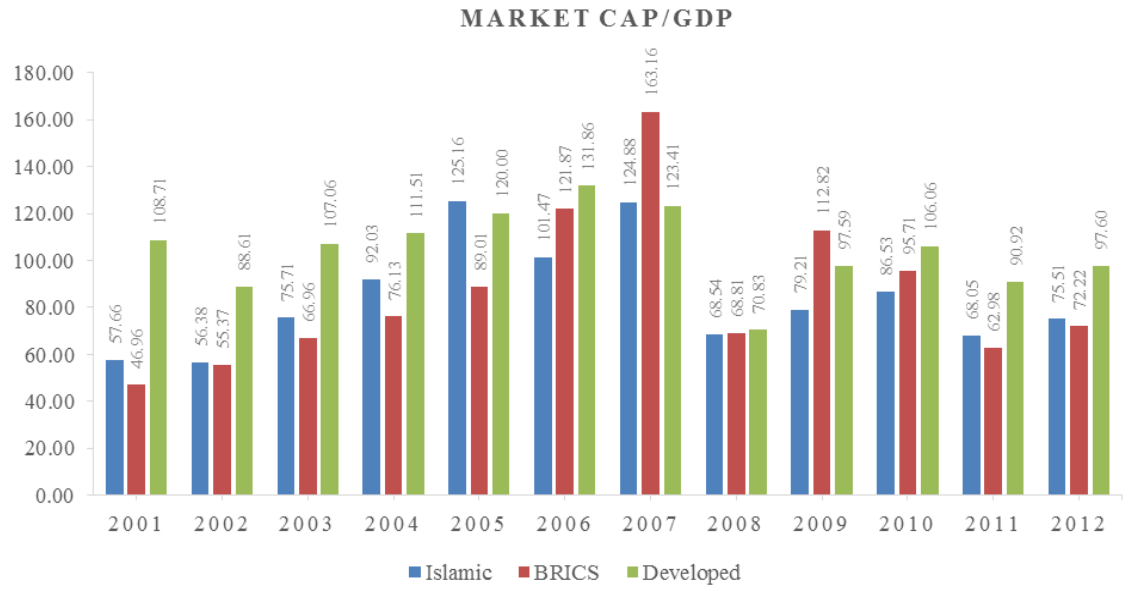


Figure 2: Average value traded/GDP

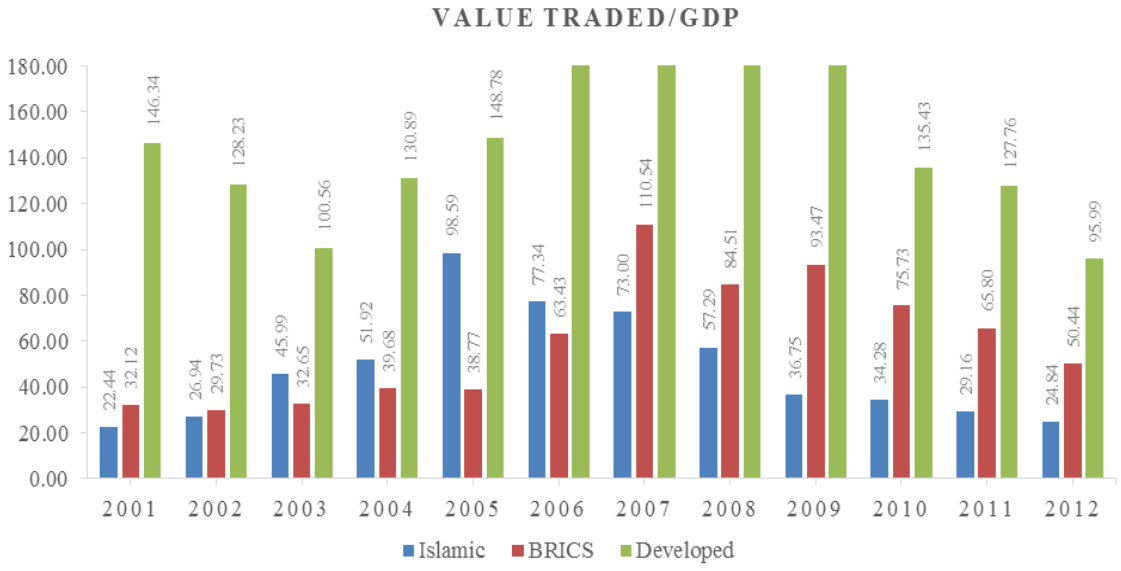
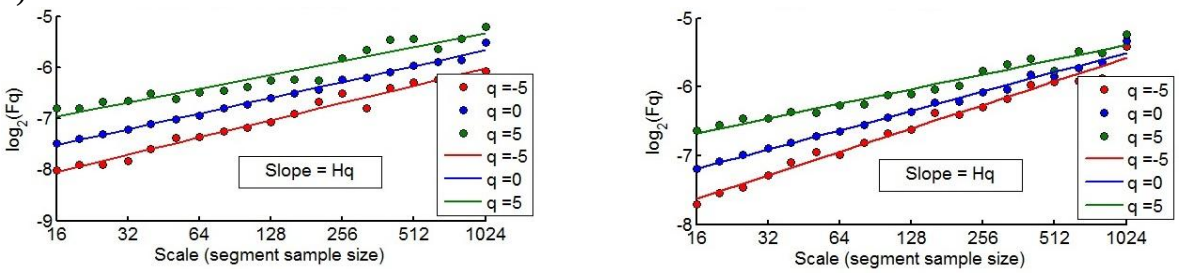


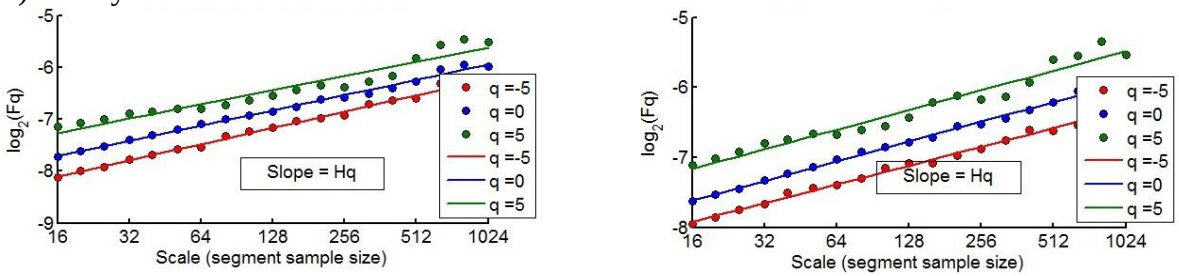
Figure 3: Scaling function Fq (q-order RMS) of conventional and Islamic counterparts

Conventional stock market **Islamic stock market**

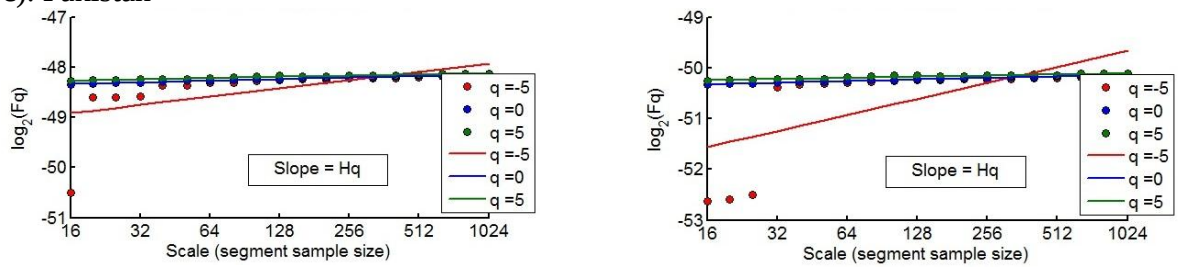
a). Jordan



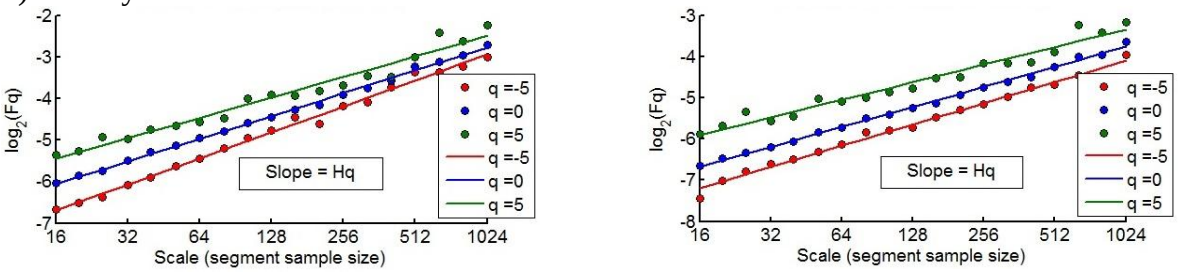
b). Malaysia



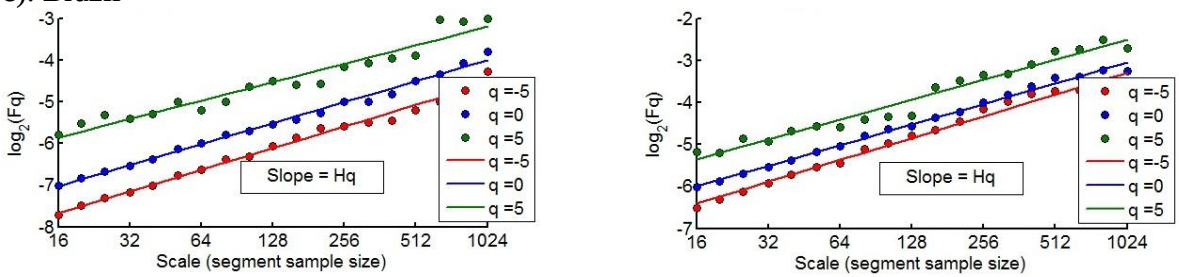
c). Pakistan



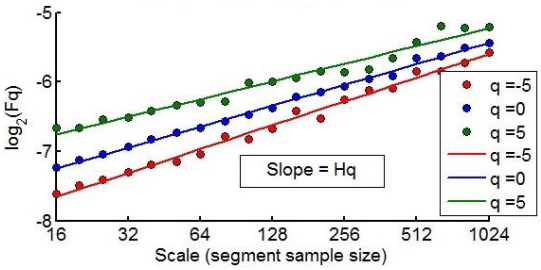
d). Turkey

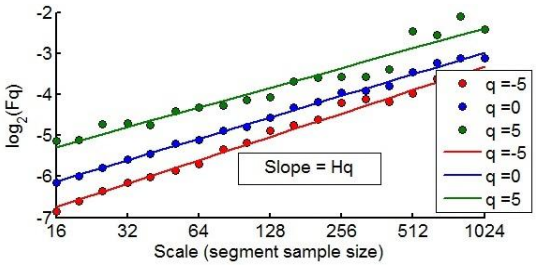


e). Brazil

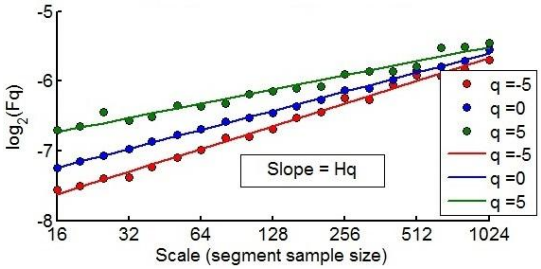


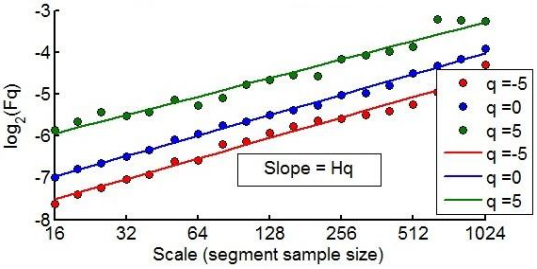
f). China



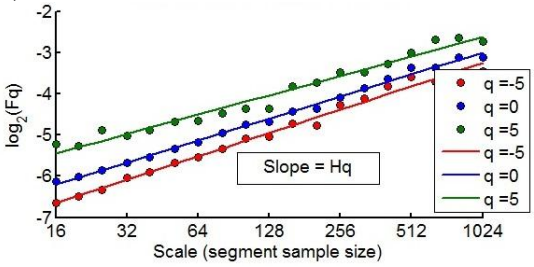


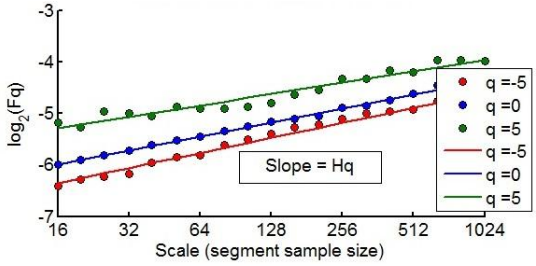
g). India



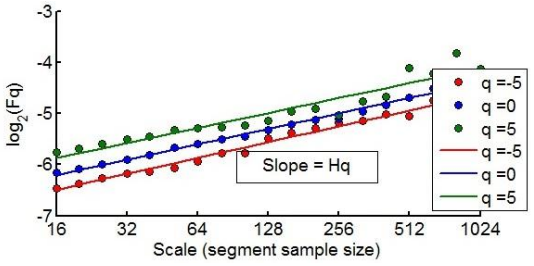


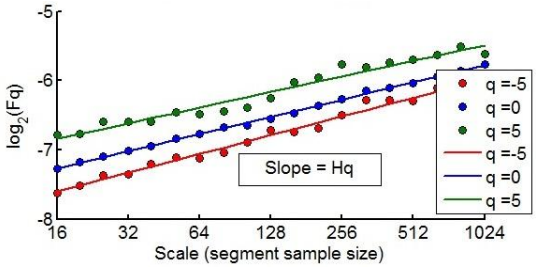
h). Russia



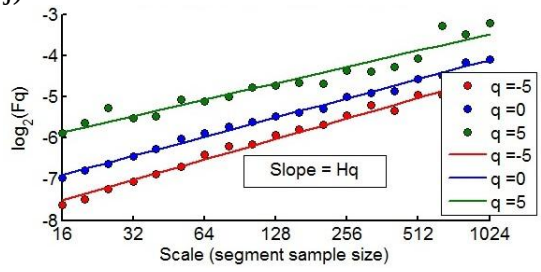


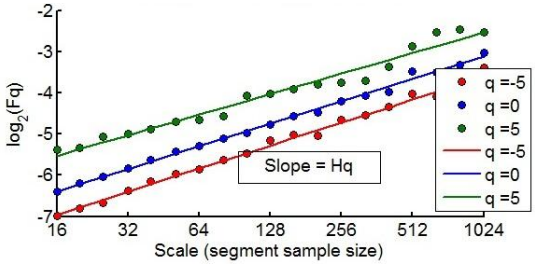
i). South Africa



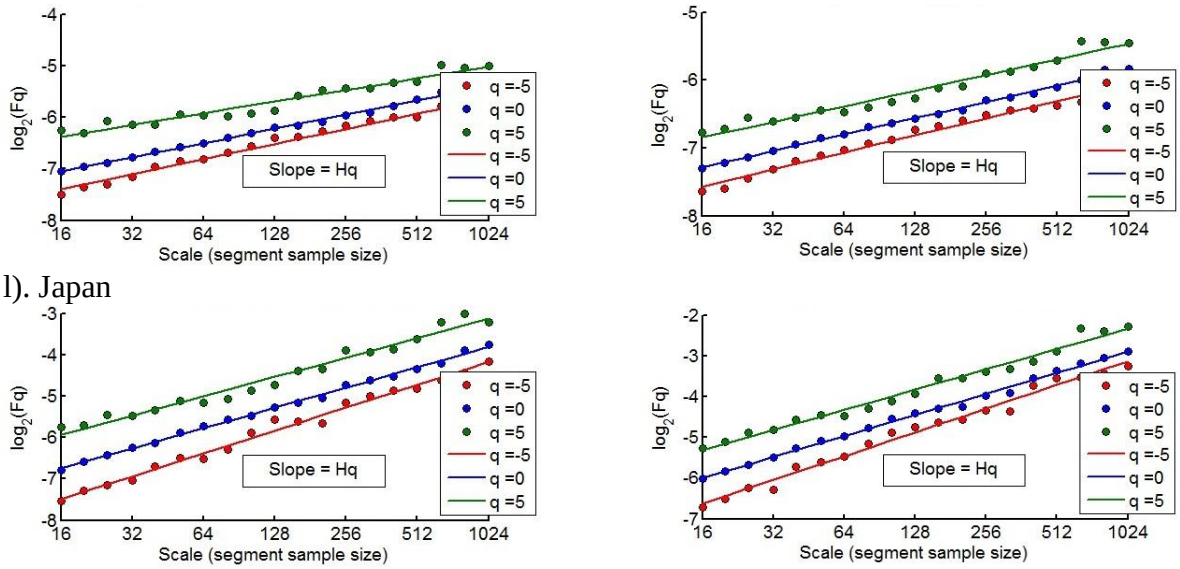


j). USA





k). UK



l). Japan

Note: These figures show the log-log plots of $F_q(s)$ (on the vertical axis) versus s (on horizontal axis) for conventional (left panel) and Islamic (right panel) counterparts of the sampled countries. The scale s on the horizontal axis indicate the days. A time series is long-range power-law multifractality correlated if the $F_q(s)$ increases with the scale (s).

Table 1: Generalized Hurst exponents for conventional and Islamic stock markets −4 to 4

Panel A: Conventional Stock Markets

	Jordan	Malaysia	Pakistan	Turkey	Brazil	China
-4	0.6736	0.6262	3.2837	0.6259	0.518	0.6847
-3	0.6382	0.5999	3.127	0.5909	0.5014	0.6535
-2	0.6236	0.5894	2.9428	0.5738	0.4963	0.6364
-1	0.6172	0.584	2.5102	0.5588	0.4966	0.6192
0	0.6181	0.586	0.6369	0.5464	0.5041	0.6027
1	0.6155	0.5916	0.597	0.5365	0.5133	0.5865
2	0.6024	0.5912	0.5747	0.5275	0.5104	0.569
3	0.5818	0.5803	0.5504	0.5175	0.4912	0.5495
4	0.5399	0.5446	0.5047	0.4936	0.4426	0.5109
	India	Russia	South Africa	USA	UK	Japan
-4	0.6477	0.5669	0.6206	0.4967	0.585	0.5525
-3	0.6041	0.5514	0.6035	0.4778	0.5578	0.5187
-2	0.5828	0.5443	0.5979	0.4696	0.5496	0.5035
-1		0.5386	0.597	0.4647	0.5474	0.493
0	0.5457	0.5344	0.6017	0.4648	0.5502	0.4897
1	0.5276	0.5306	0.6087	0.4668	0.5519	0.4924
2	0.5052	0.524	0.6106	0.4613	0.5418	0.4948
3	0.475	0.5113	0.605	0.4442	0.5151	0.4908
4	0.4057	0.4701	0.583	0.3984	0.4496	0.4677

Panel B: Islamic Stock Markets

	Jordan	Malaysia	Pakistan	Turkey	Brazil	China
-4	0.6827	0.5357	6.319	0.5149	0.5197	0.567
-3	0.6445	0.5339	6.1792	0.4956	0.5031	0.5433
-2	0.6204	0.5373	6.0183	0.4896	0.4962	0.5329
-1	0.5928	0.5464	5.5656	0.4868	0.4918	0.5253
0	0.5621	0.5631	0.6229	0.4861	0.4913	0.5226
1	0.5298	0.5828	0.5638	0.4852	0.4945	0.5238
2	0.4987	0.5924	0.5432	0.4803	0.4979	0.522
3	0.471	0.5875	0.5158	0.4681	0.4967	0.5125
4	0.4277	0.5599	0.4609	0.4274	0.4771	0.4802
	India	Russia	South Africa	USA	UK	Japan
-4	0.4901	0.582	0.5402	0.5578	0.5058	0.5828
-3	0.4792	0.5549	0.514	0.5456	0.4893	0.5489
-2	0.4776	0.5454	0.5045	0.5428	0.4828	0.5337
-1	0.4809	0.5424	0.4989	0.5434	0.4806	0.522
0	0.4897	0.5462	0.4967	0.5467	0.4851	0.5155
1	0.499	0.5499	0.4956	0.5489	0.4937	0.5142
2	0.4988	0.5403	0.4915	0.5448	0.4974	0.5147
3	0.4849	0.5115	0.4817	0.5329	0.4906	0.5126
4	0.4427	0.4431	0.4521	0.4993	0.4604	0.4977

Table 2: Ranking of stock markets for full sample (2003–2016)

Conventional Stock Markets			Islamic Stock Markets		
Rank	Country	MDM	Rank	Country	MDM
1	Brazil	0.0377	1	Brazil IS	0.0213
2	Japan	0.0424	2	UK IS	0.0227
3	Russia	0.0484	3	USA IS	0.0292
4	USA	0.0524	4	India IS	0.0336
5	Turkey	0.0661	5	Japan IS	0.0423
6	UK	0.0677	6	China IS	0.0434
7	Malaysia	0.0854	7	Turkey IS	0.0438
8	China	0.0978	8	South Africa IS	0.0441
9	South Africa	0.1018	9	Malaysia IS	0.0478
10	Jordan	0.1068	10	Russia IS	0.0694
11	India	0.1210	11	Jordan IS	0.1275
12	Pakistan	1.3942	12	Pakistan IS	2.9290

Note: IS denotes Islamic stock market.

Table 3: Ranking of Stock markets for pre-crisis sub-sample (2003–2006)

Conventional Stock Markets			**Islamic Stock Markets**		
Rank	Country	MDM	Rank	Country	MDM
1	Russia	0.0681	1	China IS	0.0693
2	Brazil	0.0886	2	USA IS	0.0721
3	South Africa	0.1026	3	Japan IS	0.0796
4	Japan	0.1029	4	UK IS	0.0883
5	India	0.1131	5	Brazil IS	0.0949
6	Turkey	0.1149	6	South Africa IS	0.1005
7	Malaysia	0.1198	7	Malaysia IS	0.1023
8	Jordan	0.1604	8	India IS	0.1099
9	China	0.1612	9	Turkey IS	0.1136
10	USA	0.1625	10	Russia IS	0.1433
11	UK	0.1735	11	Jordan IS	0.1739
12	Pakistan	0.1898	12	Pakistan IS	0.1863

Note: IS denotes Islamic stock market.

Table 4: Ranking of stock markets for GFC sub-sample (2007–2010)

Conventional Stock Markets			Islamic Stock Markets		
Rank	Country	MDM	Rank	Country	MDM
1	USA	0.0416	1	Brazil IS	0.0113
2	UK	0.0443	2	USA IS	0.0384
3	Japan	0.0530	3	Japan IS	0.0387
4	Brazil	0.0595	4	China IS	0.0391
5	China	0.0660	5	UK IS	0.0408
6	Malaysia	0.0747	6	India IS	0.0453
7	South Africa	0.0766	7	Malaysia IS	0.0487
8	Turkey	0.0837	8	South Africa IS	0.0513
9	Jordan	0.1033	9	Russia IS	0.0634
10	Russia	0.1157	10	Turkey IS	0.0737
11	India	0.1189	11	Jordan IS	0.1125
12	Pakistan	0.5192	12	Pakistan	0.1425

Note: IS denotes Islamic stock market.