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Modeling Volatility of Islamic Stock Indexes: Empirical Evidence and Comparative Analysis

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Abstract: *This paper aims to investigate the volatility behavior of Islamic stock indexes compared to their conventional counterparts. Four major Islamic stock indexes have been the subject of our paper namely the Standard and Poor's Sharia'h index (S&P Sharia'h), the Dow Jones Islamic Market (DJIM) index, The FTSE Islamic index, The MSCI Islamic World as well as their conventional counterparts, respectively, the S&P 500, the Dow Jones Industrial Average (DJIA), the FTSE All world and the MSCI World Indexes. GARCH models (Generalized Autoregressive Conditional heteroscedastic) are used to estimate the conditional variance particularly the Exponential GARCH model due to its ability to capture the leverage effect and leptokurtosis as the main stylized facts usually observed in financial times series. GARCH models are used also with Gaussian and non-Gaussian distribution in order to take into account the thick tails of daily data distribution. The results reveal that Islamic stock indexes were significantly affected by the financial crisis but they were less volatile than their conventional counterparts. This finding confirms the relative resilience of Islamic indexes to the global financial crisis which has affected the Islamic finance as soon as the crisis has affected the real sector of the economy.*

Keywords: *Islamic finance, financial crisis, conditional variance, leverage effect, Islamic index.*

JEL Classification: *C51, C52, G15.*

INTRODUCTION

The recent financial crisis has shaken the fundamental principles of the current financial system. Several factors have been cited as the cause of the crisis. Chapra (2008) identified three factors. First, the inadequacy of market discipline in the current financial system, resulting from the low use of risk-sharing instruments. Indeed, an unbridled financial innovation has led to indiscriminate lending and

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excessive risk-taking (Mohamed Ali, 2010). Second, the staggering expansion of the size of derivatives, including credit default swaps (CDS) and the concept of "too big to fail" which tends to assure the big banks that the central bank would always come to their rescue to prevent them from going bankrupt in order to avoid systemic disturbances.

All these factors have contributed to the emergence of a financial environment characterized by unhealthy expansion in the volume of credit, excessive debt, and the unsustainable rise in asset prices. Thus, the onset of the crisis was unavoidable.

Consequently, the severity of crash and its repercussions on the global economy has led policy-makers to search for alternatives that could restore the dynamics in the global economy in recession since 2007. In the wake of the crisis, the global financial community has intensified efforts to reform the international financial architecture to ensure its stability and resilience in a more challenging environment. The challenge for the financial community was to not only undertake the necessary regulatory reform that will minimize potential risks, but to also build a new financial architecture that will promote greater efficiency in the financial intermediation process, including across borders (Zeti, 2010).

In fact, the system should provide financial services that add value to the real economy. The close link between finance and the real sector of the economy is one of the fundamental principles of Islamic finance.

The Islamic financial services industry has thus been in a relatively stronger position to weather the global financial crisis, demonstrating its robustness as a stable form of financial intermediation (Maher and Dridi, 2010). The inherent features of Islamic finance have the potential to serve as a basis to address several of the issues and challenges that have surfaced in the conventional financial system during the current crisis.

Islamic finance derives its key strength from its inherent underlying principles. Islamic financial transactions must be accompanied by an underlying productive economic activity that will generate legitimate income and wealth, thereby establishing a close link between the financial transactions and productive flows. This reduces the Islamic financial system from over exposure to risks associated with excessive leverage and imprudent risk taking. Thus, in the Islamic finance business model, financing or equity participation can only be extended to activities in the real sector that have economic values. As a result, Islamic financial assets are expected to grow in tandem with the growth of underlying economic activities (Zeti, 2010).

Born in the 70s, Islamic finance has been developed in the oil-producing countries; today it is still highly concentrated in the Persian Gulf and South East Asia. Recently, it has been exported to the United States and Europe due to the sharp increase in oil prices in recent years. Indeed, the excess liquidity from the Gulf countries flocked to the world's major financial centers, and increasing interest in this

economic system. In Europe, the UK has been a pioneer with the rapid adoption of legal and economic measures to promote the emergence of Islamic finance. As such, the London site offers services and products compatible with the spirit of Islamic finance (Fadhlaoui, 2007).

Thus, Islamic finance is becoming one of the fastest growing segments of the global financial industry. It is estimated that the size of the Islamic banking industry at the global level was close to $820 billion at end-2008 (International Monetary Fund, 2010). Several factors have contributed to the strong growth of Islamic finance, including: strong demand in many Islamic countries for *Sharia'h*-compliant products; growing demand from conventional investors and the capacity of the industry to develop a number of financial instruments that meet most of the needs of corporate and individual investors (Maher and Dridi, 2010).

We can also explain this strong growth by others factors including the liberalization of capital movement, the global integration of financial markets and structural reforms in financial systems.

Islamic finance is based on the application of classical Islamic law in the management of money: this implies the prohibition of interest, excessive risk, the exclusion of investments in arms, tobacco, casinos, pork and pornography and a major attention on social welfare (Charle *et al.*, 2012).

Moreover, the recent global crisis has renewed the focus on the relationship between Islamic banking and financial stability and, more specifically, on the resilience of the Islamic banking industry during crises (Maher and Dridi, 2010).

In addition to the activities in the banking sector, Islamic finance has extended their activities to the financial markets, namely funds management. The first Islamic index was launched on the market in 1998. This is the "Muslim social awareness index" SAMI. Since then, the main providers of conventional indices extended their range and propose a wide range of Sharia'h index to accompany the accelerated development of Islamic finance, especially the "Sharia'h Compliant" funds. Through this range of Sharia'h indexes, all geographic areas are covered as well as all sectors and all levels of capitalization.

The majority of Islamic indices are subsets of the benchmarks indexes. Their construction is the result of filtering their parent index. Islamic indices use different screening method securities to include in their selection. Thus, the Dow Jones Islamic Market Index (DJIM) reflects the prices of the 2700 companies, mostly owned by Dow Jones, but whose activities are consistent with the basics of Sharia'h.

Despite the increasing importance of Islamic finance over the past several years, empirical studies on Islamic finance are scarce. There are few empirical studies which estimated Islamic stock market volatility. In fact, the study of volatility is important to academics, policy makers, and financial market participants for several reasons. First, prediction of financial market volatility is important to economic agents because it

represents a measure of risk exposure in their investments. Second, a volatile stock market is a serious concern for policy makers because instability of the stock market creates uncertainty and thus adversely affects growth prospects. So, studying Islamic stock market volatility is a promising area for investors wishing to invest according to the guiding principles of their faith. Furthermore, our paper aims to conduct a comparative analysis between Islamic and Conventional stock indexes in order to investigate the volatility in the last decade coinciding with the subprime crisis.

Our paper will be structured as follows: section 1 expose the literature review, section 2 presents the theoretical basics, and section 3 the empirical finding before concluding.

LITERATURE SURVEY

In accordance with Islamic law (Sharia'h), Islamic financial products are based on specific types of contracts. These Sharia'h-compliant contracts support productive economic activities without betraying key Islamic principles as some conventional financial products do. Sharia'h-compliant contracts cannot create debt, cannot involve the payment of interest, and must provide for a sharing of risk and responsibility between the involved parties (Faleel, 2012).

To be valid, an Islamic contract must feature subject matter that is lawful, has value and is specific enough to avoid uncertainties. The service or asset described in the contract generally must exist when the contract is being created, must be owned by the seller (hence prohibiting short sales of stock, for example), and must be deliverable.

Here are some of the most commonly used contracts in Islamic finance:

- Contracts of partnership allow two or more parties to develop wealth by sharing both risk and return:
    - Mudaraba: One party gives money to another party, which invests it in a business or economic activity. Both parties share any profit made from the investment (based on a pre-agreed ratio), but only the investor loses money if the investment flops. The fund manager loses the value of the time and effort it dedicated to the investment. (However, the fund manager assumes financial responsibility if the loss results from its negligence.)
    - Musharaka: This contract creates a joint venture in which both parties provide investment capital, entrepreneurial skills, and labor; both share the profit and/or loss of the activity.
- Contracts of exchange are sales contracts that allow for the transfer of a commodity for another commodity, the transfer of a commodity for money, or the transfer of money for money:
    - Murabaha: In this *cost plus* contract, an Islamic financial institution sells a commodity to a buyer for its cost plus the profit margin, and both parties know the cost and the profit in advance. The buyer makes deferred payments.

  - Salam: In this *forward* contract, the buyer (or an Islamic financial institution on behalf of the buyer) pays for goods in full in advance, and the goods are delivered in the future.
  - Istisna: This second type of forward sale contract allows an Islamic financial institution to buy a project (on behalf of the buyer) that is under construction and will be completed and delivered on a future date.
- Contracts of safety and security are often used by Islamic banks; these contracts help individual and business customers keep their funds safe:
  - Wadia: A property owner gives property to another party for the purpose of safeguarding. In Islamic banks, current (checking) accounts and savings accounts are based on the wadia contract.
  - Hiwala: Debt is transferred from one debtor to another. After the debt is transferred to the second debtor, the first debtor is free from her obligation. This contract is used by Islamic financial institutions to remit money between people.
  - Kafala: A third party accepts an existing obligation and becomes responsible for fulfilling someone's liability. In conventional finance, this situation is called *surety* or *guaranty.*
  - Rahn: A property is pledged against an obligation. A customer can offer collateral or a pledge via a rahn contract in order to secure a financial liability.

Islamic finance also provides the opportunity to invest in the stock market according to the principles of Sharia'h. In fact, the Islamic financial services industry has developed a stringent set of criteria for investment, specifically to facilitate investments in the various stock markets around the world. These criteria represent part of the screening process to identify companies which business activities do not comply with a minimum Shari'ah compliant standard, thereby rendering their stocks ineligible for purchase by Shari'ah based investors. The criteria include tests at the level of a company's primary business and at the level of its financial or capital structure. In the more recent decade, such Shari'ah "screens" have been adopted by the major international index providers to establish specialised Islamic market indexes (Zeti, 2010).

Since their launch in 1998, the Islamic indexes have been the subject of some academic researches. The first works focused on the feasibility of introduction of this new class of indexes, their mode of operation, and their ethical character. Then, other empirical studies have investigated their absolute and relative performance and tried to attribute the outperformance or underperformance to various explanatory factors. Thus, the majority of studies have focused on the performance of Islamic stock indexes compared to their conventional counterpart.

Ahmad and Ibrahim (2002) conducted a comparative study between Kuala Lumpur Sharia'h Index (KLSI) and Kuala Lumpur Composite index (KLCI). They compare the risk and return performance of Kuala Lumpur Sharia'h Index (KLSI) with Kuala Lumpur Composite index (KLCI) during the period 1999 to 2002. The results reveals that KLSI underperforms during overall period and decline period but it over perform in growing period. Moreover, they find that there is no significant difference in performance of both indices during the given period.

Hakim and Rashidian (2004) analyses the risk and return of Dow Jones Islamic Stock Market Indexes (DJIM) from 1999 to 2002. They initially compare DJIM index, Wilshire 5000 stock market index, they find that return and risk of the Islamic index are less than the Wilshire 5000. The study also examines the long run and short run relationship existing among the variables using unit root test, co-integration and causality test. They find that Islamic index returns and Wilshire 5000 returns are not co-integrated.

Hussein (2004) compares the performance of ethical investment with their unscreened benchmarks. The study empirically tests whether returns of FTSE Global Islamic Index are significantly different from their index counterpart (FTSE All-World Index). The results show that the 215 application of ethical screening does not have an adverse effect on the FTSE Global Islamic Index performance.

Hussein (2005) tests whether monthly returns of Financial time stock Exchange (FTSE) Global Islamic index and Dow Jones Islamic Market Index are significantly different from their common index for the period January 1996 to December 2004. In short run period, Islamic indexes over perform statistically during whole period and second bull market period. In long run, Islamic indexes over perform during entire period and second bull market period. Finally, the study finds that there is a similar performance between indexes.

Concerning studies about stock market volatility, Yusuf and Majid (2007) attempt to explore the extent to which the conditional volatilities of both conventional and Islamic stock markets in Malaysia are related to the conditional volatility of monetary policy variables. Generalized Autoregressive Conditional Heteroskedasticity GARCH-M, GARCH (1,1) models and Vector Autoregressive (VAR) analysis are used for the monthly data during the period starting from January 1992 to December 2000. The results show that interest rate volatility affects the conventional stock market volatility but not the Islamic stock market volatility. This highlights the tenet of Islamic principles that the interest rate is not a significant variable in explaining stock market volatility. The results provide further support that stabilizing interest rate would have insignificant impact on the volatility of the Islamic stock markets.

Chiadmi and Ghaiti (2012) analyzed the volatility behavior of S&P Sharia'h index and its counterpart S&P 500 using ARCH models in the period from December 29th 2006 to March 09th 2011. The results reveal that volatility persistence of both stock indexes was very significant but S&P Sharia'h index was less volatile than the

conventional index. This result is very important indicating that Islamic stock indexes are more resilient than conventional indexes especially on the crisis period. Nevertheless, the study presents some limitations, particularly it has been the object of studying a single Islamic stock index and has not taken into account some stylized facts of financial times series namely the leptokurticity and the leverage effect captured by the Exponential GARCH model. So, our paper aims to extend the previous study by investigating other Islamic stock indexes and using asymmetric GARCH models with normal and non-normal distribution of residuals.

ECONOMETRIC FRAMEWORK

Empirical studies have shown that linear models are usually unable to explain the relevant features of financial data. This disability can be explained by four major reasons. First, financial relationships may be nonlinear. Second, financial asset returns may have distributions that present fat tails and excess peakedness at the mean. Third, the volatility in financial markets tends to appear in clusters. Fourthly, the volatility may rise more following a large price fall than following a price rise of the same magnitude.

Campbell, Lo and Mac Kinlay (1997) defined a nonlinear relationship function that relates the current value to the current and past values of the error. The relationship is given as follow:

$$y_t = g(u_{t-1}, u_{t-2}, \cdots) + u_t \, \sigma^2 (u_{t-1}, u_{t-2}, \cdots. \quad (1)$$

Where u_t is independent and identically distributed error term, $g(\bullet)$ and $\sigma(\bullet)^2$ are non-linear. Campbell, Lo and Mac Kinlay suggested a classification for process y_t. It may be linear if both $g(\bullet)$ and $\sigma(\bullet)^2$ are linear (e.g. ARMA models). If $g(\bullet)$ is no linear, the process is characterized as nonlinear in mean (e.g. GARCH models), whereas it is characterized as nonlinear in variance when $\sigma(\bullet)^2$ is nonlinear (e.g. bicorrelations models).

Consequently, conditional heteroskedastic models are the basic econometric tools used to estimate and forecast asset returns volatility. In this chapter we review succinctly the different ARCH models used in this paper.

ARCH AND GARCH MODELS

Traditional time series techniques such as ARIMA models assume generally that the error term ε_t is white noise; that is, with a zero mean and a constant variance. However, high frequencies data are associated with heteroscedasticity, that is, the variance of error term change over time. In his analysis of UK inflation, Engle (1982) observed that forecast errors appeared into clusters, that is, large forecast errors tend to follow large forecast errors and small forecast errors to follow small forecast errors. He suggested the first form of heteroscedasticity in which the variance of the forecast error depends on the size of the previous disturbance.

Alternatively to usual time-series techniques, Engle (1982) suggested the autoregressive, conditionally heteroscedastic, or ARCH model. The Engle's model and its derivatives are widely spread in modeling financial and economic time series. Coulson and Robins (1985) used ARCH model to study the volatility of inflation. Engle, Hendry, and Trumble (1985) used ARCH specification to model the term structure of interest rates. Engle, Lilien, and Robins (1987) prove the power of ARCH model in forecasting the volatility of stock market returns. Domowitz and Hakkio (1985) and Bollerslev and Ghysels (1996) used also ARCH model for modeling the behavior of foreign exchange markets.

In ARCH model architecture, the conditional variance, denoted by σ_t^2, depends on the information available at time *t*–1. It can represented as a linear function of a constant (which is long term mean of the variance) and the square residual return, denoted by ε_t, observed at the preceding period *t*–1.

$$\begin{cases} Mean\,equation: & r_t = \mu + \varepsilon_t \\ Variance\,equation: \sigma_t^2 = Var(\varepsilon_t \left| [\varepsilon_{t-1}, \varepsilon_{t-2}, ...] \right.) = \omega + \alpha_1 \varepsilon_{t-1}^2 + ... + \alpha_p \varepsilon_{t-q}^2 \end{cases} \quad (2)$$

Where the residual return is defined by: $\varepsilon_t = \sigma_t z_t$ and z_t is a white noise.

The conditional variance σ_t^2 should be strictly positive at any point of time. To ensure that fact, all coefficients would be required to be non-negative: $\alpha_i > 0 \, \forall i = 0,1,2,...,q$, (Brooks, 2008).

In practice, researchers usually encounter some difficulties. First, there is no clear approach that leads to determinate the value of *q*. Second, the value of q might be very large. Third, the non-negativity constraints might be violated.

To overcome some of these difficulties, Bollerslev (1986) and Taylor (1986) has suggested generalizing the ARCH modeling the direction of the ARMA model. The model is known as the Generalized Auto-Regressive Conditional Heteroscedastic model (GARCH model). This model allows the conditional variance σ_t^2 to be dependent on its own lags. The specification of GARCH model is as follows:

$$\begin{cases} Mean\,equation: & r_t = \mu + \varepsilon_t \\ Variance\,equation: \sigma_t^2 = Var(\varepsilon_t \left| [\varepsilon_{t-1}, ...; \sigma_{t-1}, ...] \right.) = \omega + \sum_{i=1}^{q} \alpha_i \varepsilon_{t-i}^2 + \sum_{j=1}^{p} \beta_j \sigma_{t-j}^2 \end{cases}$$

Where *p* is the number of lagged σ_t^2 terms and q is the number of lagged ε_t^2 terms. All parameters $\omega, \alpha_i \, \forall i = 1,2,...,q$ and $\beta_j \, \forall j = 1,2,...,p$ should be positive to ensure the non-negativity of the conditional variance.

Although the standard GARCH model can capture several important phenomena in the financial time series, however, it is unable to capture other volatility properties such as leverage effect. For example, the model assumes that the effect of different shocks on volatility depend only on the size regardless of its sign. As shown in Eq. 2, the model depends on summation of square of shocks. It is well known that volatility is higher after negative shocks than after positive shocks of the same magnitude (Black, 1976) , in other terms, bad news increases volatility more than good news. This has led to the use of non-linear distribution to take into account that type of stylized fact. Such non-linear models are asymmetric GARCH models, for example, EGARCH model.

EGARCH MODEL

The exponential GARCH model (EGARCH) has been introduced by Nelson (1991). Contrary to GARCH model, this model can deal with the leverage effect. The specification of EGARCH (p, q) is given as follows:

$$Ln(\sigma_t^2) = \omega + \sum_{j=1}^{p} \beta_j Ln(\sigma_{t-j}^2) + \sum_{i=1}^{q} \left[\alpha_i \left\{ \left| \frac{\varepsilon_{t-i}}{\sigma_{t-i}} \right| - \sqrt{\frac{\pi}{2}} \right\} \right] + \sum_{i=1}^{q} \left[\gamma_i \frac{\varepsilon_{t-i}}{\sigma_{t-i}} \right]$$

In the EGARCH model, the logarithm of the variance is modeled. Therefore, there is no need to impose the non-negativity constraints on the model parameters α, β and γ. The parameters γ measure the asymmetry or the leverage effect. The EGARCH model allows then testing the asymmetry. If $\gamma = 0$ then the model is symmetric and it can reduce to symmetric GARCH model. Notice that when ε_{t-i} is positive, the total effect of ε_{t-i} is $(\alpha_i - \gamma_i)|\varepsilon_{t-i}|$; whereas the total effect ε_{t-i} of is $(\alpha_i - \gamma_i)|\varepsilon_{t-i}|$ if ε_{t-i} is negative, (Roman Kozhan, 2009). Therefore, the volatility generated by positive shocks should be less than that generated by negative shocks when $\gamma \prec 0$. In contrast, if $\gamma \succ 0$ then positive innovations are more destabilizing than negative innovations.

DENSITIES

The GARCH models are estimated using a maximum likelihood (ML) approach. The logic of ML is to interpret the density as a function of the parameters set, conditional on a set of sample outcomes. This function is called the likelihood function.

As already noted in section 2, financial time-series often exhibits non-normality patterns, i.e. excess kurtosis and skewness. Bollerslev and Wooldridge (1992) propose a Quasi Maximum Likelihood method (hereafter QML) that is robust to departure from normality. Indeed Weiss (1986) and Bollerslev and Wooldridge (1992) show that under the normality assumption, the QML estimator is consistent if the conditional mean and the conditional variance are correctly specified. This estimator is, however, inefficient with the degree of inefficiency increasing with the degree of departure from normality (Engle and Gonz´alez-Rivera, 1991).

Since it may be expected that excess kurtosis and skewness displayed by the residuals of Conditional heteroscedasticity models will be reduced when a more appropriate distribution is used, we consider three distributions in this study: the Normal, the Student-t and the generalized error distribution justified by excess kurtosis.

GAUSSIAN DISTRIBUTION

The Normal distribution is by far the most widely used distribution when estimating and forecasting GARCH models. If we express the mean equation as in equation (1) and the log-likelihood function of the standard normal distribution is given by

$$L_T = -\frac{1}{2}\sum_{t=1}^{T}[\ln(2\pi) + \ln\left(\sigma_t^2\right) + z_t^2]$$

STUDENT'S DISTRIBUTION

Known fat tail in financial time series, it may be more appropriate to use a distribution which has fatter tail than the normal distribution. Bollerslev (1987) suggested fitting GARCH model using student's distribution for the standardized error to better capture the observed fat tails in the return series.

For a Student-*t* distribution, the log-likelihood is

$$L_T = \sum_{t=1}^{T}\ln\left[\Gamma\left(\frac{v+1}{2}\right)\right] - \ln\left[\Gamma\left(\frac{v}{2}\right)\right] - 0.5\ln[\pi(v-2)] - 0.5\sum_{t=1}^{T}\left[\ln\sigma_t^2 + (1+v)\ln\left(1+\frac{z_t^2}{v-2}\right)\right]$$

Where v is the degrees of freedom ....., $2 < v \leq \infty$ and $\Gamma(\cdot)$ is the gamma function. When $v \to \infty$ we have the Normal distribution, so that the lower v the fatter the tails.

GENERALIZED ERROR DISTRIBUTION

The log-likelihood function of the Generalized Error distribution is given by

$$L_{GED} = \Sigma_{t=1}^{T}\left[\ln\left(\frac{v}{\lambda_v} - 0.5\left|\frac{z_v}{\lambda_v}\right|^v\right) - (1+v^{-1})\ln(2) - \ln\Gamma\left(\frac{1}{v}\right) - 0.5\ln\sigma_t^2\right] \text{ Where } \lambda_v = \sqrt{\frac{\Gamma\left(\frac{1}{v}2^{\frac{-2}{v}}\right)}{\Gamma\left(\frac{3}{v}\right)}}$$

To capture the non-normal density function, the generalized error distribution was used. It's a powerful alternative in cases where the assumption of conditional normality cannot be maintained. It can assume a Normal distribution, a leptokurtic distribution (fat tails) or even a palitykurtic distribution (thin tails).

DATA SET AND EMPIRICAL FINDING

Islamic Stock Indexes: Description and Screening Process

One of the aspects of Islamic finance innovations was the launch of Sharia'hh-compliant indices, which is a part of faith-based or morally responsible investments (Ghoul and Karam, 2007). Their principles are similar to that of social indices in terms of screening, with both of them having supervisory boards, which provide advice on eligibility of companies. In order to meet the growing demand for ethical products and services, Sharia'hh-compliant indices were introduced by globally reliable index providers including Dow Jones, Financial Times Stock Exchange (*FTSE*), Standard & Poor's, Stoxx and Morgan Stanley Capital International (MSCI).

Islamic indexes were launched for the first time in the late nineties, beginning in April 1998 with the DMI 150 index (Dar al Mal al-Islami) launched jointly by two private banks (Faisal Finance and Bank Vontobel) in order to track the performance of the 150 largest global publicly-traded companies. Later, another index was created in November of the same year, called the SAMI (Socially Aware Muslim Index) which measured the performance of 500 Sharia'hh-compliant companies. Following this, several financial markets launched their own Islamic indices as a new alternative for investors seeking investment opportunities without compromising their beliefs.

Thus, Dow Jones created the Dow Jones Islamic Market Index (DJIMI) in February 1999 and the FTSE Group launched the Global Islamic Index Series (GIIS) at the London Stock Exchange in October 1999. Index provider Standard and Poor's created the Global Benchmark Sharia'hh indices in December 2006 and Morgan Stanley Barra launched its global family of Islamic indices in March 2007. In February 2011, Stoxx Limited introduced the first set of Sharia'hh-compliant indices for Europe and the Euro zone to measure the performance of Sharia'hh-compliant companies selected from the Stoxx Europe 600 index.

Most Sharia'hh scholars agree that buying and selling corporate stocks is lawful under Islamic legislation since stocks and shares represent real assets and dividends are not debt-based revenues. However, it is not permissible to hold preferred stocks that give their owner priority claims to the company's assets (El-Gamal 2006).

In many resolutions and recommendations related to purchasing stocks, the OIC (Organization of Islamic Conference) ruled that stocks could be characterized into three categories, according to the lines of business and the practices of their issuer:

(i) Companies whose main business and products are unlawful in Sharia'hh (pork-related products, alcohol, conventional banks and insurance companies, etc.). The stocks of these companies are unanimously deemed to be prohibited to own, to purchase or to sell.

(ii) Stocks of companies whose activities are lawful and that respect the rules of Sharia'hh (Islamic banks and insurance companies, etc.). Trading the stocks of these firms is permissible under the stipulations of Sharia'hh.

(iii) Companies whose primary activities are permissible but which are involved in unlawful transactions (depositing money in banks for interest, contracting interest-based loans, etc.). This category could not gain unanimous support from Sharia'hh scholars.

Following the above conditions strictly, the market would be left with a small universe of Sharia'hh compliant stocks, which may not be sufficient for diversification and consequently, risk would be increased. Some Islamic Financial Institutions, in order to mitigate this problem, may be in favor of minor relaxing of the above conditions by inclusion of little interest related activities in their investment portfolios (El-Gamal 2006). Khan (2010) argues that even if ethical investors try to avoid interest, this is not possible in most situations. Some opinions were strict but others argue for this category to be made an exception until there are a reasonable number of companies from the second category.

All Islamic indices follow a common stock selection process which is called stock screening.

Due to the prohibition of some unlawful sectors, Sharia'hh compliance criteria used by the providers of Islamic indices take the form of negative screens. While basic prohibitions and Sharia'hh rules are strictly maintained in the screening process, indices may differ in some screening criteria. The benchmarks from which Islamic indices are selected are well-recognized conventional indices. In practice, Sharia'hh scholars and regulators have developed qualitative and quantitative screens to filter out the stocks and to assess their compliance with Islamic principles. So to be included in the Islamic index, companies must have a lawful activity according to the Sharia'hh guidelines and must respect some financial and extra-financial criteria. The independent Sharia'hh boards carry out a two-step screening process regarding the scope of activities of firms and their financial ratios.

For example, The DJIM approach takes place on several levels. The first level examines the debt ratios of the company: The ratio: debt / market capitalization was set by the Sharia'h Board of Dow Jones less than 33%. Then, a screening is established by minimizing the level of interest income unusable; Haram's share of income must be purified via a charitable donation. In terms of liquidity, many Muslim scholars consider it permissible for Islamic investors to buy shares of a company whose debts do not exceed 45% percent of total assets. The DJIM screening also requires that an Islamic investor may not purchase securities with a predetermined rate of return and a guaranteed capital, and he cannot buy the shares of companies whose main activity is illegal. In contrast, the Sharia'h Board index recommends the inclusion of companies with pro-environmental policies, or companies which provide humanitarian services.

Despite the unavailability of very recent data due to technical reasons, our sample covers the period before and after the financial crisis. We will study four major Islamic stock indexes with their conventional counterparts. The stock indexes are:

- The DJIM index: Launched in February 1999, the Dow Jones Islamic Market Index (Dow Jones 2010) reflects the evolution of societies from 66 countries around the world that meet the criteria of Islamic finance. The DJIMI family includes more than 90 indicators divided into different geographical areas, sectors and company size.
- The FTSE All Sharia'hh: The FTSE Sharia'h All-World Index is the result of a joint initiative between FTSE and Yasaar to create a Sharia'h compliant index family. Yasaar is responsible for reviewing the Sharia'h compliance of existing and prospective constituents of the FTSE Sharia'h All-World Index, which is made up of the large and mid-capitalization stocks from the FTSE Sharia'h Global Equity Index Series. The FTSE Sharia'h Index covers all regions across both developed and emerging markets, to create a comprehensive Sharia'h indexing solution.
- The S&P Sharia'h index: The Standard & Poor's launched in 2006, the Islamic version of its benchmark S&P 500.
- The MSCI Islamic: Launched in March 2007, the family of Islamic indices Morgan Stanley Capital International provides a wide geographical coverage.

EMPIRICAL FINDING

The data consist of 1053 daily observations of S&P Sharia'h index and its conventional counterpart from the period December 29th 2006 to March 09th 2011, 3083 daily observations of the DJIM index and its conventional counterpart from the period December 31th 1998 to March 09th 2011, 877 daily observations of the FTSE All Sharia'h and its conventional counterparts from October 26 2007 to March 09th 2011, and 831 daily observations the MSCI Islamic World and its conventional counterparts from October 26 2007 to March 09th 2011.

The comparison of the Standard and Poor's 500 Sharia'h following developments about 216 U.S. companies Sharia'h compliant with its conventional benchmark Standard & Poor's 500 is made from January 2007.

The analysis of the figures above shows that the Islamic stock index moves in the same direction as its conventional counterpart (Fig 1, 3). In terms of evolution, we can identify three main phases. The first phase is characterized by a lull, it is spread over the first year, and we see a stagnation of both indexes. From December 2007, both indexes have entered a phase of decline that lasted until the first quarter of 2009, during which both Islamic and conventional indices declined respectively by -30.82% and -39.06%. March 2009 marks the beginning of the third phase up to regain their pre-crisis level in March 2011.

Figure 1: Daily Closing prices of S&P Sharia'h Index

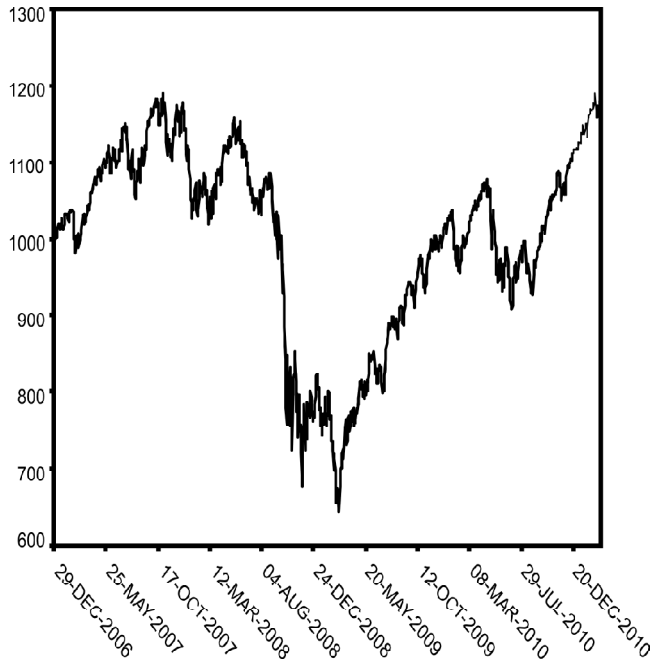


Figure 2: Daily Returns of S&P Sharia'h Index

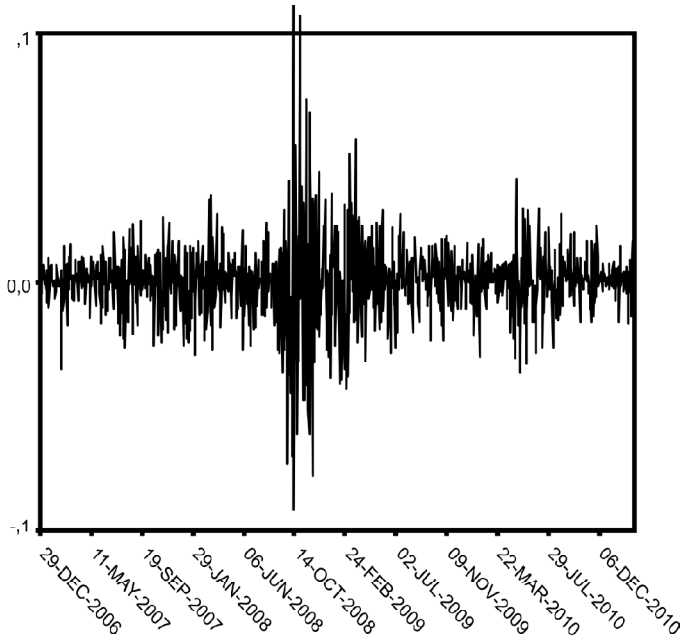


Figure 3: Daily Closing Prices of S&P 500 index

Figure 4: Daily Returns of S&P 500 Index

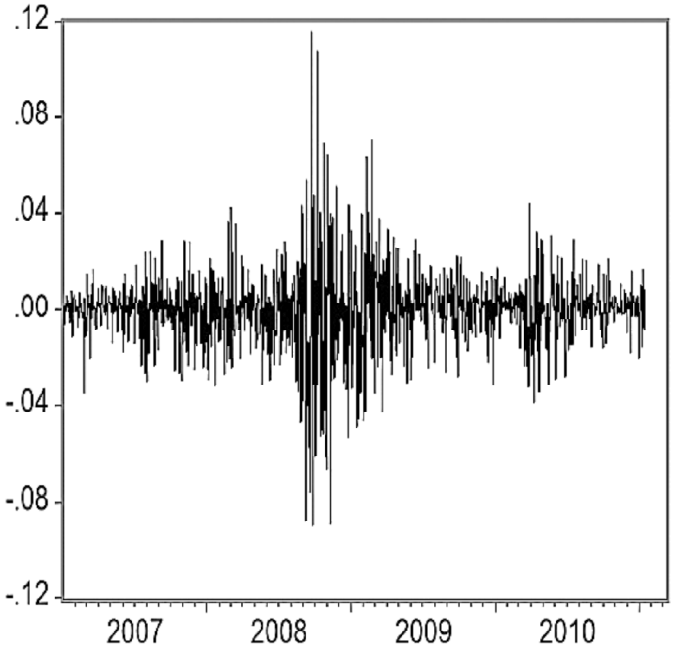


Figure 5: Daily Closing Prices of DJIM Index

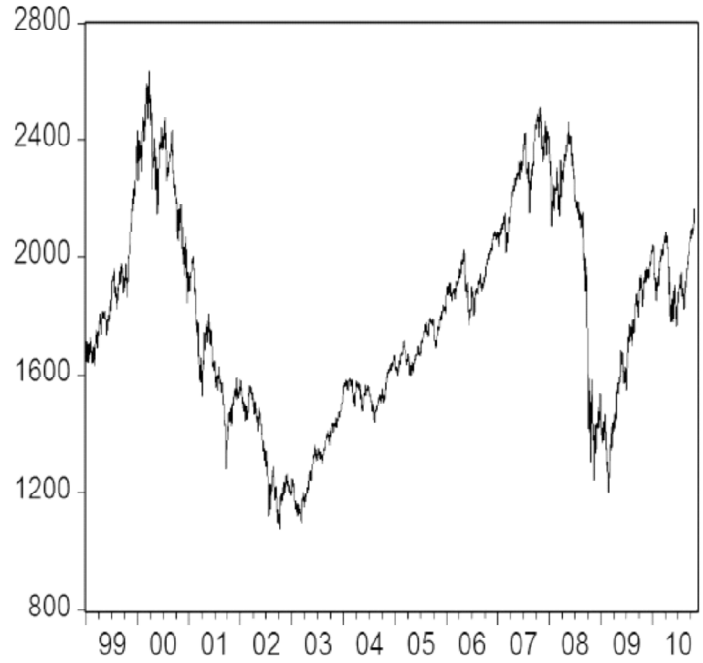


Figure 6: Daily Returns of DJIM Index

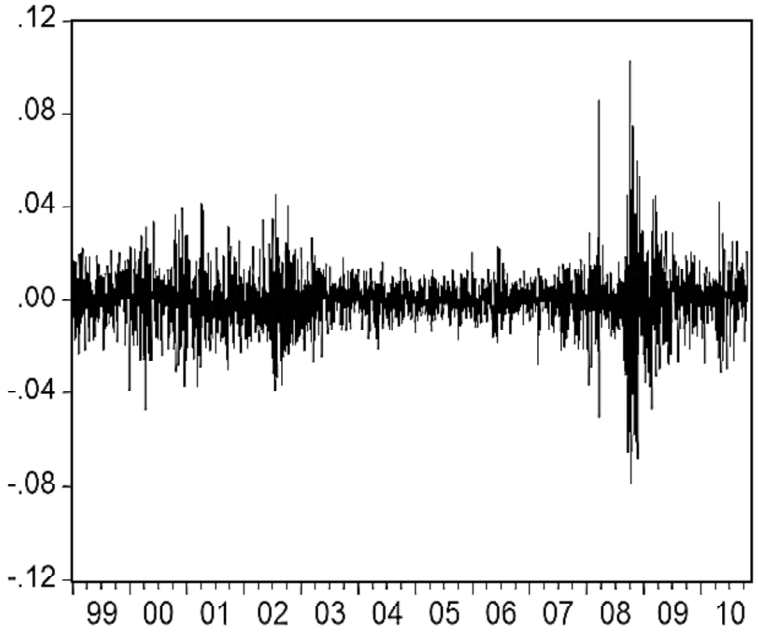


Figure 7: Daily Closing Prices of DJIA Index

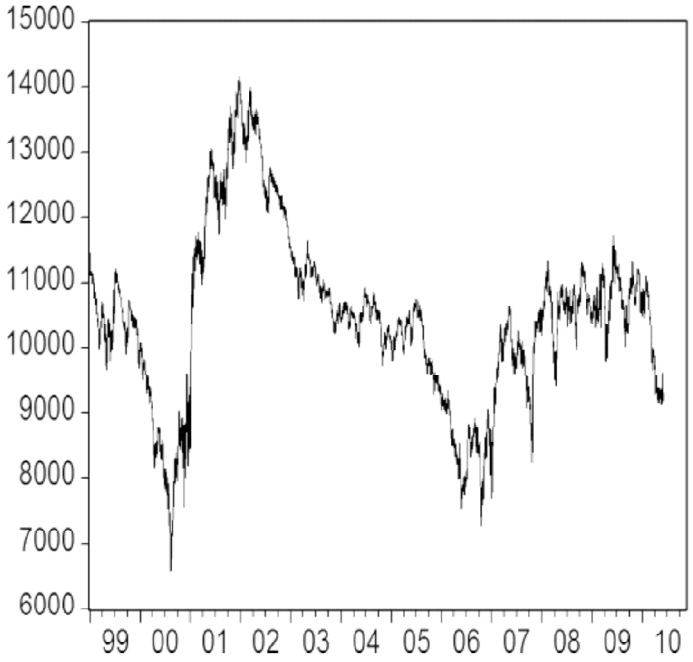
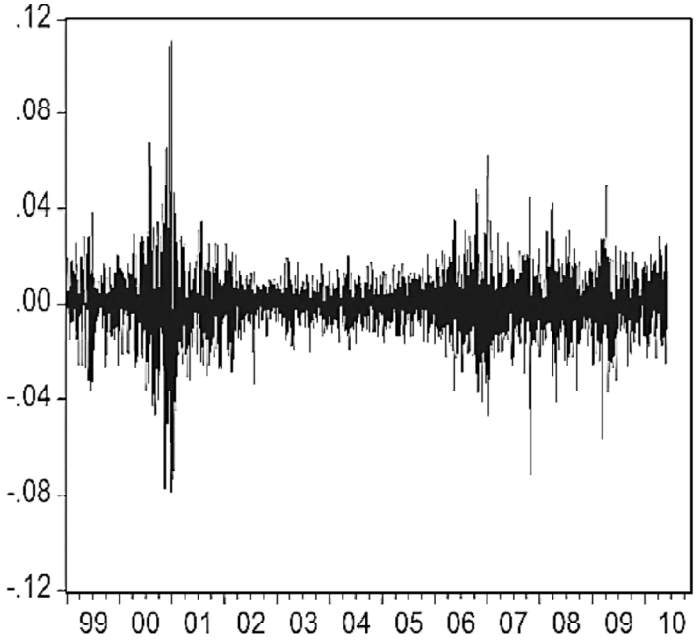


Figure 8: Daily Returns of DJIA Index



Regarding the DJIM index and its conventional counterpart DJIA, we notice that the closing prices of both indexes show an alternation in terms of trend like S&P Sharia'h and S&P 500 indexes, with a sharp decline for both indexes in 2000 coinciding with the Internet bubble that has impacted the field of new information technologies. Both indexes are also affected in 2007-2008 period coinciding with the subprime crisis (Fig. 5, 7).

Furthermore, over the entire period, daily data show that both indices move in the same direction whether it is rising or falling. In fact, the evolution of both indexes has undergone several phases.

From 1999 to 2000: The launch of Islamic equity indices is occurred in a global geopolitical context characterized by strong economic and financial instability. Thus, he succeeded to the 1997 Asian crisis, the Russian crisis of 1998 and the near collapse of the U.S. hedge fund LTCM; these events have contributed to the increased volatility in financial markets. Globalization of the indices and the intervention of operators from different backgrounds including emerging countries explain the recovery and growth of the market accelerated by the Internet bubble that peaked in the late 90s and beginning of the 2000s. Among the manifestations of this bubble is increased growth of telecommunications and investment in this sector. The indexes followed the trend, W1DOW increased by an average of 25% and 46.81% DJIMKT.

From 2000 to 2003: The macroeconomic environment during this period was characterized by the bursting of the Internet bubble, the September 11 attacks and financial scandals with Enron, WorldCom and other companies. In this context, Islamic and conventional indices have fallen on average of -18.78% and -16.08%.

From 2003 to 2007: This period was characterized by an American economic growth and renewed confidence of financial operators. Oil prices have increased significantly during this period, while the dollar fell boosting U.S. exports. A favorable investment environment which positively affected indices worldwide, W1DOW index rose 16.8% and 15.33% DJIMKT.

From 2007 to 2009: The subprime mortgage crisis is the main feature of the event period. This period was characterized by significant depreciation related to securitized assets and failures of large banks in the United States. Also, oil prices fell sharply to reach historically low levels and the liquidity crisis has also affected other continents. Despite the efforts that were designed to save the financial system with all its components, these emergency measures have been taken in a climate of reluctance and lack of confidence, economic and social consequences of the crisis were dramatic. The indexes followed the market trend and fell by -36.68% and -31.47%. This is the third quarter of 2008 which was the least profitable during the quarter both conventional and Islamic indices respectively lost 58.38% and 55.35% of their value.

Figure 9: Daily Closing Prices of MSCI Islamic Index

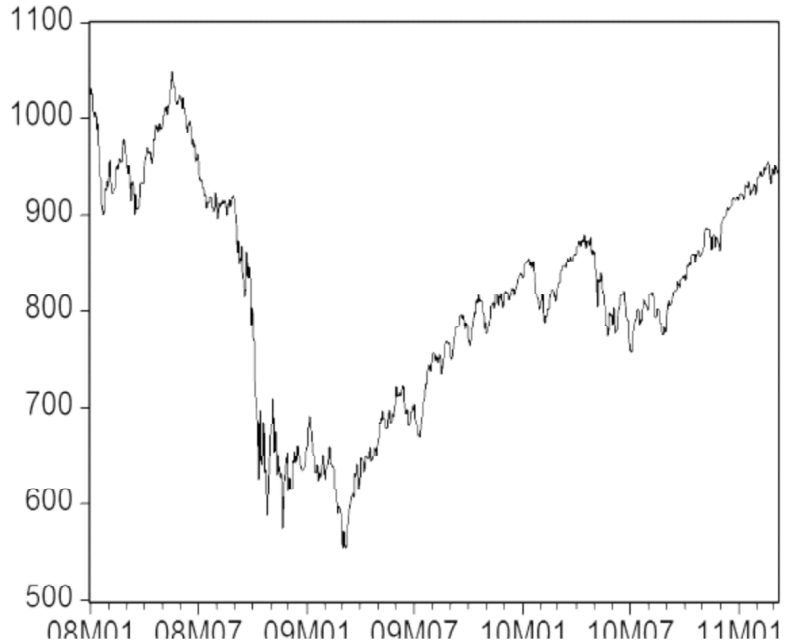


Figure 10: Daily Returns of MSCI Islamic Index

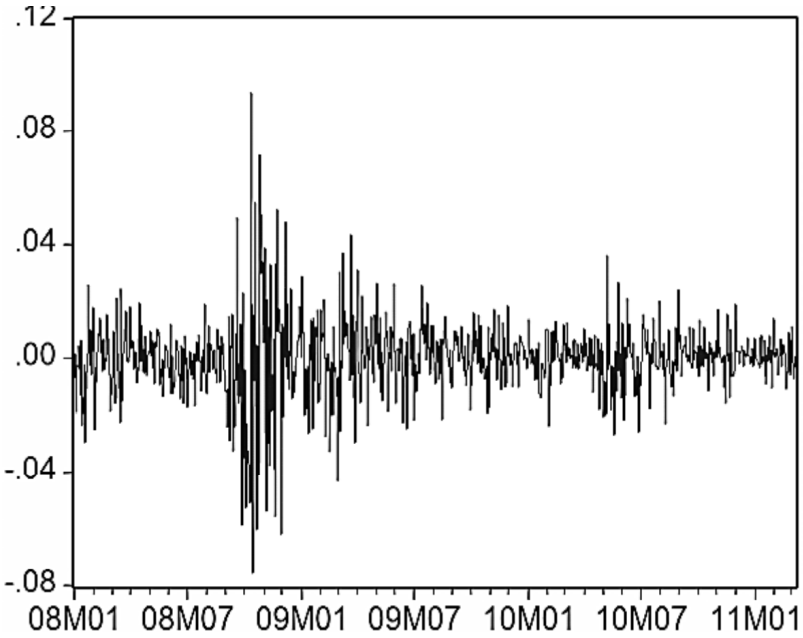


Figure 11: Daily Closing Prices of MSCI Shariah Index

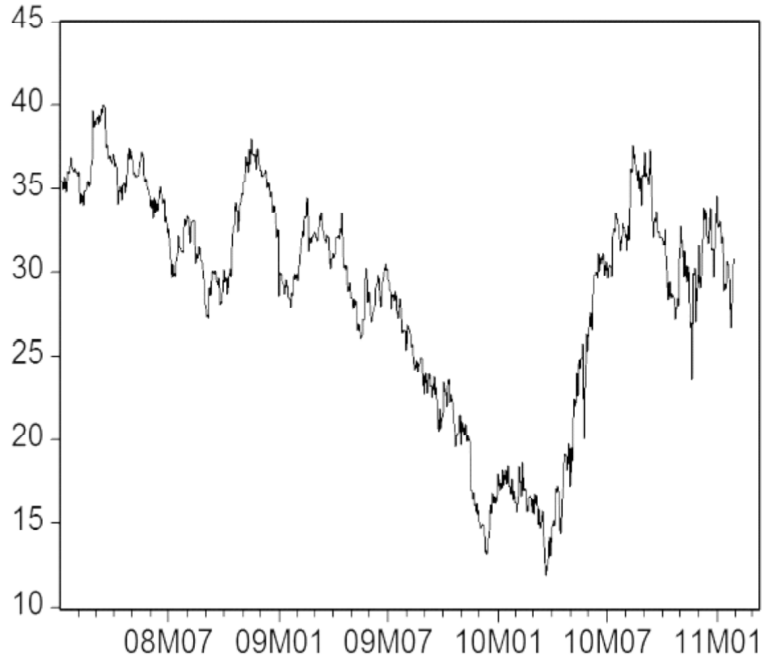


Figure 12: Daily Returns of MSCI Index

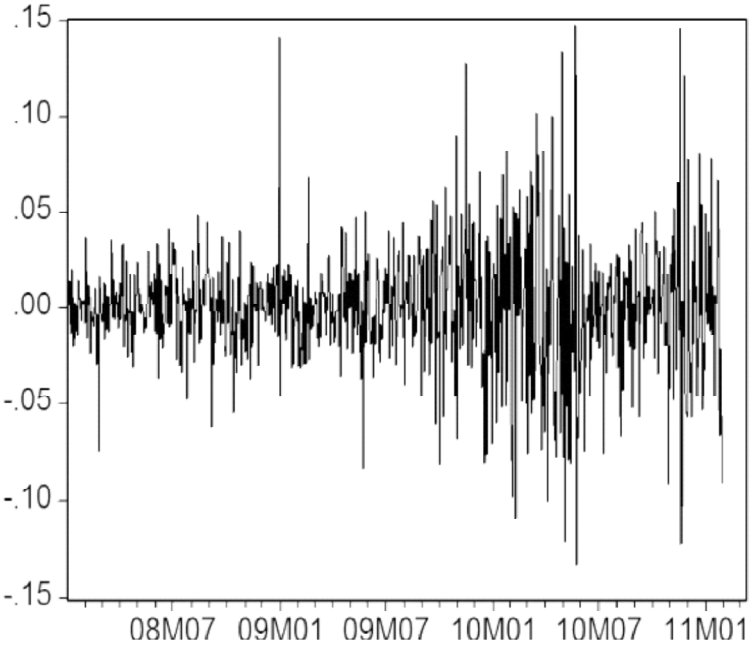


Figure 13: Daily Closing Prices of FTSE Sharia'h

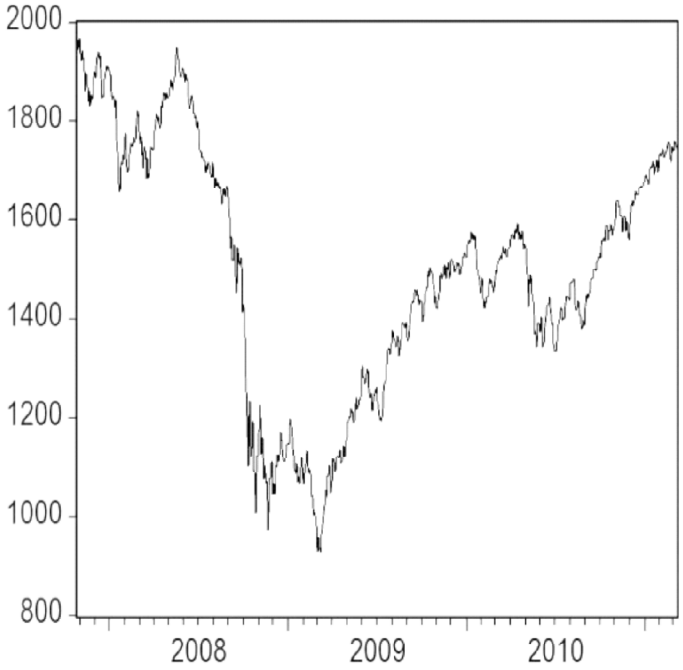


Figure 14: Daily Returns of FTSE Sharia'hh

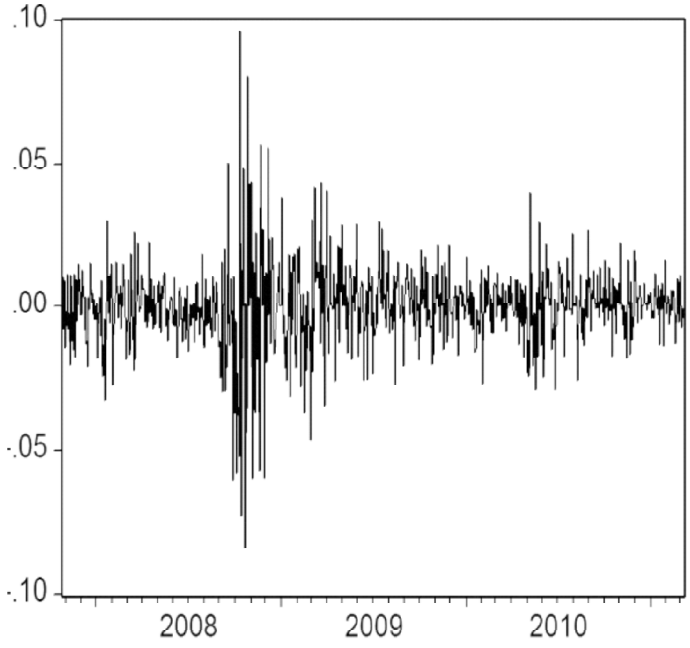


Figure 15: Daily Closing Prices of FTSE All World

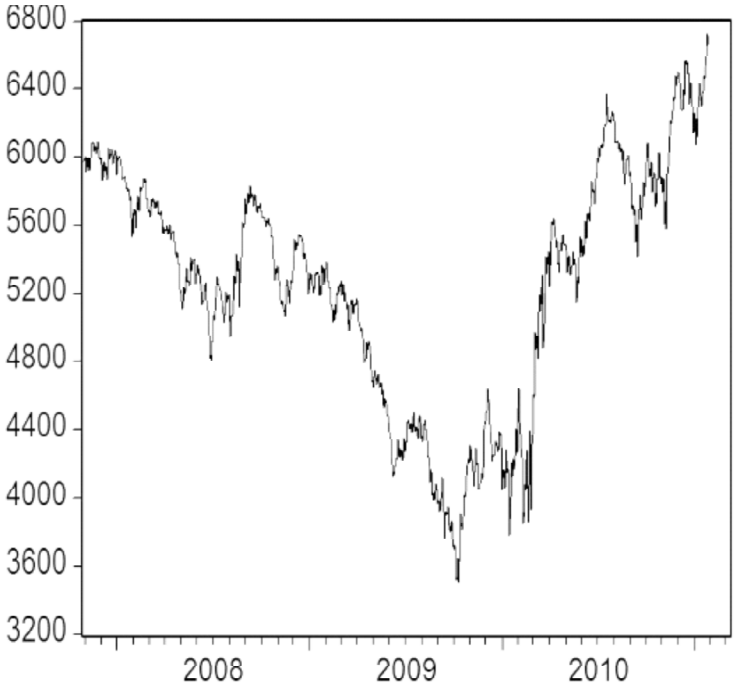
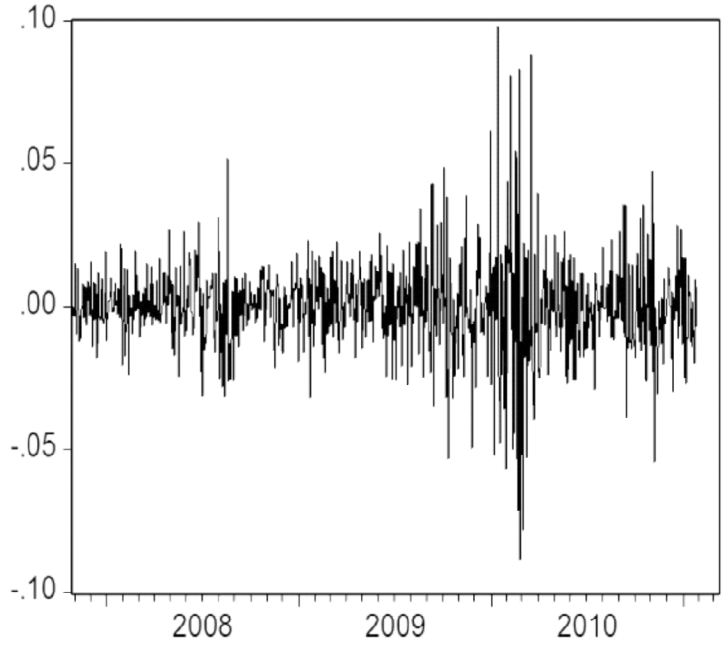


Figure 16: Daily Returns of FTSE All World



Islamic stock index MSCI was launched in full subprime financial crisis, which explains the decrease in the first year of existence. The graph above shows that both indices follow the same trend both the upside and downside of the market. March 2009 marked the end of the downward phase of the two indices and a gradual return on the rise, Islamic index permanently amplifies this trend. Indeed, the increase in both indices continued without reaching the level before the crisis.

Finally, we compared the evolution of the FTSE Shariah Islamic with its benchmark FTSE All world index since its inception. In January 2007, the FTSE Shariah Index has replaced the former Islamic Stock Exchange index of Malaysia: Kuala Lumpur Shariah Index (KLSI).

When reading the chart above, on the evolution of FTSE Shriah and FTSE All world, we note that both of indexes follow the same trend both the upside and downside. We can distinguish four main phases. The first phase is bullish; it starts from the start of the Islamic index FTSE Shariah which amplifies the trend of rising more than conventional FTSE All world index. This bull episode lasted 12 months, during which the two indices increased by 50% and 34.77%. The subprime crisis has affected the Malaysian stock market in January 2008 with a historically high level for both registered on 11/01/2008 indices. From that date the two indices began a phase of decline that lasted until October 2008, during the downward period both indices recorded a negative return of - 42.04% for FTSE Shariah and - 38.53% for the FTSE All world. Then, the two indices have entered phase stagnation until the first quarter of 2009, and then began to increase gradually from March 2009 to return to the levels before the crisis in early 2011.

We can also notice that the four series of closing prices are not stationary. We will proceed to the logarithmic differentiation of closing prices. Daily logarithmic returns seem to be stationary around a constant. We can note in Figures 2, 4.6 and 8 that fluctuations that take both positive and negative values around the mean. The evolution of returns of four indexes shows that the four series are highly volatile.

Knowing that the distribution of white noise mark an extreme regularity of the random Gaussian, we can observe clearly that the four distributions of logarithmic returns seem to be different from a white noise distribution's and cycles seem to occur due to the high variability of logarithmic returns of the four indexes.

Given graphs showing the evolution of the closing prices and daily returns of Islamic indexes, it is clear that they have been significantly affected by the subprime crisis and therefore a significant volatility was recorded in this period, as well as their conventional counterparts.

We will decline the statistical properties of the daily returns of Islamic indexes and their conventional counterparts in Table 1 below.

Table 1
Statistics Properties of Daily Returns of Islamic Stock Indexes and their Conventional Counterparts

	S$P Sharia'hh	*S$P 500*	*DJIM*	*DJIA*	*FTSE All Sahria*	*FTSE All World*	*MSCI Islamic*	*MSCI World*
Obs	1053	1053	3083	3083	877	877	831	831
Mean	0.000263	0.000077	0.000154	0.000152	-0.00002	0.00002	-0.00005	0.0006
Median	0.001016	0.000898	0.000546	0.000402	0.000258	0.00009	0.000589	0.000930
Maximum	0.122799	0.115800	0.102682	0.110803	0.096252	0.098387	0.093807	0.147373
Minimum	-0.09085	-0.09035	-0.07859	-0.07873	-0.08439	-0.088483	-0.07553	-0.13370
St Deviation	0.015477	0.016985	0.011498	0.012774	0.014459	0.016745	0.013554	0.033167
Skewness	0.263343	0.021419	0.001989	0.179974	-0.141075	0.161587	-0.10866	0.138447
Kurtosis	12.64286	10.37128	10.39399	10.70916	10.26335	8.761433	10.68207	5.946362
JarqueBera	4091.876	2384.065	7022.952	7400.423	1930.708	1177.936	2045.001	292.6538
Probability	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000

First, the coefficient of kurtosis for the four Islamic indexes as well as their conventional counterparts is very high and greater than 3 (kurtosis value for a normal distribution). This excess kurtosis indicates a high probability of occurrence of extreme points for both conventional and Islamic indexes. Second, the coefficient of skewness of the four indices is different from 0 (the case of a normal distribution). This illustrates the presence of asymmetry, which can be an indicator of nonlinearity since the Gaussian linear models are necessarily symmetrical. The distributions of daily logarithmic returns of Islamic and conventional indices do not follow a normal distribution as shown by the Jarque-Bera whose probability is less than 0.05 (for returns four indices), which is a general feature General financial series.

We noticed in Figures 2, 4, 6 and 8 that strong variations are usually followed by strong variations and small variations are usually followed by small variations. This is the phenomenon of volatility clustering. This also leads us to reject the hypothesis that states that the returns are independent and identically distributed.

This grouping volatilities packet is mainly due to correlations of financial series. Because of this correlation, a large movement corresponding to a high volatility is likely to be followed by a movement of the same magnitude. It is the same for small movements (Brooks, 2008).

The volatility clustering is quantified by the autoregressive heteroscedastic volatility models. In fact, the ARMA models (autoregressive and moving average) time series suppose constant variance (homoscedasticity assumption). This model neglects potentially the information contained in the residual factor in the series. We model the volatility using a GARCH (1.1).

Table 2
Coefficients of GARCH (1.1) Model for DJIA and DJIM Indexes

	DJIA			*DJIM*		
	Gaussian	*Student's*	*GED*	*Gaussian*	*Student's*	*GED*
α_0	0,00000107 [0.0001]	0,00000107 [0.0021]	0,00000104 [0.0041]	0.000001 [0.0000]	0.0000009 [0.0013]	0.000001 [0.0007]
α_1	0,086068 [0.0000]	0.084951 [0.0000]	0.085477 [0.0000]	0.080535 [0.0000]	0.077044 [0.0000]	0.078775 [0.0000]
β_1	0,908927 [0.0000]	0.910415 [0.0000]	0.909932 [0.0000]	0.911689 [0.0000]	0.916768 [0.0000]	0.913873 [0.0000]
v		9.143704 [0.0000]	1.457629 [0.0000]		9.209713 [0.0000]	1.381061 [0.0000]
	0,0002138	**0,0002309**	**0,0002265**	**0,0001350**	**0,0001438**	**0,0001360**
LnL*	9391.781	9415.703	9425.129	3214.400	10025.01	10026.08
AIC*	-6.297740	-6.313118	-6.319442	-6.095727	-6.501628	-6.502325

With $\sigma^2 = \alpha_0 / (1-\alpha_1-\beta_1)$ is the unconditional volatility and represents the volatility limit σ_t^2 when t tends to $+\infty$ for GARCH (1.1).

LnL: represents the log-likelihood of the parameters linked to the data.

AIC: (Akaike Information Criterion, 1973) is a criterion used to select the best model.

Let us remember that the first term α_0 represents a minimum variance threshold below which the conditional variance does not go down. It is small and very close to 0 for Islamic indexes as well as their conventional counterparts.

The second term α_1 represents the sum of squared residuals, which reflects the impact of shocks on volatility. When a crash occurs at time t the value of returns is very different from the average, and so the residue is very large. In view of Table 2, we can see that the subprime crash significantly impacted the volatility of the Islamic index (DJIM) as well as its conventional counterpart (DJIA). The magnitude of the impact of the shock is more important for the conventional index DJIA than the Islamic index DJIM regardless of the nature of the innovation distributions.

The third term β_1 represents the sum of past variances modeling the persistence of volatility. This persistence seems to be significantly higher for the both indexes DJIM and DJIA, whatever the distributional nature of innovation with a very small difference between both indexes.

Regarding the unconditional volatility, it is clear from the table above, the DJIM is considerably less volatile than the DJIA. We can confirm the remarkable impact of the subprime crisis on the volatility of the Islamic index, but it is lesser scale for its

conventional counterpart DJIA. This confirms the empirical results highlighting the relative resilience of Islamic assets to face the global financial crisis.

About the most suitable model, we can retain the GARCH (1.1) with a Generalized error distribution for both indexes (DJIM and DJIA), as it minimizes the Akaike criterion and maximizes the log-likelihood.

Table 3
Coefficients of GARCH(1.1) Model for S&P Sharia'h and S&P 500 Indexes

	S&P 500			*S&P Sharia'h*		
	Gaussian	*Student's*	*GED*	*Gaussian*	*Student's*	*GED*
α_0	0.00000294 [0.0000]	0.00000157 [0.0452]	0.000002 [0.0158]	0.0000032 [0.0000]	0.000002 [0.0141]	0.000003 [0.0079]
α_1	0.088232 [0.0000]	0.104018 [0.0000]	0.097740 [0.0000]	0.093636 [0.0000]	0.102103 [0.0000]	0.098654 [0.0000]
β_1	0.898366 [0.0000]	0.900956 [0.0000]	0.898077 [0.0000]	0.887777 [0.0000]	0.890314 [0.0000]	0.888939 [0.0000]
v		4.901273 [0.0000]	1.171684 [0.0000]		7.250350 [0.0000]	1.318836 [0.0000]
σ^2	0,0002193	The conditionis $\alpha_1 + \beta_1 < 1$, not verified	0,0004781	0,0001721	0,0002637	0,0002418
LnL	3094.021	3118.848	3128.547	3187.202	3202.858	3208.084
AIC	-5.867087	-5.912342	-5.930763	-6.045968	-6.073805	-6.083731

Regarding S&P Sharia'h index and its conventional counterpart S&P 500 index, it is clear, in Table 3, that all coefficients of the GARCH (1.1) are very significant for both indexes, with little difference of α_1 coefficient measuring the impact of shocks on volatility, but the persistence of volatility is almost more important for the conventional index. It is due to the severe impact of the crisis. Finally, the unconditional volatility of S&P Sharia'h is also significantly lower than S&P 500. The difference is very significant, in fact, holding the GARCH (1.1) with a generalized error distribution minimizing the Akaike criterion and maximizing the likelihood, the unconditional volatility of the S&P 500 is two times higher than S&P Sharia'h. The same results are observed for FTSE shariah and MSCI Islamic indexes (Tables 4 and 5) that confirm the persistence of the volatility for Islamic indexes but with a lesser magnitude than their conventional counterparts.

Despite these conclusive results, GARCH model used to model the volatility presents some limitations; it does not take into account the phenomenon of asymmetric volatility. Nelson (1990) studied the asymmetric variance in variance with the EGARCH model. Nelson argued that there is an asymmetry between the effect of past positive and negative variations in the volatility. Asymmetries in the

volatility dynamics are known by the term leverage effect since Black noted that the returns are negatively correlated with variations in volatility, in the sense that volatility tends to rise in response to bad news and fall in response to good news.

We will model this asymmetry using EGARCH (1.1) with Gaussian; student's and generalized error distribution.

Table 4
Coefficients of GARCH (1.1) Model for FTSE Islamic and FTSE Indexes

	FTSE All Sharia'h			*FTSE*		
	Gaussian	*Student's*	*GED*	*Gaussian*	*Student's*	*GED*
α_0	0,00000198 [0.00147]	0,00000207 [0.0265]	0,00000214 [0.0645]	0.00000384 [0.0045]	0.0000053 [0.0264]	0.0000047 [0.0349]
α_1	0.091447 [0.0000]	0.081644 [0.0000]	0.087059 [0.0000]	0.095441 [0.0000]	0.102038 [0.0002]	0.099087 [0.0002]
β_1	0.897317 [0.0000]	0.902717 [0.0000]	0.899737 [0.0000]	0.891840 [0.0000]	0.879320 [0.0000]	0.883759 [0.0000]
v		12.12391 [0.0308]	1.357393 [0.0000]		6.556908 [0.0001]	1.394059 [0.0000]
σ^2	**0,000176**	**0,000132**	**0,000162**	**0,000302**	**0,000284**	**0,000273**
LnL*	2680.478	2689.219	2695.553	2417.954	2431.856	2432.502
AIC*	-6.108397	-6.126070	-6.140532	-5.690930	-5.721359	-5.689323

Table 5
Coefficients of GARCH (1.1) Model for MSCI World Islamic and MSCI World

	MSCI Islamic World			*MSCI World*		
	Gaussian	*Student's*	*GED*	*Gaussian*	*Student's*	*GED*
α_0	0,00000160 [0.0115]	0,00000169 [0.0500]	0,00000165 [0.0714]	0.000020 [0.00000]	0.000009 [0.0654]	0.000014 [0.0183]
α_1	0.101301 [0.0000]	0.094866 [0.0000]	0.095191 [0.0000]	0.076943 [0.0000]	0.080186 [0.0001]	0.081275 [0.0004]
β_1	0.888316 [0.0000]	0.895751 [0.0000]	0.893304 [0.0000]	0.906184 [0.0000]	0.916375 [0.0000]	0.908871 [0.0000]
v		5.890053 [0.0007]	1.292832 [0.0000]		6.259647 [0.0000]	1.333545 [0.0000]
σ^2	**0,000154**	**0,000180**	**0,000143**	**0,001185**	**0,002617**	**0,001420**
LnL*	2620.167	2632.176	2638.235	1700.628	1729.504	1723.522
AIC*	-6.309210	-6.335768	-6.350386	-4.233777	-4.303380	-4.288444

Table 6
Coefficients of EGARCH (1.1) for DJIM and DJIA Indexes

	DJIM			*DJIA*		
	Gaussian	*Student's*	*GED*	*Gaussian*	*Student's*	*GED*
α_0	-0.229536 [0.0000]	-0.204369 [0.0000]	-0.21817 [0.0000]	-0.225957 [0.0000]	-0.198505 [0.0000]	-0.204149 [0.0000]
α_1	0.127555 [0.0000]	0.111969 [0.0000]	0.120749 [0.0000]	0.100818 [0.000]	0.102202 [0.0000]	0.100998 [0.0000]
γ_1	-0.069400 [0.0000]	-0.088791 [0.0000]	-0.078355 [0.0000]	-0.112760 [0.0000]	-0.114772 [0.0000]	-0.113355 [0.0000]
β_1	0.985935	0.987535	0.986736	0.983873 [0.0000]	0.987200 [0.0000]	0.986539 [0.0000]
v		9.325166 [0.0000]	1.499693 [0.0000]		8.912048 [0.0000]	1.448431 [0.0000]
LnL	10022.70	10063.75	10056.97	9801.403	9836.854	9839.709
AIC	-6.500133	-6.526122	-6.521718	-6.360651	-6.383022	-6.384876

In view of Table 6, the coefficients of EGARCH (1.1) model are all significant. The effect of negative asymmetry exists for both the Islamic index DJIM and his conventional counterpart DJIA. This means that for both indexes, negative past returns increased more volatility than past positive returns. For DJIM and DJIA indexes, a slight difference is observed between the EGARCH coefficients.

Table 7
Coefficients of EGARCH (1.1) Model for S&P Sharia'h and S&P 500 Indexes

	S&P Sharia'h			*S&P 500*		
	Gaussian	*Student's*	*GED*	*Gaussian*	*Student's*	*GED*
α_0	-0.36493 [0.0000]	-0.33120 [0.0000]	-0.3511 [0.0000]	-0.310214 [0.0000]	-0.216530 [0.0000]	-0.244580 [0.0000]
α_1	0.094479 [0.0003]	0.100026 [0.0013]	0.096478 [0.0047]	0.111267 [0.0000]	0.107999 [0.0003]	0.110174 [0.0015]
γ_1	-0.172442 [0.0000]	-0.180886 [0.0000]	-0.184521 [0.0000]	-0.145154 [0.0000]	-0.158202 [0.0000]	-0.152546 [0.0000]
β_1	0.966470 [0.0000]	0.970693 [0.0000]	0.968178 [0.0000]	0.974247 [0.0000]	0.985358 [0.0000]	0.982570 [0.0000]
v		8.054136 [0.0000]	1.381061 [0.0000]		5.536603 [0.0000]	1.229837 [0.0000]
LnL	3214.400	3229.366	3231.887	3116.857	3139.136	3145.017
AIC	-6.095727	-6.122253	-6.127041	-5.908561	-5.948977	-5.960147

Regarding S&P Sharia'h Index and its conventional counterpart S&P 500, all the coefficients of EGARCH model (1.1) are clearly significant (Table 7). We notice the existence of the negative asymmetry for both indexes. This is in accordance with the empirical properties of financial time series. In view of the term measuring the impact

of the shock on return, the magnitude of this impact is less for the Islamic index S&P Sharia'h compared to its conventional counterpart S&P 500. We also note that the autoregressive term quantifying the impact of previous volatility on current volatility, is also lower for S&P Sharia'h Index versus S&P 500 index.

The EGARCH (1.1) with a generalized error distribution is the best suitable for modeling the asymmetric volatility of both Islamic (S&P Sharia'h and DJIMA) and conventional indexes (S&P 500 and DJIA).

Table 8
Coefficients of EGARCH (1.1) Model for FTSE ALL Sharia'h and FTSE Indexes

	FTSE All Sharia'h			*FTSE*		
	Gaussian	*Student's*	*GED*	*Gaussian*	*Student's*	*GED*
α_0	-0.241375	-0.235067	-0.238067	-0.095083	-0.094768	-0.097511
	[0.0000]	[0.0000]	[0.0000]	[0.0018]	[0.0260]	[0.0302]
α_1	0.121432	0.116695	0.117930	0.103982	0.102074	0.105831
	[0.0000]	[0.0001]	[0.0002]	[0.0000]	[0.0000]	[0.0000]
γ_1	-0.111073	-0.119002	-0.117007	0.121576	0.136929	0.125872
	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0000]
β_1	0.983609	0.983978	0.983818	0.997354	0.997459	0.997605
	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0000]
v		7.413288	1.418603		7.385978	1.455543
		[0.0000]	[0.0000]		[0.0001]	[0.0000]
LnL	2697.415	2705.326	2709.024	2432.914	2446.004	2444.361
AIC	-6.144784	-6.160561	-6.169004	-5.723853	-5.752369	-5.748493

Regarding FTSE Shariah and MSCI Islamic indexes and their conventional counterparts, we can also notice that all the coefficients of EGARCH model (1.1) are clearly significant. We also note that the autoregressive term quantifying the impact of previous volatility on current volatility, is also lower for the two Islamic indexes.

Table 9
Coefficients of EGARCH (1.1) Model for MSCI Islamic World and MSCI World

	MSCI Islamic World			*MSCI World*		
	Gaussian	*Student's*	*GED*	*Gaussian*	*Student's*	*GED*
α_0	-0.270833	-0.260295	-0.260252	-0.082426	-0.025356	-0.026276
	[0.0000]	[0.0000]	[0.0000]	[0.0003]	[0.0959]	[0.1107]
α_1	0.122873	0.121528	0.119578	0.058160	0.024950	0.021918
	[0.0000]	[0.0005]	[0.0014]	[0.0002]	[0.1124]	[0.1628]
γ_1	-0.141072	-0.147654	-0.144570	0.064368	0.074214	-0.067769
	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0000]
β_1	0.981048	0.982188	0.982115	0.994143	0.998883	0.998397
	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0000]
v		7.437413	1.387711		6.903031	1.382900
		[0.0067]	[0.0000]		[0.0000]	[0.0000]
LnL	2643.172	2650.358	2655.188	1715.307	1742.739	1735.144
AIC	-6.362296	-6.377221	-6.388873	-4.267932	-4.333929	-4.314966

It is evident from these conclusive results, that Islamic stock indexes were significantly affected by the global financial crisis. In fact, they recorded a very significant volatility due to the disruptions in the global financial system exposed to the disintegration because of the severity of the crisis and its negative impact on the entire economy. However, Islamic stock indexes have shown relative resilience compared to their conventional counterparts. This empirical result is already verified by a study by two researchers from the International Monetary Fund, Maher and Dridi (2010), who showed that during the crisis, Islamic banks have shown a greater resilience than their conventional counterparts.

Resilience is due to several factors. First, the adherence to Islamic principles has protected Islamic financial institutions against the damaging effects of the crisis. These principles include the requirement of ethical conduct in doing business; the risk-sharing principle; the availability of credit primarily for the purchase of real goods and services; restrictions on the sale of debt, short sales, and excessive uncertainty; and the prohibition to sell assets not owned. Second, the inherent strengths of Islamic finance, including the close link between financial transactions and productive flows and the built-in dimensions of governance and risk management, had contributed to its viability and resilience (Zeti, 2009). These views were echoed by Governor Durmuº YIlmaz of the Central Bank of Turkey, who noted that there was a lack of a consensus view on the role of Islamic finance on price and financial stability, but argued that during the recent crisis, Islamic financial institutions had demonstrated significant resilience. In particular, he noted that these institutions offer products that limit excessive leverage and disruptive financial innovation, thereby ensuring macroeconomic stability.

El-Said and Ziemba (2009) agree that Islamic financial institutions have avoided the subprime exposure, but they are subject to the second round effect of the global crisis. They argue that because the global financial crisis originated from subprime mortgage portfolios that were spun off into securitized instruments subsequently offered as investments, Islamic financial institutions were not affected because Islamic finance is based on a close link between financial and productive flows. However, the protracted duration of the crisis affected Islamic financial institutions as well as the conventional institutions, not because these institutions have a direct exposure to derivative instruments, but simply because Islamic finance contracts are based on asset-backed transactions. With the global economic downturn, property markets have seen a decline in a number of countries where Islamic financial institutions have a significant presence. This carries negative implications for these banks as a large number of contracts are backed by real estate and property as collateral. In such a situation, credit risk arises from the erosion in the value of the collateral, especially in highly leveraged countries like the UAE (Dubai) and Qatar, where a large share of financing was channeled to the once-booming real estate market.

Despite the resilience of Islamic finance to the crisis, it should be noted that some Islamic financial institutions have experienced deterioration in their financial situation as Dubai Islamic bank due to the crisis. We can explain this exceptional case by the fact that Dubai Islamic bank is directly linked to the local economy that lacks natural resources that could financing the development. Its economy is based solely on non-productive sectors such as tourism and real estate (Masmoudi and Belabed, 2007).

Elsewhere, the unconditional volatility of conventional stock indexes was doubly higher (Table 2 and 3). The persistence of volatility was also higher for conventional indexes. This is due to several factors. First, there is a place increasingly prominent attributed to the financial sector in modern economies making any crisis in this sector a source of instability in the economic system as a whole. Then, there's a growing integration of financial markets, driven by advances in the field of information technology and also the installation of complex financial instruments, so any shock in a financial center will probably spread to affect different investors in various financial markets. Finally, the crisis began in the United States of America, which is the greatest economy in the world and facing worrying macroeconomic imbalances marked by chronic federal budget deficit and growing public debt (Lim 2008). This considerable fragility is also due to a lack of regulatory rigor that encouraged excessive risk-taking.

Kameel (2009) argued that the severity of financial crisis is due also to the imperfection of the monetary system where fiat money is mainly emitted in the form of debt generating compound interest. So the debt burden is growing exponentially imposed on productive real economy. Being unable to grow at the same rate as debt, the real economy finally succumbs and falls into a liquidity trap, where even low interest rates cannot encourage investment that is necessary to stimulate the economy.

Al-Suwailem (2010) argued that *Riba* (interest) is the main factor of crises and financial instability. It creates a separation between the real economy and the financial sector and allows inflation of debt compared to the real production. In this perspective, *Riba* is not restricted to loans, but rather embraces any transaction involving the exchange of money for money with two unequal amounts and deferral of payment of one of the amounts. Keynes confirmed this view and emphasized the existence of a gap in financial capitalism manifested by the predominance of debt contracts based on interest in classical economy. Thus, there is no assurance that an amount of money paid today, and to be paid in the future with a greater amount, to be used in investment projects generating jobs in the real sector. Indeed, the money could be used for consumption or purchase of financial assets arising from past investments. For Keynes, this flaw in the financial capitalism exacerbates the problem of coordination between savings and investment as a source of instability for the system. (Mirakhor and Krichene, 2009)..

Desai and Brewster (2008) argue that if the Islamic principles related to economics and finance had been applied, the financial crisis could have been prevented. With

emphasis on equity modes of financing, financing would not only require higher standards of due diligence, but also have active monitoring. As debt cannot be traded because it can lead to *Riba*, products like CDO /MBS would not exist in an Islamic system. Furthermore, derivative products like CDS are prohibited under Islamic law due to, among other reasons, the existence of uncertainty. As Islamic financial institutions were not exposed to the toxic securities that caused the crisis due to the Sharia'h prohibitions, they were not directly affected by the crisis.

CONCLUSION AND IMPLICATIONS

Islamic finance is a part of global finance; therefore it has been affected by the crisis when the crisis affected the real sector of the economy. Thus, at the beginning of this crisis which was essentially financial, Islamic financial institutions have been less affected for two main reasons: first, by applying the principle of prohibition of interest, Sharia'h councils forbade them to engage in speculative transactions with leverage effect (Hassoun 2008) and secondly, because these institutions have not participated in the structuration of derivatives due to their speculative nature which is prohibited by Sharia'h. Furthermore, risks of loss as the main principle of Islamic investment are shared between the surplus fund holder and the entrepreneur. There is no opportunity to expand credit and leverage beyond what can be supported by the real sector output (Krichene and Mirakhor, 2008).

The principle of risk-sharing is the founding principle of Islamic finance. For this reason, Islamic finance promotes transactions that are based on profit and risk sharing. It encourages participatory finance or active participation in the business, through its financing instruments sucha as mudarabah (partnership of work and capital) and musharakah (joint venture) contracts. This approach promotes participation in the risk-reward and financial results or outcome of such businesses. This risk sharing requires the Institutions offering Islamic financial services undertake the appropriate due diligence on the viability of business proposals. Oversight and review by the relevant parties such as Shari'ah boards or Shari'ah compliant review process provide additional safeguards against irresponsible practices. In contrast, conventional financial instruments generally separate such risks from the underlying assets. As a result, risk management and wealth creation may, at times, move in divergent directions, with adverse consequences for effective risk management. Conventional financial instruments also allow for the commoditization of risks. This has led to its proliferation through multiple layers of leveraging and disproportionate distribution, which, in turn, could result in higher systemic risks, thus, increasing the potential for instability in the financial system.

Nevertheless, when the financial crisis has turned financial crisis to an economic crisis and becoming after a systemic crisis affecting the real sector, Islamic finance was significantly affected. The subsequent tightening of liquidity and credit in the global financial markets did adversely impact all financial institutions in general, including Islamic financial institutions. As the financial crisis becomes prolonged, the

global recession, the collapse in commodity and oil prices, and the sharp erosion of asset values that followed, affected the performance of the Islamic financial institutions. This has resulted in significant and persistent volatility of Islamic indexes as demonstrated in this paper. Islamic indexes had fallen together with the conventional stock indices but to a lesser extent. Indeed, we have demonstrated in our empirical study that unconditional volatility of conventional stock indexes was almost doubly higher than Islamic stock indexes. Anyway, and despite the strong effect of financial crisis, Islamic finance has shown a relative resilience during the shock due to several factors.

The combination of the factors mentioned below including the prohibition of investing in derivatives instruments and conventional banking investment based on interest minimized the impact of the financial crisis on Islamic financial institutions.

In conclusion, the recent financial crisis has called into question the theoretical foundations of the international financial system. Despite the severity of the crisis and its negative impact on the global economy, Islamic financial institutions showed a relative resistance which gave credibility to the Islamic finance and attracted more attention to its fundamental principles namely the principle of sharing profits and losses. The technical flaws of traditional financial system added to the inherent shortcomings of the system with a lax regulatory environment have created fertile ground for the emergence of the crisis. The adoption of the principles of Islamic finance may prevent the occurrence of these problems given the principle of sharing profits and losses. Especially, the experience of Islamic finance whose purpose is the approximation of the monetary and financial economics of the real economy deserves special attention when modern finance is beset by crises that could destabilize the global economic balance (securitization, excessive speculation ...) (Boudjellal, 2010).

However, Islamic finance as an emerging industry has again a number of challenges to overcome namely the harmonization of legal opinions due to the diversity of jurisprudence schools and the establishment of a suitable regulatory framework. The major challenge is the need for the design and development of a comprehensive and dynamic regulatory prudential supervisory framework, uniquely and properly designed for an Islamic financial system. Such a framework will satisfy the requirements of any existing regulatory framework anywhere in the world, and go beyond them to ensure the stability of the system. Theory has demonstrated the stability of an equity based, risk sharing financial system. Moreover, theory can also demonstrate, easily and comfortably, that the institutional framework (rules of behavior) of Islam, within which its financial system must operate, reinforces to a high degree the stability and efficiency of the financial system. (Mirakhor, 2009). In practice, however, and as long as the institutional framework is not fully in place, an Islamic financial system can fall victim to the same adversely designed incentive structure as the conventional system, particularly because Islamic finance is presently operating in an institutional framework which is basically that of the conventional system.

Furthermore, the current crisis will certainly challenge the classical models of finance. It has highlighted some limits of conventional models (Herlin, 2010). Despite the emergence of highly advanced models and commonly used in finance like the GARCH models and their extensions, this model capture partially the stylized facts observed in financial markets, such as long memory and scale invariance. Previously criticized by Mandelbrot (1963), the classic model based on contestable assumptions seems to be inappropriate facing extreme risks which frequently affect the financial institutions.

The multi-fractal modeling (Herlin, 2010) opens new ways in mathematical modeling by proceeding to the application of fractals in finance. This track will allow to Islamic finance to avoid the shortcomings of the classical modeling and the forecasting imperfections.

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