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A Market Efficiency Comparison of Islamic and Non-Islamic Stock Indices

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ABSTRACT: This paper examines the martingale difference hypothesis (MDH) and the random walk hypothesis (RWH) for nine conventional and nine Islamic stock indices: Asia-Pacific, Canadian, Developed Country, Emerging, European, Global, Japanese, UK, and US. It investigates whether Islamic stock indices are more, less, or as efficient as their conventional counterparts. We test four sub-periods of bullish and bearish stock markets, together with the financial meltdown and its recovery, over the period 1997–2012. We use the Escanciano and Lobato's (2009) automatic portmanteau test (AQ) and Deo's (2000) test for the MDH. We also apply the automatic variance ratio test (AVR) developed by Choi (1999) and Kim (2009) for the RWH. Over the period from 1997 to 2012, we find that three conventional indices (Europe, Japan, and UK) are efficient, but that none of the Islamic indices are efficient in these markets. During the recent financial crisis, our results indicate slightly more efficiency for the Islamic indices than their conventional counterparts. Our study finds that overall the conventional indices are more efficient than their Islamic counterparts. Nevertheless, during periods of general downturns the Islamic indices have shown the same level of efficiency as their counterparts. Furthermore, it appears that during the last two sub-periods under study, the Islamic indices have moved towards efficiency, displaying the same level of efficiency as their counterparts.

KEY WORDS: Islamic stock indices, efficient market, random walk hypothesis, martingale difference hypothesis

JEL Classification: F31, G11, G15

Introduction

During the last two decades the world has witnessed huge growth and diversification in Islamic financial services around the globe.[1] Islamic investments must act in accordance with the principles of the *Shariah*,[2] the Islamic code governing Muslim life.[3] Islamic investments are insofar often referred to as *Shariah-compliant investments*. The Islamic financial system was established to take moral, ethical, social and religious aspects into consideration. Islamic investing is a form of ethical investing. Ethical investing gives investors the opportunity to invest in companies in a way that does not conflict with their environmental, religious, political or moral precepts.[4] Conversely, a number of ethical investments also qualify as Shariah-compliant, providing that they do not have contractual uncertainty, are not speculative in nature, and no income is derived from interest, the sales of alcohol, pork products, pornography, gambling, military equipment or weapons, etc.

Researchers and practitioners point out that the rapid dissemination and remarkable growth of Islamic financial services is due at least in part to the following factors. First, Islamic investing gained considerable interest among Muslim investors as sharp oil price increases and modernization contributed to a formidable increase in wealth in the Middle East. This wealth needs to be secured and accumulated, and Muslim investors want suitable Shariah-compliant alternatives to conventional investments. Second, Islamic investing is based on the principle of

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[1] The fastest-growing segment of the global financial industry is reportedly Islamic investments. Global Islamic financial assets are estimated to reach USD 2.0 trillion by the end of 2014 (GIFF, 2013).

[2] *Shariah* is an Arabic word meaning Islamic laws and regulations.

[3] Islamic investments are not allowed in companies whose core business involves alcohol, gambling, conventional financial services, entertainment, pork-related products, tobacco, or weapons. In addition, other company screenings are applied based on certain financial ratios. For instance, companies with unacceptable levels of debt (more than one-third of market capitalization) (Hussein & Omran, 2005) or "impure" interest income are excluded from the set of investable stocks. Finally, investments in securities that promise interest payment or investments in derivative securities are not allowed under Islamic law, such as bonds, options and futures contracts (Naughton & Naughton, 2000).

[4] See El Khamlich *et al*. (2013).

profit-and-loss sharing (PLS). Al-Zoubi and Maghyereh (2007) claimed that, in terms of risk, *PLS* has advantages over conventional finance.[5] Chapra (2008) attributed the 2008–2009 global financial crisis to inadequate market discipline resulting from insufficient profit-loss sharing modes of financing, expansion of the size of the derivatives, and "too big to fail" institutions. In recent developments involving the Madoff Ponzi scheme scandal, some have questioned whether some firms are "too big to indict". Chapra (2008) called for regulations and mechanisms leading to a "new architecture" that could prevent the occurrence of similar crises. Third, Islamic investment was encouraged by the financial instability that shook the US and Europe in 2007–2008, which resulted in the contraction of conventional capital markets. Fourth, it appears that Islamic banks may not have suffered as much as conventional banks during the 2008–2009 global crisis. Researchers have shown that no major Islamic financial institution failed during or after the global financial crisis.[6] Siddiqi (2008) identified the credit (liquidity) crunch, over-extended leverage, complexity of the financial products, and speculation and gambling (risk shifting) as the main features of the crisis. He underlined 'a moral failure' which led to 'exploitation' and 'corruption'. Indeed, recent striking examples of this are the billions of dollars paid out by some of the biggest financial institutions in the US to settle an array of lawsuits and investigations, and the Libor scandal in 2012. Finally, the tremendous growth in Shariah-compliant investments may also be tied to the fact that including Islamic mutual funds or Islamic stocks in a portfolio contributes to hedging the downside risk in adverse economic conditions due to the *PLS* system. Studies by Milly and Sultan (2012) and Alam and Rajjaque (2010)

[5] See Al-Zoubi and Maghyereh (2007) for a more detailed discussion.

[6] For further discussion, see Hussien, A. (2010). Hussien states that Islamic banks appear to be more resilient to the global economic turndown and international financial crisis than conventional banks. They tend to avoid speculative investments, such as derivatives, that many analysts believe led to the financial crisis affecting conventional banks. For many observers, Islamic finance serves as a vehicle for recovering from the international financial crisis. The Islamic banking industry may be able to strengthen its position in the international market as investors and companies seek alternate sources of financing.

showed that Islamic investing is less risky than conventional investing in periods of economic slowdown.

To cope with the fast growth of the Islamic investment sector and to meet investor demand, many conventional financial institutions (e.g. Citibank, Barclays, Morgan Stanley, Merrill Lynch and HSBC) now sell Islamic financial products and provide Islamic financial services. Many conventional and new investment houses have introduced Islamic indices in various countries worldwide. For instance, the Dow Jones Islamic World Market index rapidly gained worldwide recognition shortly after its introduction.[7] The index provides a benchmark for investors seeking Shariah-compliant stocks. After the world financial crisis of 2008, an increased number of practitioners and academicians became interested in Islamic stock indices as an investment vehicle. Moreover, researchers started to investigate the behavior and performance of Islamic indices, Islamic equity funds, and Islamic bonds. For instance, Al-Khazali *et al.* (2013) and Ho *et al*. (2013) found that Islamic stock indices outperformed conventional indices during the recent financial crisis, although Hassan and Girard (2011) and Albaity and Mudor (2012) found no significant difference in performance between Islamic and conventional indices during different crisis periods. Concerning Islamic equity funds, Hayat and Kraeussl (2011) reported that, on average, Islamic Equity Funds (IEFs) substantially underperformed both their Islamic and conventional benchmarks. Merdad *et al*. (2010) also reported that Islamic funds underperformed conventional funds overall and during bullish periods, but that they outperformed conventional funds during bearish periods and during the financial crisis. Azmat *et al*. (2013) emphasized that Islamic bonds differ in nature from conventional bonds.

Despite the development of Islamic finance, the academic literature on the subject, while increasing, has so far provided very little information on the market efficiency of Islamic stock

[7] Other Islamic indices include the FTSE, Standard & Poor's, Stoxx and Morgan Stanley's.

indices. The rapid growth of Islamic capital markets is making it increasingly necessary to better understand their market efficiency. To the best of our knowledge, only two published papers have investigated the informational efficiency of Islamic stock indices. Hassan (2002) applied serial correlation, variance ratio, and Dickey Fuller tests and found that the Dow Jones Islamic index was efficient over the period of 1996–2000. Guyot (2011) could not validate his null hypothesis that Islamic indices present better than conventional indices in terms of informational efficiency, but he reported that only the World Dow Jones Islamic Market Index exhibited informational efficiency. Using Wright tests, his results could not be generalized over the period 1999–2008.

The limited number of studies found in the literature and their inconclusive results accentuate the need to further investigate whether the application of religious or moral Islamic principles may have led investors to make sacrifices in market efficiency. This paper investigates the relative market efficiency of Islamic stock indices compared to their conventional counterparts using the martingale difference hypothesis (MDH) to test Islamic and non-Islamic stock indices.

Most efficient market hypothesis (EMH) studies on financial markets test for weak-form market efficiency using the MDH. Under this condition, current returns are the best predictor of future yields, and returns are uncorrelated with past observations. When returns follow a martingale difference sequence (MDS), markets are weak-form efficient, and one cannot expect to earn an abnormally high return from technical analysis or other strategies aimed at exploiting market inefficiencies.

Fama (1970) stated that markets are said to be efficient when asset prices fully incorporate all relevant information, and hence returns demonstrate unpredictable behavior

around their equilibrium. Furthermore, Fama (1965) pointed out that a market following a random walk is consistent with equity being appropriately priced at an equilibrium level —in other words, there is no arbitrage opportunity yielding excess over equilibrium profits. In stock prices not characterized by a random walk, the return-generating process is dominated by a temporary component and therefore future returns can be partly predicted by the historical sequence of returns. Market efficiency is an attractive feature that improves the pricing and availability of capital, invites foreign investment, and boosts domestic savings. As pointed out by Belaire-Franch and Opong (2005), Kuan and Lee (2004), and Lo and MacKinlay (1988), knowledge of the behavior of marketable assets with respect to efficiency/randomness issues is of considerable interest to regulators, traders and academicians: regulators certainly aim to improve the conditions under which markets are efficient, traders are obviously interested in exploitable inefficiencies in the market, and technical analysis is pointless when the return process is a martingale.

It is essential for Islamic stock indices to be efficient, or at least to be moving toward that goal, and it is important for investors in Islamic markets to know how efficient the stock market is. The analysis presented in this paper can contribute to helping financial analysts better assess Islamic investments. This study can also help investors and regulators better understand the probabilistic behavior of the Islamic equity markets.

In addition to the above-mentioned motivations, this paper investigates the following important features of one of the fastest-growing segments of the financial industry. First, it examines whether Islamic stock indices were more efficient than their conventional counterparts over the period 1997–2012. The paper extends the limited current literature, examining the weak-form market efficiency by testing the MDH and the random walk hypothesis (RWH) in

nine Islamic and conventional indices. Second, we use the most recent robust statistical techniques (the automatic portmanteau test or "AQ", the automatic variance ratio, and Deo's tests) to test the two hypotheses. Escanciano and Lobato's (2009) AQ is very attractive compared to the models used in previous studies because it offers higher power in simulations than other models commonly employed in empirical finance. It does not require that the order of the autocorrelation tested be specified, as the test automatically chooses this number. Its asymptotic null distribution is chi-square with one degree of freedom, so there is no need to use a bootstrap procedure to estimate the critical values, and the test is robust to the presence of conditional heteroskedasticity of unknown form. Third, to identify structural changes and the impact of the financial crisis on market efficiency, we split the study period into four sub-periods I, II, III, and IV (bullish, bearish, bullish, and the financial crisis). Thus, this paper covers a longer period of time than the previous studies that examined market efficiency for Islamic indices. Finally, our paper motivates further investigations on Islamic investing. The results of this study indicate that Islamic stock indices are less efficient in earlier sub-periods, but appear to have achieved greater efficiency over time, particularly during the recent financial crisis, when their prevalence greatly increased.

The remainder of this paper is organized as follows. Section 2 reviews the relevant literature on Islamic investing. Section 3 describes the data and methodology used in Section 4. We present our results in Section 5, and our conclusions in Section 6.

Literature Review on Islamic Investing

Research on Islamic capital markets is currently at an initial stage, and more work is needed. Unlike conventional capital markets, little attention has been paid to Islamic markets. The recent

fantastic growth of this sector now calls for comprehensive investigation by academicians. Using monthly data for the Dow Jones Islamic Market index (DJIM) from January 1996 through December 2000, Hassan (2002) examined the market efficiency and time-varying risk return relationship. He applied the serial correlation, variance ratio and Dickey Fuller tests to investigate market efficiency in the DJIM. His results showed that the DJIM returns are normally distributed and efficient. He also found that there were no anomalies in the DJIM returns, and there was a positive correlation between conditional volatility and the DJIM Equity index returns. Hakim and Rashidian (2004) explored the risk and return of the DIJM and its parallel conventional counterpart, the Wilshire 5000 index (W5000). Their findings suggest that the DIJM presents unique risk and return characteristics compared to the risk profile of W5000. Hussein (2005) examined the performance of Islamic indices by identifying the effects of industry, size and economic conditions on DJIM returns. Covering the period 1996–2003, he reported that returns on Islamic indices outperformed non-Islamic indices during the bull market sub-period, but not during the bear market sub-period. He concluded that the abnormal returns were the result of investments in small, basic materials, consumer cyclical, industrial and telecommunication firms. Hussein (2004) investigated whether the Islamic FTSE index funds out- or underperformed conventional FTSE funds. Covering the period 1996–2003 and using Sharpe, Treynor, Jensen and CAPM, he found that Islamic funds were overall on par with conventional funds when the entire period was considered, but that they outperformed conventional funds during the bullish market period and underperformed during the bearish period. Elfakhani *et al*. (2005) examined the behavior of 46 Islamic mutual funds and found that their performance did not significantly differ from conventional funds: some Shariah-compliant mutual funds outperformed their benchmarks, while others underperformed them. Hassan et al.

(2005) found that there was no adverse impact on the FTSE Global Islamic index performance resulting from the application of ethical screens. For the Islamic index and the FTSE All-World index, a comparison of the raw and risk-adjusted performance pointed to an overall similar performance for the entire period considered. It appears that the Islamic index statistically significantly outperformed during the bull market period, but that it statistically significantly underperformed the FTSE All-World index during the bear market period.

Abdullah *et al*. (2007) analyzed 65 Malaysian unit trusts (14 Islamic and 51 conventional funds) and concluded that both types of funds slightly underperformed the Kuala Lumpur Composite Index (KLCI). When taking risk into account, they found that the Islamic funds performed better than conventional funds during bear markets, while during bull markets the Islamic funds underperformed their conventional peers. Hussein and Omran (2005) compared the performance of Dow Jones Islamic indices to their conventional peers over the period 1996–2003 and found that Islamic indices showed economically and statistically significantly higher returns for the whole period as well as for the sub-period from January 1996 to March 2000; they also showed statistically significant lower returns during the sub-period from April 2000 to July 2003. Hayat and Kraeussl (2011) reported that Islamic funds outperformed the Islamic and conventional market indices during the bear market of 2002, but not during normal market conditions. Over the period 2001–2006, they found that Islamic funds possessed high systematic risk-to-return ratios and were attractive as part of a fully diversified portfolio.

The differences between Islamic and non-Islamic indices over the period of January 1999 to December 2006 were discussed by Girard and Hassan (2008), who reported that Islamic indices are "growth and small-cap"-oriented while conventional indices are relatively more "value and mid-cap"-oriented. However, they asserted that, given market size, momentum and

global factors, the differences between the two types of indices are not significant; they attributed the difference in performance to a difference in style between the two indices. Hoepner et al. (2009) examined the behavior of Islamic mutual funds and found that Islamic equity funds are particularly suitable to play a hedging function, as their investment universe is limited to low debt/equity ratio stocks. They found that Islamic funds from eight countries (mostly from Western regions) underperformed their international equity markets, Islamic funds from three other countries outperformed their respective benchmarks, and that Islamic funds from the Gulf Cooperation Council (GCC) or Malaysia did not significantly differ from their respective benchmarks. Alam and Rajjaque (2010) investigated the performance of the Islamic equity markets in the European market; their analysis and results provided statistical evidence supporting the hypothesis that Shariah-compliant equities outperformed the market during the period of general economic downturn they examined. Their results confirmed that portfolios of Shariah-compliant equities are less variable, and hence less risky, and that they exhibit higher robustness during periods of general downturn.

Researchers have also examined the difference in risk and return observed between Islamic investment vehicles and conventional ones. For instance, Al-Zoubi and Maghyereh (2007) studied the relative risk performance of the Dow Jones Islamic Index (DJII) and found that it outperformed the Dow Jones World Index (DJWI) in terms of risk. They interpreted their finding as a consequence of the profit-and-loss sharing principle of Islamic finance: banks share profits and bear losses or share both profits and losses with the firms they finance.[8] Using weekly data from the years 2000–2009, Milly and Sultan (2012) compared the performances resulting from investing in conventional stocks, Islamic stocks, and socially responsible stocks. They

[8] These two investments schemes which in Islamic finance replaces lending are known as *Mudarabah* and *Musharakah*.

found that Islamic stock portfolios generated significantly larger sharp ratios. Based on these results, they concluded that Islamic stocks appear inherently safer than conventional ones during periods of economic and financial distress. Hayat and Kraeussl (2011) examined the performance of Islamic equity funds (IEFs) and conventional equity funds over the period 2000–2009 and found that IEFs underperformed compared to their Islamic and conventional equity benchmarks. They reported that this underperformance was more pronounced during the recent financial crisis, and suggested that portfolio performance could be improved by investing in Islamic index tracking funds or Islamic exchange-traded funds rather than Islamic equity funds.

In a recent paper, Al-Khazali *et al*. (2013) used stochastic dominance (SD) analysis to compare the performance of Islamic stock indices to that of conventional stock indices. They studied nine Dow Jones Islamic indices and their Dow Jones conventional counterparts: Asia-Pacific index, Canadian index, Developed Country index, Emerging Markets index, European index, Global index, Japanese index, UK index and the US index. They found that over the periods 1996–2012 and 2001–2006 almost all conventional indices stochastically dominated Islamic indices at the second and third orders in all markets except the European market. However, the European, US and Global Islamic stock indices dominated conventional ones during the 2007–2012 period. Their results indicated that Islamic indices outperformed their conventional peers during the recent global financial crisis, suggesting that Islamic investing performs better than conventional investing during economic meltdowns. Ho *et al*. (2013) also found that Islamic indices outperformed their conventional counterparts during the crisis periods, but their findings for the non-crisis periods were inconclusive. They attributed this to the conservative nature of Shariah-compliant investments, which could motivate a specific interest in that type of investment during crisis periods.

An important feature of any market, Islamic or conventional, is its level of efficiency and how it reflects current and historical information on the market prices of its securities. Guyot (2011) examined both the market quality and price dynamics of Islamic indices during the period 1999–2008 and concluded that efficient investment allocation is not compromised by the selection of Shariah-compliant assets. However, while the World Dow Jones Islamic Market index exhibited informational efficiency, Guyot had to reject the hypothesis that Islamic indices are more informationally efficient than unrestricted indices; his results could not be generalized using the Wright test for the period 1999–2008. He pointed out that Islamic indices can contribute to the international diversification of investors' portfolios. Furthermore, he noted that Islamic indices are globally as liquid as conventional indices and that they are co-integrated with the latter. Ardiansyah and Qoyum (2011) examined the semi-strong form of efficiency for the Jakarta Islamic Index (JII) of Indonesia and found that it is not efficient.

Due to the limited number of studies available on the efficiency of Islamic stock markets, this paper expands the current literature by examining the MDH and the RWH for nine Islamic and nine conventional indices. We investigate whether Islamic stock indices are more, less, or equally efficient as their conventional counterparts.

Data

The daily prices of nine Islamic and nine conventional stock indices were obtained from *Datastream* for the period ranging from January 2, 1997 to December, 31 2012. The conventional indices considered are the Asia-Pacific, Canada, Developed Country, Emerging Markets, Europe, Global, Japan, UK and US indices. The Islamic indices studied are the Dow Jones Islamic Market Indices (DJIMI), a set of indices that includes companies which are

Shariah-compliant as assessed by an independent compliance board. The Dow Jones indices studied are organized by geographic zone.

We assess the performance of the whole sample over the period from January 2, 1997 to December 31, 2012, as well as over five bullish and bearish sub-periods. In order to determine the bullish and bearish periods, we examine the value of Dow Jones Industrial Average index during this period, which clearly exhibits five sub-periods of alternating general expansion and general contraction of the market. These five sub-periods were objectively determines by the highest and lowest points of the index. Indeed, from 1/2/1997 to 1/14/2000, the Dow Jones index increased from 6442.49 to its peak of 11722.98 on 1/14/2000, from which followed a contraction down the lowest value 7286.27 of the index on 10/9/2002. A general increase in the value of the index followed up to a highest point of 14164.53 on 10/9/2007. From there the index, eventually caught into the world crisis decreased to a low of 6547.05 on 3/9/2009. Since then the recovery has generally propelled upward the index. The four sub-periods are determined by these peaks and lows. Hence, our first sub-period is the bullish period that from 1/2/1997 to 1/14/2000, our second sub-period is the bearish period from 1/14/2000 to 10/9/2002, the third sub-period is the bullish period from 10/9/2002 to 10/9/2007, the forth sub-period is crisis period from 10/9/2007 to 3/9/2009. Our last period consists in the recovery sub-period that followed, which is hence from 3/9/2009 to 12/31/2012. The figure below presents information for the five sub-periods. Testing these periods has the advantage of allowing for the possibility of structural changes, so that the market may follow a random walk in some periods while the hypothesis may be rejected in other periods. Furthermore, we are interested to see whether conventional and Islamic stock indices behave differently during such periods.

The descriptive statistics for the returns of the 18 indices over the entire period are reported in Table 1.[9] As can be seen, the means and standard deviations vary widely across the 18 indices. For the Islamic indices, the US Islamic index has the highest mean returns, while the Japanese has the lowest over the entire period. And the developed index has the lowest standard deviation, while the Japanese has the highest. For the conventional indices, Table 1 reports that the Global index has the lowest standard, while the US index has the highest mean returns.

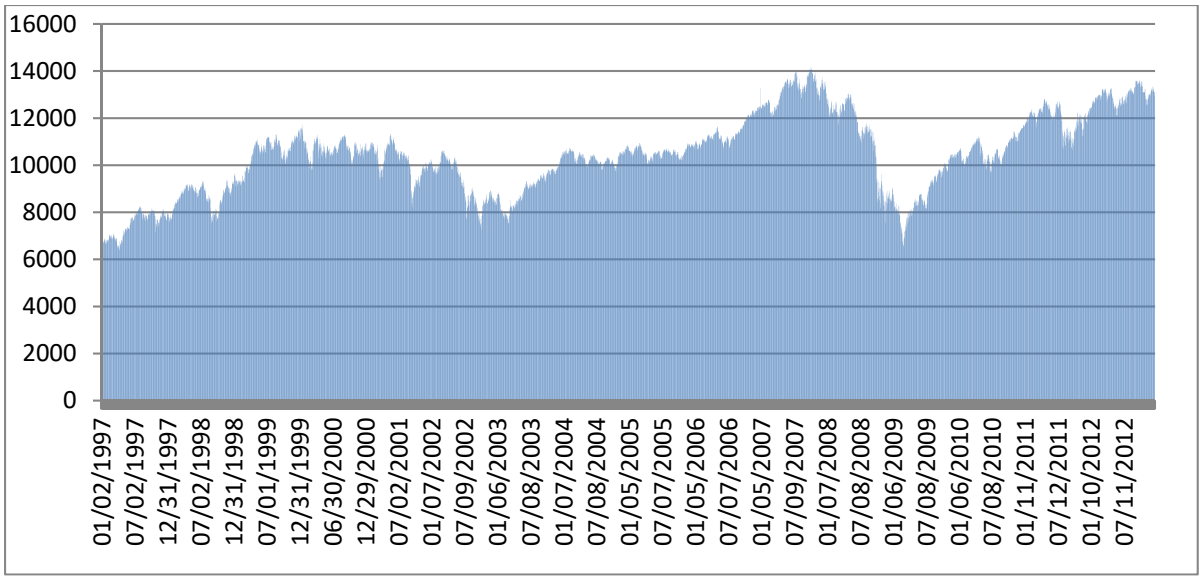
The returns series of the 18 indices exhibit significant levels of skewness and kurtosis. The skewness of return series is negative for 15 indexes and positive for the other three indices. The negative skewness implies that the stock index returns are flatter to the left compared to the normal distribution. The kurtosis reported for each index indicates that the stock return distributions have sharp peaks compared to a normal distribution. Jarque-Bera statistics confirm non normality returns in the 18 indices. On the other hand, we note that the Islamic and the non-Islamic Indices are highly correlated and the results are reported in Table 2. For instance, the correlation in the Asia-Pacific indices is 93%.

To examine the weak-form market efficiency, we calculate the return on a daily basis by taking the logarithmic difference of the price index, so that:

$$R_{i,t} = log\ (P_{i,t}) - log\ (P_{i,t-1})$$

where $R_{i,t}$ is the raw return for index i for the time t, $P_{i,t}$ refers to the price of index I at time t, and $P_{i,t-1}$ is the price on index i at time $t-1$.

[9] Due to space limitation, results of descriptive statistics for all sub-periods are not reported in the paper, but available upon request.



Dow Jones Industrial Average Index, downloaded from http://quotes.wsj.com/DJIA/index-historical-prices#

Methodology

Testing the MDH

Automatic Portmanteau Test

Let Y_t be a stationary process, and let $\overline{Y}$ be the empirical average of the sample $\{Y_t\}_{t=1}^{n}$. For $j = 0,\ldots,n-1$, set

$$\hat{\gamma}_j = \frac{1}{n-j}\sum_{t=j+1}^{n}\left(Y_t - \overline{Y}\right)\left(Y_{t-j} - \overline{Y}\right)$$

as a consistently estimated estimator of the auto-covariance of order j ,

$$\gamma_j = Cov\left(Y_t, Y_{t-j}\right).$$

The robustified portmanteau statistic (Escanciano and Lobato 2009) is

$$Q_p^* = n\sum_{j=1}^{p}\tilde{\rho}_j^2,$$

with

$$\tilde{\rho}_j^2 = \frac{\hat{\gamma}_j^2}{\hat{\tau}_j}$$

$$\hat{\tau}_j = \frac{1}{n-j}\sum_{t=j+1}^{n}\left(Y_t - \overline{Y}\right)^2\left(Y_{t-j} - \overline{Y}\right)^2.$$

Here $\hat{\tau}_j$ is the sample analogue of the jth order autocorrelation of $\left(Y_t - \mu\right)^2$. The Escanciano

and Lobato (2009) statistic AQ is defined as

$$AQ = Q_{\tilde{p}}^{*},$$

where

$$\tilde{p} = \min\{p \ : \ 1 \le p \le d, \ L_p \ge L_h, \ h = 1,2,...,d\},$$
$$L_p = Q_p^{*} - \pi(p,n,q),$$
$$\pi(p,n,q) = \begin{cases} p\log(n) & \text{if } \max_{1\le j\le d} \sqrt{n}\left|\tilde{\rho}_j\right| \le \sqrt{q\log(n)} \\ 2p & \text{otherwise} \end{cases}$$

Following Escanciano and Lobato (2009), we set $q = 2.4$ and $d = 75$. According to Escanciano and Lobato (2009), under the null hypothesis,

$$H_0 \ : \ \rho_j = 0 \text{ for } j \ge 1$$

and the assumption that Y_t is an MDH, satisfying some boundedness conditions,

$$AQ \xrightarrow{d} \chi_1^2.$$

Additionally, the test is consistent against the alternative H_1^k for $k \le d$, with

$$H_1^k \ : \ \rho_1 = 0, \rho_2 = 0,..., \rho_{k-1} = 0, \rho_k \ne 0.$$

Deo's Test Statistic

Deo's test statistic (2000), which has a martingale difference assumption with conditional heteroskedasticity, is also well suited for testing the weak form of market efficiency of Islamic indices. It is defined as

$$D_n = \sum_{j=1}^{n-1} n\tilde{\rho}_j^2 \left(\frac{1}{j\pi}\right)^2.$$

Then, under the null hypothesis of MDH and some technical conditions,

$$D_n \xrightarrow{D} \int_0^1 B_t^2 dt \ .$$

where B_t is a standard Brownian bridge on [0, 1].

Testing the RWH

Automatic Variance Ratio Test

Choi (1999) and Kim (2009) used the automatic variance ratio test to assess market efficiency. It is defined as

$$VR(k) = 1 + 2\sum_{j=1}^{n-1} m\left(\frac{j}{k}\right)\hat{\rho}_j ,$$

where

$$\hat{\rho}_j = \left(\frac{n-j}{n}\right)\frac{\hat{\gamma}_j}{\hat{\gamma}_0},$$

$$m(x) = \frac{25}{12\pi^2 x^2}\left(\frac{\sin(6\pi x/5)}{6\pi x/5} - \cos(6\pi x/5)\right).$$

From Choi (1999) we get that, under the null hypothesis of RWH and some moment assumptions,

$$\sqrt{n/k}\,(VR(k)-1)/\sqrt{2} \xrightarrow{D} N(0,1)$$

as $k(n) \to \infty, n \to \infty, n/k(n) \to \infty$. In Choi (1999) and Kim (2009), a data drive optimal choice $k(n)$ is made in order to mitigate the small sample effect. As our samples are large, we here we choose simply $k(n) = \sqrt{n}$.

Results

We present here the results of our tests which indicate whether or not in a given sub-period, a given index rejects market efficiency in the weak form. To simplify the reading, we say that an index shows efficiency, or that market efficiency is accepted, when tests fail to reject such hypothesis.

Results for MDH

The AQ Test

The values of the AQ statistical tests are reported in Tables 3–8 for the 18 indices (nine Islamic indices and the corresponding nine conventional indices). At a 10% level of significance, the results show that over the entire period, the MDH is rejected in all indices except for the European and UK Islamic and conventional indices, and the Japanese conventional index. These indices thus show efficiency in the weak form, but the remaining indices do not. Hence the tests

show that both peers provide similar results over the full period, although the conventional indices are slightly more efficient.

For the first bullish sub-period (1/2/1997 - 1/14/2000), the MDH is rejected for both conventional and Islamic Asia, Developed Country, Emerging Markets, and Global indices, while the remaining indices (Canadian, European, Japanese, UK and US) show efficiency in both peers. Interestingly, we find that both peers exhibited the same level of efficiency over this bullish period, with the same five indices in both peers showing efficiency over the first sub-period.

However, the MDH is rejected for five Islamic indices, but only for three conventional indices during the first bearish period (1/14/2000 - 10/9/2002). Overall, six conventional and four Islamic indices demonstrate efficiency during this period. The Developed Country, Emerging Markets and Global indices are not efficient in both peers, which is consistent with the findings for sub-period I. On the other hand, moving from period I to period II, we find that the UK Islamic index lost efficiency while the Asia-Pacific conventional maintained it, making the conventional indices more efficient than the Islamic ones during this period.

For the second bullish period (10/9/2002–10/9/2007), the MDH is rejected in all Islamic and conventional indices, except in the Asia-Pacific and Japanese indices and the European conventional index. It must be noted that both peers behaved similarly during the bullish periods (1/2/1997–1/14/2000 and 10/9/2002–10/9/2007); hence the tests show that both peers provide similar results over the full period, although the conventional indices show slightly more efficiency in the period from 10/9/2002 to 10/9/2007.

For the financial crisis period (10/9/2007–3/9/2009), the AQ tests give the same results in both peers. The MDH is rejected for both Islamic and conventional Japan, US, and, Emerging Markets; the remaining indices in both peers showed efficiency.

Finally, during the recovery period (3/9/2009–12/31/2012), six Islamic indices rejected the MDH (Asia, Canadian, Japanese, Developed Countries, Emerging Market, Global) and three Islamic indices accepted the MDH (European, UK, US). The conventional displayed slightly more efficiency with five indices rejecting the MDH (Canadian, US, Developed Countries, Emerging Market, Global) and four conventional indices accepting the MDH (Asia, European, Japan, UK).

Over the 6 periods tested for the 9 Islamic indices, 54 results were obtained for the AQ test, and 32 out of these 54 tests rejected the MDH. For the conventional indices, 54 tests were also performed rejecting the MDH 26 times. Thus, the conventional indices display a higher tendency towards efficiency than the Islamic ones.

Deo's Test

The results of Deo's test are again reported in Tables 3–8. For the entire period, the MDH is rejected at the 10% level for all Islamic indices and rejected for six conventional indices. None of the Islamic indices and only the conventional European, Japanese, and UK indices displayed efficiency. We note that the AQ and Deo's tests returned the same results for both peers except for the European and UK Islamic indices, where the AQ test failed to reject the MDH.

For the first bullish period (1/2/1997–1/14/2000), we find that five indices showed efficiency in both peers (Canadian, European, Japanese, UK and US). This may be a result of

high trading volume and large liquidity during this period. During this sub-period both the AQ and Deo's tests returned identical results, and are thus mutually reinforcing.

For the bearish period (1/14/2000–10/9/2002), we observed that six indices in both peers (Asia, Canadian, European, Japanese, UK and US) indicated efficiency. Apart from the efficiency gained in the conventional Asia-Pacific index, all other indices retained the level of efficiency they exhibited in the previous sub-period. Although this period was a trough cycle, it seems that the indices' efficiency was carried over from the previous period.

Interestingly, during the second bullish sub-period (10/9/2002–10/9/2007) we find that only one Islamic index (Asia-Pacific) and four conventional indices (Asia-Pacific, European, Japanese, and UK) display efficiency. This means that the bearish period (1/14/2000–10/9/2002) affected efficiency during the subsequent period, particularly the Canadian and US indices where results indicates a loss of efficiency in both peers. We observe that the Islamic indices showed far less efficiency than their conventional counterparts during this sub-period.

The next period subjected to Deo's test, the financial crisis (10/9/2007–3/9/2009), shows that efficiency of the Islamic indices greatly improved, with six of them demonstrating efficiency (Asia-Pacific, Canadian, European, UK, Developed Countries and Global). Except for the Global index, the corresponding six conventional indices showed also efficiency during the same period. Thus, during the global crisis period, and with the explosion in prevalence of this niche market, we observe that the Islamic indices showed a remarkable gain in efficiency, doing indeed slightly better than their conventional counterparts.

During the recovery period (3/9/2009–12/31/2012), four indices (Canadian, Developed Countries, Emerging Market, Global) did not show efficiency in both peers. On the other hand, the Islamic indices of Asia-Pacific and Japanese failed the test, but not their conventional

counterparts. Moreover the US Islamic index was seen efficient but not the US conventional index.

Considering all the tests performed for all 9 Islamic indices and their 9 conventional counterparts over the 6 periods under study, the Islamic indices were seen efficient 21 times compared to 27 times for the conventional ones. Thus, based on Deo's test, the conventional indices appear to have a higher tendency towards efficiency than the Islamic ones.

Results of RW (The AVR Test)

Tables 3–8 report the AVR statistics for the 18 indices studied in this paper. We see from Table 3 that the four Islamic indices (Asia-Pacific, European, UK and Emerging Markets) and the two conventional indices (Emerging Markets and Global) rejected the random walk hypothesis for the entire sample period from January 1997 to December 2012. Hence, seven conventional and five Islamic indices showed efficiency in the weak form.

During the first bullish period (1/2/1997–1/14/2000) for which the results are reported in Table 4, all tests on conventional indices indicate that a random walk is followed except for the Canadian and Emerging Market indices. Hence, seven of the nine conventional indices are efficient. On the other hand, six Islamic indices can be seen as following a random walk during that period, namely the Asia, Canadian, Japanese, US, Developed Country and Global indices, with the RWH being rejected for the remaining three indices. Thus, the AVR test points to an overall greater efficiency for the conventional indices than the Islamic indices during this period.

Table 5 displays the results for the bearish market period of 1/14/2000–10/9/2002. The results of the AVR test indicate that all Islamic indices followed a random walk except for the European, UK and Emerging Markets indices. For the conventional indices, the RWH is rejected

for the Japanese, UK and Emerging Markets indices; the RWH is accepted for the other six indices. Both conventional and Islamic indices tested efficient in six markets of the nine markets.

The results of the second bullish period (10/9/2002–10/9/2007) are detailed in Table 6. We observe efficiency in five of the nine indices tested in both peers: Asia, Canadian, Developed Countries, Emerging Market, and Global. On the other hand, the European and Japanese markets demonstrated efficiency only for the conventional indices, but the US conventional index rejected the RWH unlike its Islamic counterpart. This indicates that, in terms of our efficiency test, both peers demonstrate a similar level of efficiency.

The results for the crisis period (10/9/2007–3/9/2009) are reported in Table 7. The AVR test shows that all Islamic and conventional indices follow a random walk except for both peers of the Japanese market. Once more, the conventional and Islamic indices display a common tendency toward efficiency. All indices except one in both peers can be seen as efficient in the weak form.

Finally, Table 8 gathers the results for the AVR test for the recovery period 3/9/2009 - 12/31/2012. Again all indices displayed common efficiency with all indices accepting the RWH in both peer except the Emerging Markets index where both peers rejected the RWH.

In summary, over all the sub-period the AVR test for the nine Islamic indices and the nine conventional indices results in the RWH being rejected 14 times for the Islamic indices and 10 times for the conventional indices. Thus, based on the AVR test, we see the conventional indices having a higher tendency towards efficiency than the Islamic ones.

Combined Results by index

This study examines both the RWH and MDH to compare the efficiency in the weak form of the Islamic indices with their conventional counterparts. We examine here the results on both peers of each individual index on each sub-period, with the stand point that the efficiency hypothesis is rejected for a given index on a given sub-period if any of the tests rejects the efficiency hypothesis at 10%. Once more, to simplify the reading, we say that an index is considered efficient on some sub-period if none of the tests rejects the efficiency hypothesis.

For the Asia-Pacific region, we note that the Islamic index was seen efficient during three of the six sub-periods, namely the bearish period (1/14/2000–10/9/2002), the bullish period (10/9/2002–10/9/2007) and the crisis period (10/9/2007–3/9/2009) only. On the other hand, the conventional Asia-Pacific index not only appears efficient during the same sub-periods, but it is additionally seen efficient during the recovery sub-period (3/9/2009–12/31/2012). Note that on that period two of the three tests rejected the efficiency hypothesis for the Islamic index. Thus, overall, the conventional Asia-Pacific index showed a slightly greater tendency toward efficiency than the Islamic Asia-Pacific index.

Regarding the Canadian index, we find that both the Islamic and the conventional indices rejected the efficiency hypothesis during the full period (1/2/1997–12/31/2012), sub-period III (10/9/2002–10/9/2007) and sub-period V (3/9/2009–12/31/2012). Additionally, the Canadian conventional index rejected the efficiency hypothesis during sub-period I (1/2/1997–1/14/2000). We note, nevertheless that only one of the three tests failed to accept the efficiency hypothesis. Therefore, overall the conventional and Islamic Canadian index showed a comparable tendency towards efficiency, although the Islamic index showed a slightly greater tendency than the conventional Canadian index.

For the European indices, we observed that, remarkably, the conventional index is seen efficient during the entire period, as well as during every sub-period considered. In sharp contrast, the European Islamic index shows efficiency only during sub-period IV (10/9/2007–3/9/2009) and sub-period V (3/9/2009–12/31/2012). Hence, the conventional index appears overall far more efficient than its Islamic counterpart.

For the Japanese indices, we notice that the conventional index displayed efficiency during the entire period and all sub-periods with the exception of sub-period IV (10/9/2007–3/9/2009). On the other hand, the Islamic index failed the efficiency test on all six periods considered except sub-periods I and II. Again, overall the conventional index displayed far more efficiency than its Islamic counterpart.

For the UK indices, the conventional index was seen efficient during the entire period (1/2/1997–12/31/2012), the first bullish period (1/2/1997–1/14/2000), the crisis period (10/9/2007–3/9/2009) and the recovery period (3/9/2009–12/31/2012). On the other hand, the UK Islamic index shows efficiency only during the crisis (10/9/2007–3/9/2009) and recovery period (3/9/2009–12/31/2012), suggesting that the Islamic index, while displaying significantly less efficiency than its conventional counterpart might have improved over time.

For the US indices, both peers showed mixed but identical results in terms of efficiency: they were seen efficient during the bullish period (1/2/1997–1/14/2000), the bearish period (1/14/2000–10/9/2002) and the recovery period (3/9/2009–12/31/2012).

Interestingly, we observe that the Developed Countries indices showed very low tendency toward efficiency, rejecting it on every periods except the crisis sub-period (10/9/2007–3/9/2009). As for the Emerging Market indices, they rejected efficiency in both peers over all

periods. Analogously, the Global indices rejected efficiency in every period except for the Islamic index during the crisis sub-period (10/9/2007–3/9/2009).

Our results are summarized in Tables 9 and 10. We notice that, over the years, Islamic indices became more efficient. Indeed, during the sub-periods I, II and II, the Islamic indices were seen efficient in 30% of the tests, and they were seen efficient during sub-periods IV and V on 50% of the tests. In contrast, the conventional indices displayed 50% more efficiency than their Islamic counterparts during the sub-periods I, II and II, but the same level of efficiency during sub-periods IV and V. This may be due to the following reasons. First, it experienced a tremendous increase in size: global Islamic assets held by commercial banks are projected to reach $2.0 trillion by the end of 2014. Second, Islamic assets are more liquid than ever before, due to the increase in trading volume.[10] Third, information about Islamic products has become widely available in terms of accessibility and cost, and is now released to investors in a timely manner. Fourth, transaction costs have diminished, making investments in Islamic shares a convenient alternative to direct investments in Islamic products. Lastly, Shariah-compliant shares are held by non-Muslims, in non-Muslim countries, by individual unconcerned with Islam, as long as they are shares of companies associated with economic activities which meet the conditions to be compliant with Shariah precepts. Many conventional banks have started to tap into the niche of ethical investments to which Islamic financial products belong. This has resulted in tremendous growth in the market and yielded significant gains in maturity, in turn resulting in a sharp increase in market efficiency of Islamic indices.

Finally, another interesting observation can be made. During the bullish periods (I, III, V), the Islamic indices displayed efficiency only on 26% of the tests, but they displayed

[10] See global Islamic asset management report (2014) at http://www.zawya.com/files/islamic-reports/tr-global-islamic-asset-mgmt-report-2014.pdf

efficiency on 56% of the tests during the bearish sub-periods (II and IV). In contrast, the conventional indices displayed 39% more efficiency than their Islamic counterparts during the bullish periods, but they displayed exactly the same overall efficiency during the bearish sub-periods. This reinforces the notion that *Shariah-compliant* stocks perform better during periods of general downturn.

Summary and Conclusion

This paper examines the martingale difference hypothesis (MDH) and the random walk hypothesis (RWH) for nine conventional indices and nine Islamic stock indices: Asia-Pacific, Canadian, Developed Country, Emerging Market, European, Global, Japanese, UK and US. We investigate whether Islamic stock indices are as efficient as their conventional counterparts. For the years 1997–2012, we test four sub-periods of bullish and bearish stock markets, together with the financial meltdown and its recovery. We use Escanciano and Lobato's (2009) automatic portmanteau test (AQ) and Deo's (2000) test D_n for the MDH. We also apply the automatic variance ratio test (AVR) developed by Choi (1999) and Kim (2009) for the RWH.

The daily prices of nine Islamic and nine conventional stock indices were obtained from *Datastream*. We examine the whole sample period from 2 January 1997 to 31 December 2012, as well as five sub-periods which are defined by different trends in the market index. The five sub-periods are: the bullish period of 1/2/1997 to 1/14/2000, the bearish period of 1/14/2000 to 10/9/2002, the bullish period of 10/9/2002 to 10/9/2007, the crisis period of 10/9/2007 to 3/9/2009 and partial recovery period of 3/9/2009 to 12/31/2012. Testing these sub-periods gives the advantage of allowing for the possibility of structural changes: the market may follow a random walk in some periods, while in other periods that hypothesis may be rejected.

Furthermore, we are particularly interested to see whether conventional and Islamic stock indices behave differently during these periods.

Broken down by periods and rejecting efficiency if one or more tests fail, we see that during the entire period (1/2/1997–12/31/2012) the conventional European, Japanese, and UK indices are efficient, but none of the Islamic indices are. During the first bullish sub-period (1/2/1997–1/14/2000), four conventional indices displayed efficiency: European, Japanese, UK, and US indices. Three Islamic indices only did not reject efficiency: Canadian, Japanese and US. During the first bearish sub-period (1/14/2000–10/9/2002), the conventional Asia-Pacific, Canadian, European, Japanese and US indices are seen efficient; the Islamic indices displayed efficiency in the same markets except the European market. For the bullish period (10/9/2002–10/9/2007), our results show that weak-form efficiency was exhibited for the conventional Asia-Pacific, European and Japanese indices; on the other hand efficiency was consistent only for the Islamic Asia-Pacific index during that period. Interestingly, for the crisis sub-period (10/9/2007–3/9/2009), our tests indicated more efficiency for the Islamic indices than their conventional counterparts. Indeed, while the conventional Asia-Pacific, Canadian, European, UK and Developed Countries indices manifested efficiency, their Islamic counterparts also showed efficiency in addition to the Islamic Global index. During the recovery period (3/9/2009–12/31/2012), four conventional indices presented efficiency: Asia-Pacific, European, Japanese, and UK. During the same period three Islamic indices showed efficiency: European, UK, and US.

The conventional indices displayed an overall greater efficiency than their Islamic counterparts. Yet, over the years, Islamic indices appear to have significantly improved in efficiency, showing a level of efficiency equal to that of their conventional counterparts over the

last two periods from 10/9/2007 to 12/31/2012. Moreover, the Islamic indices appear to be overall as efficient as the conventional counterparts during the bearish sub-periods (1/14/2000–10/9/2002) and (10/9/2007–3/9/2009).

The efficiency of the stock market is very important in making investment decisions, to insure that stock prices accurately reflect all available relevant information and that their values are not distorted by exogenous artificial factors rendering investments riskier. Efficiency allows an enhanced role of the stock market in the economic development process. The findings of this study have useful implications for individual, institutional and international investors as well as policy makers. Islamic equity indices have become more prevalent than ever in recent years, and our analysis contributes to the needed understanding of this niche market, in order to enable investors to fully, accurately, and efficiently assess its behavior. Our study will help financial analysts make well-informed decisions in the process of constructing investment portfolios. It enhances investors' and regulators' understanding of the behavior of the Islamic equity markets. The results of this study contributes, motivate and may also help other researchers pursue further investigations, leading to a needed thorough understanding of the behavior and specificities of the Islamic equity markets.

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Table 1: Descriptive statistics of daily returns for Islamic and Conventional Indices (1997-2012).

Islamic Indices									
Index	Asia-Pacific	Canadian	Europe	Japan	UK	US	Developed	Emerging	Global
Mean	0.022	0.0225	0.0286	0.0123	0.0288	0.0301	0.0288	0.0269	0.0291
Sdt. Dev.	0.0134	0.01243	0.0151	0.0167	0.0152	0.0141	0.0119	0.0147	0.01279
Skewness	-0.2355	-0.2131	0.1235	-0.037	-0.095	-0.167	-0.3245	0.3663	-0.354
Kurtosis	7.6362	8.367	10.150	6.7161	9.2775	9.4578	9.6625	8.3310	9.5541
Jarque-Bera	4014.8	5672	9654.8	2463.9	7215.7	7218.7	7888.9	5530.5	7692.4
Prob.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Conventional Indices									
Index	Asia-Pacific	Canadian	Europe	Japan	UK	US	Developed	Emerging	Global
Mean	0.0011	0.00252	0.0239	-0.0012	0.0260	0.0266	0.0224	0.0233	0.0228
Sdt. Dev.	0.0114	0.0147	0.0162	0.0153	0.0135	0.0128	0.0103	0.0128	0.0102
Skewness	-0.1648	-0.1881	-0.098	0.0151	-0.147	-0.258	-0.358	-0.569	-0.376
Kurtosis	7.5443	9.4082	8.1232	7.3180	11.366	10.478	9.6897	9.2410	9.8157
Jarque-Bera	4345.7	8187	4858.1	3413.8	12522	10055	8688.6	7737.0	8789.3
Prob.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Table 2: Correlation between Islamic and Conventional Indices over the entire period (1997-2012).

Index	Asia-Pacific	Canadian	Europe	Japan	UK	US	Developed	Emerging	Global
Corre.	0.93	0.94	0.95	0.78	0.93	0.93	0.94	0.92	0.93

Table 3: MDH and RWH results over the entire period (1997–2012).

Entire Period (1997–2012)									
Islamic Indices									
	Asia-Pacific	Canadian	Europe	Japan	UK	US	Developed	Emerging	Global
AQ	8.33**	4.71**	2.50	2.78*	1.33	6.08**	19.21**	68.93**	31.08**
D_n	0.88**	0.61**	0.49**	0.47**	0.35*	0.69**	2.05**	6.79**	2.97**
AVR	2.34**	1.58	-1.94**	-0.60	-1.66*	-1.41	0.97	5.86**	1.42
Conventional Indices									
	Asia-Pacific	Canadian	Europe	Japan	UK	US	Developed	Emerging	Global
AQ	3.77*	3.83*	0.05	1.45	0.58	5.49**	33.12**	79.82**	39.49**
D_n	0.42*	0.50**	0.15	0.28	0.24	0.61**	3.21**	8.16**	4.08**
AVR	1.32	1.59	-0.01	-0.88	-1.01	-1.56	1.32	7.29**	1.77*

*Significance at 10%
**Significance at 5%

Table 4. MDH and RWH results over the sub-period I (bullish, 1/2/1997 - 1/14/2000).

Islamic Indices									
	Asia-Pacific	Canadian	Europe	Japan	UK	US	Developed	Emerging	Global
AQ	4.53**	2.59	0.61	0.43	0.20	0.07	16.50**	13.73**	17.71**
D_n	0.54**	0.30	0.20	0.14	0.14	0.07	1.74**	1.46**	1.86**
AVR	0.85	1.36	-2.05**	-0.50	-1.86*	-1.36	-0.01	3.61**	0.11
Conventional Indices									
	Asia-Pacific	Canadian	Europe	Japan	UK	US	Developed	Emerging	Global
AQ	6.11**	2.05	0.20	1.46	0.32	0.16	24.15**	55.14**	26.17**
D_n	0.68**	0.27	0.08	0.21	0.11	0.06	2.49**	3.11**	2.69**
AVR	1.08	1.97**	-0.57	-0.01	-1.33	-0.89	0.93	5.88**	1.13

*Significance at 10%
**Significance at 5%

Table 5. MDH and RWH results over the sub-period II (bearish, 1/14/2000 - 10/9/2002).

Islamic Indices									
	Asia-Pacific	Canadian	Europe	Japan	UK	US	Developed	Emerging	Global
AQ	2.58	2.03	7.17**	0.98	9.23**	0.03	15.08**	12.38**	19.61**
D_n	0.32	0.24	0.28	0.19	0.32	0.09	1.64**	1.44**	1.80**
AVR	-0.92	0.84	-2.30**	-1.34	-2.40**	-0.88	-0.05	2.19**	0.04
Conventional Indices									
	Asia-Pacific	Canadian	Europe	Japan	UK	US	Developed	Emerging	Global
AQ	0.41	1.03	0.31	0.24	0.34	0.10	24.38**	10.83**	25.74**
D_n	0.09	0.14	0.16	0.07	0.27	0.11	2.22**	1.27**	2.37**
AVR	-1.19	0.45	-0.90	-1.39	-1.77*	-0.76	0.41	3.74**	0.55

*Significance at 10%
**Significance at 5%

Table 6. MDH and RWH results over the sub-period III (bullish, 10/9/2002 - 10/9/2007).

Islamic Indices									
	Asia-Pacific	Canadian	Europe	Japan	UK	US	Developed	Emerging	Global
AQ	1.27	8.14**	3.68*	2.62	5.43**	6.94**	3.82*	22.23**	6.22**
D_n	0.22	0.89**	0.44*	0.35*	0.61**	0.72**	0.42*	2.27**	0.67**
AVR	-1.02	-0.69	-1.91*	-1.92**	-2.01**	-1.37	-0.30	0.70	-0.14
Conventional Indices									
	Asia-Pacific	Canadian	Europe	Japan	UK	US	Developed	Emerging	Global
AQ	1.40	6.69**	0.35	0.11	1.80	5.03**	17.61**	28.79**	21.67**
D_n	0.20	0.74**	0.09	0.07	0.21	0.57**	1.83**	2.93**	2.24**
AVR	-0.85	-0.04	-0.50	-1.11	-1.68*	-1.67*	-0.20	0.75	-0.06

*Significance at 10%
**Significance at 5%

Table 7. MDH and RWH results over the sub-period IV (crisis, 10/9/2007 - 3/9/2009).

Islamic Indices									
	Asia-Pacific	Canadian	Europe	Japan	UK	US	Developed	Emerging	Global
AQ	0.00	0.01	0.72	5.66**	0.66	5.40**	0.31	8.99**	0.85
D_n	0.03	0.18	0.20	0.64**	0.17	0.67**	0.16	0.94**	0.20
AVR	-0.94	-0.73	-1.46	-1.68*	-1.62	-1.42	-0.51	0.08	-0.41
Conventional Indices									
	Asia-Pacific	Canadian	Europe	Japan	UK	US	Developed	Emerging	Global
AQ	0.30	0.13	0.14	5.27**	0.28	4.62**	1.92	8.54**	2.68
D_n	0.06	0.17	0.11	0.61**	0.14	0.57**	0.31	0.88**	0.38*
AVR	-1.09	-0.81	-0.65	-1.67*	-1.55	-1.43	-0.30	0.22	-0.21

*Significance at 10%
**Significance at 5%

Table 8. MDH and RWH results over the sub-period V (recovery, 3/9/2009 - 12/31/2012).

Islamic Indices									
	Asia-Pacific	Canadian	Europe	Japan	UK	US	Developed	Emerging	Global
AQ	5.48**	6.54**	1.51	3.53*	0.30	1.12	7.15**	27.09**	14.99**
D_n	0.59**	0.71**	0.19	0.47**	0.07	0.21	0.80**	2.79**	1.59**
AVR	1.20	-1.05	-0.96	-1.40	-1.16	-1.06	-0.20	2.07**	0.26
Conventional Indices									
	Asia-Pacific	Canadian	Europe	Japan	UK	US	Developed	Emerging	Global
AQ	1.19	6.30**	0.20	1.30	0.10	2.71*	10.22**	29.46**	16.91**
D_n	0.15	0.67**	0.08	0.20	0.06	0.38*	1.11**	3.03**	1.78**
AVR	0.87	-0.49	-0.07	-1.08	-0.83	-0.87	0.63	2.58**	1.01

*Significance at 10%
**Significance at 5%

Table 9: Selected Islamic Indices

Period	Asia-Pacific	Canadian	Europe	Japan	UK	US	Developed	Emerging	Global
Full	R	R	R	R	R	R	R	R	R
I (bullish)	R	F	R	F	R	F	R	R	R
II (bearish)	F	F	R	F	R	F	R	R	R
III (bullish)	F	R	R	R	R	R	R	R	R
IV (crisis)	F	F	F	R	F	R	F	R	F
V (Recovery)	R	R	F	R	F	F	R	R	R

Note: F and R refer to fail to reject and reject weak form market efficiency in each period.

Table 10: Selected Conventional Indices

Period	Asia-Pacific	Canadian	Europe	Japan	UK	US	Developed	Emerging	Global
Full	R	R	F	F	F	R	R	R	R
I (bullish)	R	R	F	F	F	F	R	R	R
II (bearish)	F	F	F	F	R	F	R	R	R
III (bullish)	F	R	F	F	R	R	R	R	R
IV (crisis)	F	F	F	R	F	R	F	R	R
V (Recovery)	F	R	F	F	F	R	R	R	R

Note: F and R refer to fail to reject and reject weak form market efficiency in each period.