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Ben Rejeb, Aymen and Arfaoui, Mongi

High Institute of Management of Sousse, University of Sousse and LAMIDED, ISG Sousse, University of Sousse, Tunisia, Faculty of Economics and Management of Mahdia, University of Monastir and LAFICOIF, FSEG Tunis, University EL MANAR, Tunisia

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Conventional and Islamic stock markets: what about financial performance?

Aymen Ben Rejeb*

High Institute of Management of Sousse, University of Sousse, Tunisia,
Member of LAMIDED, ISG Sousse, University of Sousse, Tunisia

Mongi Arfaoui

Faculty of Economics and Management of Mahdia, University of Monastir, Tunisia,
Member of LAFICOIF, FSEG Tunis, University EL MANAR, Tunisia,
Office E29, Tel. +216 73 68 31 91, Fax : +216 73 68 31 90, email: arfaoui.mongi@gmail.com

Abstract

The study aims to analyze the performance of both Islamic and conventional stock markets, particularly at normal time and during the Subprime crisis period. The performance has been assessed by reference to one of the most important financial concepts, extremely useful in investment selections, namely: the informational efficiency. For this purpose, we use a relevant methodology based on the time varying parameters model combined with a GARCH specification, Granger non-causal test and structural break points technique. Empirical results show that the weak efficiency hypothesis is relatively verified in both the Islamic and the conventional market systems, but it varies from one market to another depending on the specific characteristics of each one. Moreover, we conclude that Islamic markets are not fully immunized against effects of financial crises and strong financial fragilities. The results of the Granger non-causality test suggest that the Islamic stock markets have succeeded to relatively escape important part of the last Subprime crisis risky effects. This evidence may support investment in this brand of markets and therefore allows the strengthening of economic growth.

Key words: Informational efficiency; financial fragility; financial interdependence; Subprime crisis; Islamic stock markets; conventional stock markets

JEL classification: F15; C32; C58; G14

* Corresponding author (e-mail address: benredjeb_aymen@yahoo.fr).

1. Introduction

Islamic finance can be defined as part of the *Shariah* compliant finance industry which distinguishes it from the conventional finance industry. This difference implies the existence of financial institutions that refers to religious directives and assumes the supervision of their activities by a compliance monitoring committee.

Since the 80s, a great interest has been granted to Islamic finance that acquired more notoriety especially where Islamic banks have succeeded to absorb shocks of debt crisis that hit international banks in 1990. As of this moment, Islamic finance has been globally recognized as a fully fledged system and then international financial institutions became interested in this new industry. The most significant example is the International Monetary Fund (IMF) who has drafted its first report on Islamic finance in 1987. The recent craze for Islamic finance is explained by the success that makes Islamic financial institutions to be practically immunized against the 2008 financial crisis (Boumediene and Caby 2009). Therefore, several market participants have seen Islamic financial products as alternative investment vehicles to conventional products. Indeed, during the last two decades this sector has experienced a huge growth rates which have been currently estimated between 10 and 15% (Brack 2007; McKenzie 2011).

In that framework, major part of the financial literature interested in the performance of Islamic indices by raising the question of whether Islamic indices are more or less profitable than conventional indices (Hussein 2004; Hakim and Rashidian 2002). They mainly attend to differences in risk and return between the Islamic and the conventional financial systems (Dewandaru et *al*. 2015; Abul Basher et *al*. 2014; Milly and Sultan 2012; Hayat and Kraussl 2011; Abdullah et *al*. 2007). Nevertheless, results are much divergent and no consensus has been reached to date. Indeed, a number of studies have investigated and demonstrated the high level of Islamic finance performance compared to conventional finance (Arouri et *al*., 2013; Jawadi et *al*. 2014). Other studies noted significant diversification benefits when investing in Islamic finance assets (Hakim and Rashidian 2002; Guyot 2011), while Girard and Hassan (2008) and Kok et *al*. (2009) found contrary results. This research field is of major interest to the extent that it allows providing investment decisions support tools in new financial products that are slightly known. In fact, the success of investment decisions has become closely associated with market performance analysis.

Modern financial theory recognizes that investment decisions on stock markets depend mainly on the development level, the performance and the risk associated with that market. Indeed, in their investment decisions process, investors must consider the informational efficiency concept because on an efficient market, investors are able to easily settle on risk and profitability of their investments. Furthermore, because on an efficient market, the stock price adequately reproduces perspectives of listed firms, and the capital will be allocated effectively to the most profitable investments, which results in benefits for market development and economic growth.

The main objective of this study is to analyze the performance of both Islamic and conventional stock markets, particularly at normal time and during the Subprime crisis period. The performance has been assessed by reference to one of the most important financial concepts, extremely useful in investment decisions, namely: the informational efficiency. Additionally, we analyze the interdependence structure in terms of informational efficiency between Islamic stock markets and conventional stock markets. The originality of this research resides primarily in the use of specific econometric tools to the stock market context. Indeed, in order to test the hypothesis of weak efficiency, our empirical investigations are

essentially based on time-varying model that takes into account the variability over time of various degrees of market efficiency. To our knowledge, this econometric model has not been yet applied in the context of Islamic finance, especially when interested in the analysis of financial performance. This analysis may form a helpful support to make international investment decisions.

To achieve our objective, we first adopt a different methodological approach to that used by previous studies and, more specifically to the stock market context; we treat initially the weak efficiency hypothesis. Given the evolutionary characteristics of stock markets, we consider the hypothesis according that the weak efficiency of these markets evolves over time. This econometric model can detect both changes in the degree of efficiency and convergence speed towards the weak informational efficiency via the mutation of coefficients. One of the strengths of this approach, compared to previous studies, is the examination of interdependencies between Islamic stock markets at normal time and during the last global financial crisis. Indeed, to determine the interdependence structure, we adopted the Granger non-causality test and the Bai and Perron (1998, 2003) technique, which consists in determining the different structural break dates. This technique is very relevant in the data processing associated with stock markets that are generally characterized by the presence of multiple regimes in the variance (Bensafta and Semedo 2011; Nguyen 2008).

Since the investment decision depends on stock market performance, resulting evidence of this work has several implications for market regulators and international investors who desire to invest in Islamic and/or conventional stock markets.

The remainder of this article is organized as follows. Section 2 presents a brief literature review. Section 3 outlines the empirical methodology. Section 4 describes the data and their statistical properties. Section 5 reports and discusses the empirical results and section 6 concludes the article.

2. Literature review

The literature on equity indices in Islamic finance is not as abundant as that which deals, for instance, with socially responsible indices. Nevertheless, it illustrates a lack of unanimity on the outperformance or underperformance of this class of indices. Indeed, in accordance with modern financial theory, Islamic equity indices can be assumed as riskier than their conventional counterparts owing to the lack of diversification (Albaity and Ahmad 2008). Furthermore, these indices could be more profitable than their counterparts in so far as the included companies have fulfilled the financial and extra-financial filter criteria (Atta 2000; Hussein and Omran 2005). In addition to these two divergent positions as to the performance of this class of indices, another current literature concludes that the performance of Islamic indices is similar to their conventional counterparts (El khamlichi et *al*. 2014). In the following, we look in detail at several studies that have focused on analyzing the performance of Islamic and conventional indices.

Only few studies have addressed the issue of performance in terms of informational efficiency among Islamic and conventional stock markets. Indeed, Obaidullah (2001) support the idea that, in spite of ethical concerns, an Islamic stock market is not less efficient than a conventional one. Hassan (2004) examines empirically the market efficiency, the time-varying risk-return relationship for the DJIM index returns over the period 1996-2000. Using the serial correlation, the variance ratio, the Dickey Fuller tests and the GARCH model econometric approach, the author finds that DJIM outperformed their conventional counterparts from 1996 to 2000 and underperformed them from 2001 to 2005. In the same

way, Girard and Hassan (2008) find no convincing performance differences between Islamic and non-Islamic indices from January 1999 to December 2006. After controlling many ratios related to market risk, size, book-to-market, momentum, and local and global factors, the authors conclude that the return differential between Islamic and conventional indices is not significant. Their findings suggest that the difference in performance of Islamic indices as compared to conventional indices is attributed to style differences between the two types of series. Guyot (2011) using the Wright's multiple rank test (2000), finds that Islamic indices from Dow Jones family present the same level of efficiency than conventional indices and highlights the influence of the subprime crisis on the degree of integration.

Recently, El Khamlichi et *al*. (2014) study the efficiency of Islamic indices and their potential for diversification benefits in comparison with the conventional benchmarks. The weak-form efficiency level is analyzed by testing the random walk hypothesis using variance ratio tests. The results show that Islamic indices have the same level of efficiency as conventional indices. Jawadi et *al*. (2015) analyze the weak-form of informational efficient hypothesis for three major Islamic stock markets, using recent data over the period May 2002–June 2012 and parametric and non parametric tests to investigate efficiency in the short and long horizons. The empirical results show that Islamic stock markets are generally efficient with, specially, less efficiency for emerging Islamic markets comparing to developed Islamic markets.

From the previous literature review, one may notice a multiplicity of methodologies used in order to analyze the informational efficiency among Islamic and conventional stock markets as well as an assortment of results carried out from that previous studies. This paper attempts to explore the informational efficiency dynamics at normal times and around the last financial Subprime crisis. The following section describes the methodology used for this attempt.

3. Empirical methodology

It is worth mentioning that in the financial literature, market efficiency has been defined in different ways[1], but until now, no standard conventional definition has been advanced. Therefore, it is important to clarify how to describe and measure the informational efficiency. We adopt in this framework the definition provided by Fama (1970), according to which, an efficient market is a market that is efficient in the treatment of information. Furthermore, on an efficient market, prices fully reflect all relevant and available information. According to Fama (1970, 1998), there are three types of efficiency and this depends on all the available information on the market, i.e. weak, semi-strong and strong efficiency.

Unlike financial traditional methods, we focus on the evolution of efficiency degree over time. The idea behind this intuitive approach is based on the view that the rapid maturation of stock markets through time involves major changes in the markets structure, a greater availability of information and an increasing sophistication of markets participants. These changes are expected to get the level of market efficiency bring changes through time (Arouri and Nguyen 2010). Such feature, if it exists, cannot be taken into account only by a dynamic modeling of returns. For this purpose, we adopt the time-varying technique proposed by Zalewska-Mitura and Hall (1999), in which the autocorrelation coefficient of stock returns may vary depending on market conditions. Indeed, the weak form of efficiency can be tested by adopting the following model:

[1] For a comprehensive review of theoretical and empirical evidence on market efficiency, interested readers are invited to consult the works of Fama (1970, 1998), Dimson and Moussavian (1998) and Lim and Brooks (2010).

$$R_{i,t} = \beta_{i,t}^{(0)} + \beta_{i,t}^{(1)} R_{i,t-1} + U_{i,t} \quad \text{(Eq. 1)}$$

$$U_{i,t} = h_{i,t} z_{i,t} \quad \text{(Eq. 2)}$$

$$h_{i,t} = \alpha_i^{(0)} + \alpha_i^{(1)} U_{i,t-1}^2 + \alpha_i^{(2)} h_{i,t-1} \quad \text{(Eq. 3)}$$

$$\beta_{i,t}^{(k)} = \beta_{i,t-1}^{(k)} + \eta_{i,t}^{(k)}, \quad k = 0,1 \quad \text{(Eq. 4)}$$

Where, R_{it} represents the Islamic and conventional stock market returns at time *t*, $\beta_{i,t}^{(0)}$ and $\beta_{i,t}^{(1)}$ respectively measure, for market *i*, the long-term trend and the potential serial dependency of stock market returns. They are allowed to change over time according to a first-order random-walk process described in Eq. (4). The idea behind this dynamic modeling is that time values of these unobserved factors are a function of underlying market fundamentals that drive the formation of stock market price (Arouri and Nguyen 2010). h_t represents the conditional variance of residuals $(U_{i,t})$, which is assumed to follow the standard GARCH(1,1) specification proposed by Bollerslev (1986). The use of a standard GARCH specification was justified by the fact that many previous studies have shown the relevance of this model to the extent of the conditional volatility especially in the case of high frequency data. (Charles and Darne 2006; Nikkinen et *al*. 2008; Ramlall 2010). $z_{i,t}$ and $\eta_{i,t}^{(k)}$ represent random noises, assumed to be normally distributed with a mean of zero and respective variances of 1 and $V_i^{(k)}$. In order to apply the Kalman filter, innovations in Eq. (1) are further assumed to be uncorrelated with those in Eq. (4). One can note that to validate the hypothesis of weak form efficiency, the estimated value of $\beta_{i,t}^{(1)}$ should be equal to 'zero' or statistically insignificant.

The estimation of this state-space model which is characterized by the presence of hidden variables requires the application of an optimal algorithm (the Kalman filter). Generally, the Kalman filter recursively delivers the optimal estimator of the system's current states, depending on the available information at that time, by a two-steps process. To determine estimated values of the set of unknown parameters $(V_{i,t}^k, \alpha^{(0)}, \alpha^{(1)}, \alpha^{(2)})$, we have to construct a log-likelihood function based on the Kalman gain under the normality assumption (Harvey 1995). Estimation of the model is then carried out using the quasi-maximum likelihood[2] method introduced by Bollerslev and Wooldridge (1992), which provides asymptotic and robust estimates even though the conditional returns are not normally distributed. This model has been tested by Zalewska-Mitura and Hall (1999). Authors have shown that the model is quite powerful in the detection of the variability over time of various degrees of market efficiency in the case of the Kalman filter, except for a minimum number of observations at the beginning of the period.

Finally, and to analyze the interdependencies among Islamic financial markets in terms of informational efficiency in normal periods and at time of the last Subrime crisis, we adopted two different econometric techniques with the aim to optimize results. Indeed, the traditional technique of cause and effect has been implemented by the application of the non-causality Granger (1969) test. The test has been applied to three sub-periods; a period before the crisis, a period during the crisis and another period following the financial crisis. Secondly, we proceeded to determine the structural break dates in the time-varying predictability index using the Bai and Perron (1998, 2003) econometric technique which present a particular relevance and, to our knowledge, has not been yet used in the framework of Islamic finance.

[2] The optimization is carried out in GAUSS using the BFGS algorithm (Broyden, Fletcher, Goldfarb and Shanno).

It is worth mentioning that, in Monte Carlo experiments, Bai and Perron (2006) find that the method of Bai and Perron (1998) is powerful enough to detect structural breaks. We consider the following regression model with *m* breaks and *m +1* regimes.

$$\beta_{i,t}^{1} = \lambda_0 + \lambda \beta_{i,t-1}^{1} + \varepsilon_{i,t} \qquad \text{(Eq. 5)}$$

$\beta_{i,t}^{1}$ is the estimated time varying predictability index in period *t*. If there are *m* multiple structural breaks (T_1 , ..., T_m) in the time path of $\beta_{i,t}^{1}$. Bai and Perron (1998, 2003) explicitly treat structural break points as unknown, and estimates of the break points are generated using the ordinary least squares method (OLS). Indeed, Eq. (5) is estimated by OLS regression for each T_m. The breakpoints estimations are generated by minimizing the sum of squared residuals and are given by:

$$(\hat{T}_1,...,\hat{T}_m) = \arg\min_{T_1,...,T_M} S_T(T_1,...,T_m) \qquad \text{(Eq. 6)}$$

In this expression, S_T is the sum of squared residuals issued from the estimation of *m* regressions in the Eq. (6). The selection procedure of structural breaks is based on the Bayesian Information Criteria (BIC).

To conduct this analysis, Bai and Perron (2006) impose some restrictions on the possible values of break dates. In particular, each break date must be asymptotically distinct and bounded by the borders of the sample. For this purpose, they impose different thresholds (trimming parameters) for the estimation of their model [$\varepsilon = (0.25; 0.15; 0.10; 0.05)$], with $\varepsilon = h/T$, where *T* is the sample size and *h* is the minimal permissible length of a segment. They recommend to not using a trimming parameter below 5% when taking into account the heteroskedasticity and the serial correlation. Indeed, we retain the threshold of 5% in our work.

4. Data and descriptive analysis

We use daily frequency data for both Islamic and conventional markets. The choice of stock markets is based on the availability of data which have been sourced from Datastream. The daily series are expressed in US dollars, covering the period spanning from January 1, 1996 to January 18, 2016, and includes seven Global Islamic Indices namely: the DJIM Index, as well as its conventional counterparts, the DJ Emerging Markets Index, the DJ Islamic markets (G) Index, the DJ Canada Index, the DJ United Kingdom (UK) Index, the DJ United State (US) Index, the DJ Europe, the DJ Asia/Pacific Index. The choice of DJIM is justified by the fact that it is the most comprehensive and the most used as representative of Islamic stocks. Our sample period covers major international events such as the Lehman Brother collapse (September 15, 2008) and the extreme market movements around the 2008-2009 global financial crisis and the 2009-2012 Eurozone crisis.

Table 1 presents the descriptive statistics of daily returns. We note that they are globally similar to the findings of previous studies. First, market returns are significantly departed from normality according to the Jarque-Bera test. Second, the Dickey-Fuller unit root test clearly shows that the distributions of market returns are stationary, even at the 1% confidence level, since the ADF calculated values are strictly below the critical threshold. Finally, the Engle's (1982) test for conditional heteroscedasticity rejects the null hypothesis of no ARCH effect in daily returns and then justifies the use of the GARCH specification.

Table 1. Basic statistics of conventional and Islamic stock markets daily returns

	Mean (%)	Standard deviation (%)	Skewness	Kurtosis	Jarque-Bera	ADF Statistics	Q(6)	Q(12)	ARCH (12)
Conventional markets									
Emerging markets	0.008	1.209	-0.534	10.595	12820^{+++}	-56.651^{+++}	319.34^{+++}	332.61^{+++}	158.794^{+++}
Canada	0.020	1.383	-0.747	12.525	20255^{+++}	-33.530^{+++}	71.313^{+++}	83.740^{+++}	154.446^{+++}
United Kingdom	0.006	1.311	-0.136	11.590	16094^{+++}	-35.529^{+++}	67.687^{+++}	85.929^{+++}	157.583^{+++}
United State	0.022	1.213	-0.249	11.006	14021^{+++}	-76.951^{+++}	32.771^{+++}	47.203^{+++}	147.883^{+++}
Europe	0.012	1.314	-0.136	9.910	10421^{+++}	-34.765^{+++}	54.113^{+++}	70.275^{+++}	134.929^{+++}
Asia Pacific	-0.002	1.237	-0.083	7.962	5372^{+++}	-70.367^{+++}	15.980^{++}	21.013^{+}	85.732^{+++}
Islamic markets									
Islamic Emerging markets	0.010	1.316	-0.342	8.868	7605^{+++}	-60.005^{+++}	197.490^{+++}	207.370^{+++}	105.478^{+++}
Islamic markets (G)	0.021	1.028	-0.352	9.865	10379^{+++}	-50.670^{+++}	119.790^{+++}	123.300^{+++}	183.306^{+++}
Islamic Canada	0.013	1.741	-0.808	13.335	23846^{+++}	-33.417^{+++}	64.351^{+++}	73.346^{+++}	102.446^{+++}
Islamic UK	0.011	1.364	-0.104	9.419	8989^{+++}	-46.471^{+++}	59.375^{+++}	75.774^{+++}	155.675^{+++}
Islamic US	0.026	1.252	-0.133	9.608	9531^{+++}	-54.751^{+++}	28.799^{+++}	39.086^{+++}	131.507^{+++}
Islamic Europe	0.018	1.320	-0.055	9.623	9560^{+++}	-34.958^{+++}	54.697^{+++}	71.307^{+++}	143.841^{+++}
Islamic Asia pacific	0.010	1.427	-0.245	8.124	5774^{+++}	-68.315^{+++}	28.649^{+++}	35.214^{+++}	104.626^{+++}

Notes: The table presents basic statistics of monthly returns. Q (6) and Q (12) are statistics of the Ljung-Box autocorrelation test applied on returns with lags between 6 and 12. ARCH (12) is the statistics of the conditional heteroskedasticity test proposed by Engle (1982) using the residuals of the AR (1) model. ADF is the statistics of the ADF unit root test proposed by Dickey and Fuller (1981). The ADF test is conducted without time trend or constant. $^{+}$, $^{++}$ and $^{+++}$ denote that the null hypothesis of tests (no-autocorrelation, normality, no-stationarity and homogeneity) are rejected at 10%, 5% and 1% levels, respectively. The period of study spans from January 1, 1996 to January 18, 2016.

5. Empirical results and discussions

By examining the state-space estimation results summarized in Table 2, we can observe that the mean of $\beta_{i,t}$ coefficient is usually significantly close to zero, which shows that past returns are not very helpful to predict future returns of both conventional and Islamic markets. Then, we can conclude at the existence of independence between past prices and future prices.

A deeply reading of the results allows to firstly notice that the average values of $\beta_{i,t}^{(0)}$ coefficients, which represents the constant term in Eq. (1), are close to zero and listed in the interval [-0.011% ; 0.033%] for all conventional markets and in the interval [0.006% ; 0027] for all Islamic markets. This suggests a low predictability level of return related to other potentials, such as macroeconomic effects, political events and external shocks (Arouri and Nguyen 2010). Secondly, as regards to the $\beta_{i,t}^{(1)}$ coefficients, variations indicate the time-varying predictability (autocorrelation) of stock returns and their values are not very different across markets and stand around an average of 8.95% for the conventional markets and 8.73% for the Islamic markets. This finding supports the hypothesis of serial independence between past and future returns, except for the conventional and Islamic emerging markets.

In light of the present results, it is obvious to note that the weak efficiency hypothesis is more verified in the Islamic context than in the conventional context. Indeed, the average coefficient of the time-varying predictability is consistently lower in the case of Islamic markets than in the case of conventional markets. So, we can conclude that Islamic markets are relatively more efficient in terms of informational efficiency.

Finally, regarding the global significance of the two coefficients ($\beta_{i,t}^{(0)}$ and $\beta_{i,t}^{(1)}$), we assert an overtime relative stability given the lowest estimated values of the innovations variance issued from the state equations (Eq. 4). Moreover, it seems that the GARCH (1,1) model performs well to explain variations of the conventional and Islamic stock market returns since it detects the leptokurtic behavior and the conditional heteroscedasticity in the returns. Indeed, the parameters of the conditional variance equation are positive and statistically significant at the 1% confidence level and satisfy conditions of theoretical stability ($\alpha_i^{(0)} > 0,\ \alpha_i^{(1)} \geq 0$ et $\alpha_i^{(2)} \geq 0$).

In order to test the hypothesis of weak efficiency before and after the Subprime crisis and around financial instability periods which are generally characterized by a high volatility level, it seems important to report the evolution of the time-varying predictability indices at 95% confidence intervals, while taking into account the evolution of volatility. The analysis of the predictability index is based on the following decision rule: the assumption of weak efficiency is verified if the evolution is not significantly different from zero. A negative effect of a financial fragility/crisis on the efficiency is explained by the increase of predictability level of returns during or just after a strong increase in volatility. Even though the market was not efficient before the volatility shock, the negative effect is a decline of the efficiency degree in the period following the volatility shock.

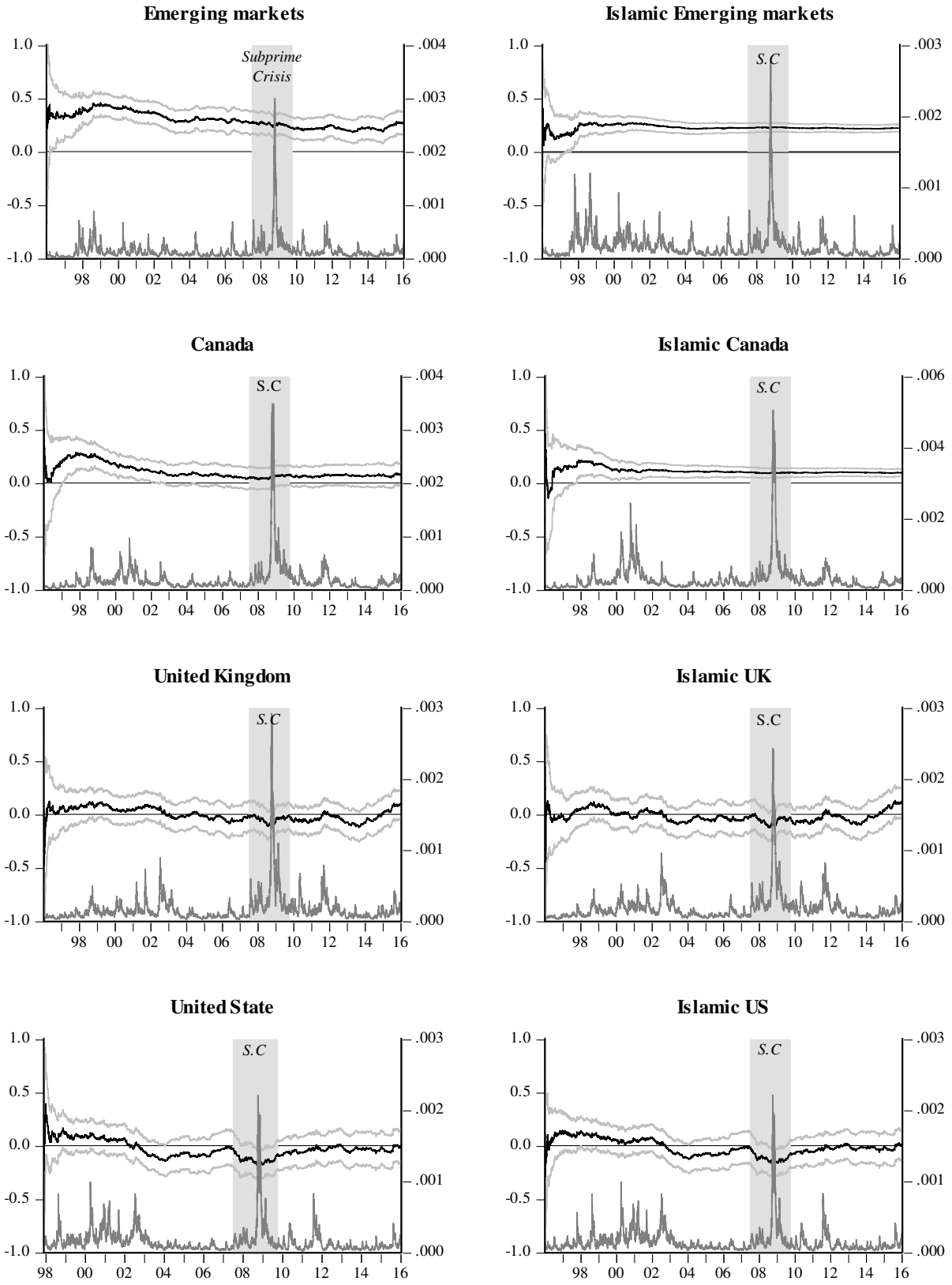
Figure 1, shows the evolution of both the time-varying predictability indices at 95% confidence intervals. In light of figure 1, we can formulate some general remarks for all studied markets as well as specific comments inside groups that are identified based on the degree of efficiency.

Table 2. Estimation results from the state space model with GARCH effects

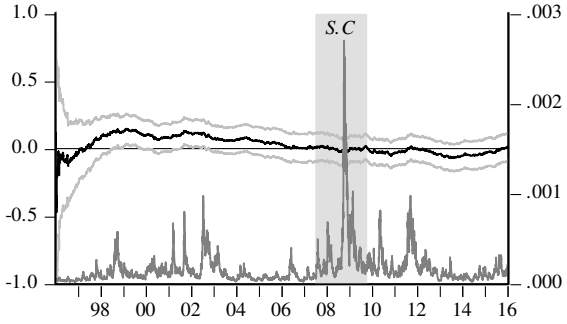
	Conditional mean equation		State equations		Conditional variance equation				Likelihood value
	$\beta_i^{(0)}$ (%)	$\beta_i^{(1)}$ (%)	$V_i^{(0)}$	$V_i^{(1)}$	$\alpha_i^{(0)}$	$\alpha_i^{(1)}$	$\alpha_i^{(2)}$	$\alpha_i^{(1)} + \alpha_i^{(2)}$	
Conventional markets									
Emerging markets	0.022 (0.000)	26.492 (0.049)	0.000** (0.000)	0.002* (0.001)	0.000** (0.000)	0.106** (0.005)	0.887** (0.005)	0.993	16548.975
Canada	0.033 (0.000)	10.276 (0.020)	0.000 (0.000)	-0.001** (0.000)	0.000** (0.000)	0.069** (0.004)	0.928** (0.004)	0.997	15720.990
United Kingdom	0.030 (0.000)	-3.215 (0.048)	-0.000 (0.000)	-0.004* (0.002)	0.001** (0.000)	0.080** (0.005)	0.909** (0.006)	0.989	15998.709
United State	0.017 (0.001)	-5.620 (0.053)	-0.000 (0.000)	0.003** (0.001)	0.000** (0.000)	0.087** (0.005)	0.900** (0.006)	0.987	14712.781
Europe	0.031 (0.000)	1.403 (0.050)	0.000 (0.001)	0.002 (0.001)	0.000** (0.000)	0.084** (0.005)	0.909** (0.005)	0.993	15970.633
Asia Pacific	-0.011 (0.001)	7.577 (0.034)	-0.000* (0.000)	-0.001 (0.000)	0.000* (0.000)	0.085** (0.005)	0.905** (0.006)	0.990	15941.030
Islamic markets									
Islamic Emerging markets	0.021 (0.001)	20.520 (0.012)	0.000 (0.000)	0.000 (0.006)	0.000** (0.000)	0.103** (0.006)	0.889** (0.005)	0.992	15951.888
Islamic markets (G)	0.006 (0.000)	15.849 (0.025)	-0.000* (0.000)	-0.000 (0.001)	0.001** (0.000)	0.082** (0.005)	0.908** (0.005)	0.990	13805.513
Islamic Canada	0.008 (0.001)	9.210 (0.007)	-0.000 (0.000)	0.000 (0.001)	0.000** (0.004)	0.063** (0.003)	0.934** (0.003)	0.997	14513.519
Islamic UK	0.021 (0.000)	-2.073 (0.047)	-0.000 (0.000)	0.004* (0.002)	0.002** (0.000)	0.063** (0.004)	0.929** (0.004)	0.992	15633.658
Islamic US	0.009 (0.000)	-4.532 (0.053)	-0.000 (0.000)	-0.004* (0.002)	0.000** (0.000)	0.086** (0.005)	0.901** (0.006)	0.987	16101.963
Islamic Europe	0.027 (0.001)	-1.407 (0.027)	0.000 (0.000)	0.002 (0.002)	0.000** (0.000)	0.075** (0.005)	0.919** (0.004)	0.994	15846.503
Islamic Asia pacific	-0.008 (0.001)	5.447 (0.038)	0.000** (0.000)	0.001 (0.000)	0.000** (0.000)	0.080** (0.005)	0.912** (0.005)	0.992	16000.810

Notes: Standard deviations of the estimated parameters are given in parenthesis. For the estimated parameters in the conditional mean equation, we report their averages since they are allowed to vary over time. The significance of these coefficients ($\beta_i^{(1)}$ in particular) in each period of time is examined by using a standard t-test and shown in the graph of time-varying predictability (see, Figure 1). The asterisks * and ** indicate that coefficients are, respectively, statistically significant at 5% and 1% level.

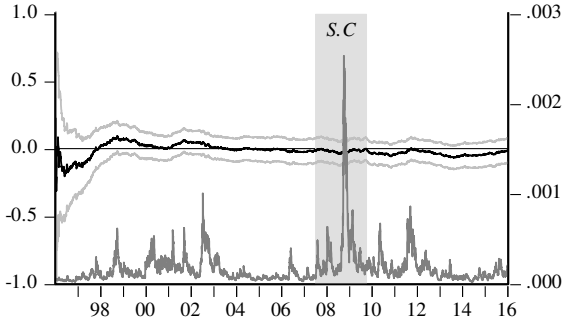
Figure 1. Evolving efficiency and volatility in Conventional and Islamic stock markets, time-varying predictability index with 95% confidence intervals



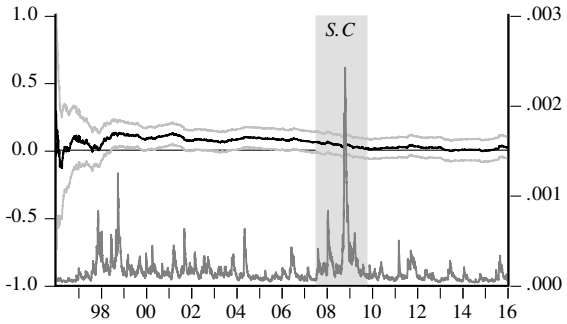
Europe



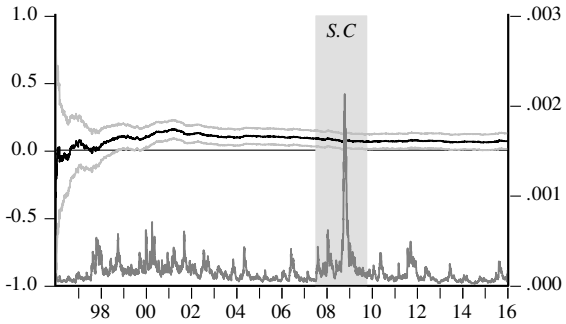
Islamic Europe



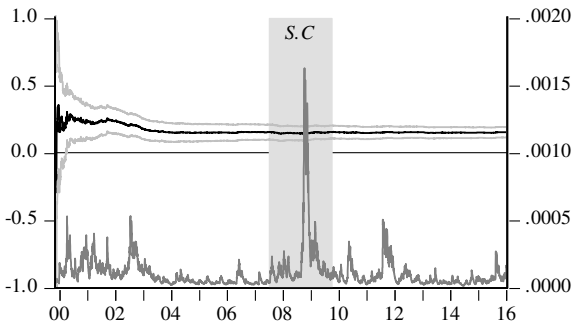
Asia Pacific



Islamic Asia pacific



Islamic markets (G)



Left axis: Efficiency Evolution Right axis: Volatility Evolution

First, as noted by Zalewska-Mitura and Hall (1999), at the beginning of the period, observations arising from the application of the Kalman filter are too volatile. Second, we distinguish three groups of markets according to their degree of informational efficiency. The first group includes two conventional markets (U.K. and U.S.) and two Islamic markets (Islamic U.K. and Islamic U.S.) evokes efficiency over the entire period of study. Indeed, the zero line is located within the estimated confidence interval which leads to accept the null hypothesis of efficiency. A second group contains markets which are characterized by the inefficiency on several sub-periods at the beginning and the middle of the period, but gradually converge towards efficiency at the end, since the associated autocorrelation coefficients decline steadily over time, and are very close to zero. This group includes three conventional markets (Canada, Europe and Asia Pacific) and tree Islamic markets (Islamic Canada, Islamic Europe and Islamic Asia Pacific). The last group that is opposed to the previous groups consists in three markets, including one conventional market (Emerging markets) and two Islamic markets (Islamic Emerging markets and Global Islamic markets (G)). These markets are characterized by the absolute inefficiency on the entire period or by a short period efficiency at the beginning of the period of study, but show a degree of increasingly inefficiency over time.

Moreover, we point out that the degree of efficiency varies from one market to another, which makes it possible to believe that the specific characteristics of each market, including the liquidity and the development level, may explain the difference in that degree of efficiency between markets. This fact is also mentioned by Arouri and Nguyen (2010) and Fontaine and Nguyen (2006). According to these authors, the lack of liquidity slows down the incorporation of available information in stock prices and then hinders the convergence process to efficiency.

Finally, we note that several changes in the trend of the time-varying predictability are realized at time of financial crisis and at financial fragility periods where one can see a weakening of the informational efficiency degree of both conventional and Islamic markets.

To sum up, we can deduce that the weak efficiency hypothesis is relatively verified in the Islamic context than in the conventional one. But it varies from one market to another depending on the specific characteristics of each of them. Moreover, we can conclude that Islamic markets are not fully immunized against the effects of financial crises and the strong financial fragilities. Our findings corroborate those obtained by Albaity and Ahmad (2008), Hussein and Omran (2005) and Hassan (2004) when he finds that the Dow Jones Islamic index is more efficient than it's conventional counterpart.

In accordance with the literature, it becomes obvious to conclude that there exists a close interdependence in terms of efficiency between conventional stock markets which reflects the existence of diversification opportunities on these markets. Our analysis of interdependencies between Islamic stock markets using break-point test allows us to conclude at the existence of a considerable interdependence between Islamic markets, especially during the subprime crisis. Indeed, from Table 3, we can observe a large similarity between the structural break dates. This similarity is rather checked during the subprime crisis (2007-2009). This interdependence means that the predictability of returns from various Islamic markets depends on each other and that these markets are not totally immune against the effects of financial crises.

Table 3. Detected structural break dates in the time varying predictability indices

Conventional stock markets					
Emerging markets	Canada	UK	US	Europe	Asia pacific
6	5	6	6	5	7
02 Apr 2003	02 Apr 2003	21 Apr 2003	02 Apr 2003	23 Jun 2003	01 Mar 2004
20 Apr 2007	05 Jul 2006	23 Jan 2006	21 Jul 2005	15 Dec 2005	08 Nov 2006
17 Jul 2007	12 Nov 2007	01 May 2008	25 Sep 2007	14 Jan 2008	12 Nov 2007
21 Sep 2007	16 Jul 2008	23 Oct 2009	22 Jun 2009	22 Jan 2009	21 Jan 2008
18 Feb 2009	22 Sep 2011	10 Mar 2011	22 Jan 2010	18 Jun 2010	09 Feb 2009
16 Oct 2013		16 Oct 2013	01 Feb 2012		18 Sep 2012
					18 Feb 2013

Islamic stock markets						
Islamic Emerging markets	Islamic markets (G)	Islamic Canada	Islamic UK	Islamic US	Islamic Europe	Islamic Asia pacific
4	3	5	6	5	5	6
02 Apr 2003	02 Apr 2003	02 Apr 2003	02 Apr 2003	02 Apr 2003	02 Apr 2003	02 Apr 2003
16 Jul 2007	31 Jul 2007	12 Sep 2005	09 Aug 2005	20 Jul 2005	24 Mar 2006	19 Jan 2006
17 Nov 2009	08 Dec 2009	13 Dec 2007	23 Jul 2007	21 Sep 2007	30 Jul 2007	01 Aug 2007
15 Aug 2012		15 Jul 20011	04 Jan 2008	08 Apr 2009	27 Oct 2009	22 Apr 2008
		17 Aug 2012	09 Mar 2011	27 Jan 2012	09 Mar 2012	27 Oct 2009
			16 Aug 2012			18 Mar 2013

Notes: This table reports the structural breaks identified in the time varying predictability indices of various conventional and Islamic stock markets generated from the State-Space model.

Table 4. Results of Granger non-causality test before, during and after Subprime Financial Crisis (SFC)

Independent variables	Sub-periods	Dependent variables							$\overline{R^2}$
		Islamic Emerging markets	Islamic markets (G)	Islamic Canada	Islamic UK	Islamic US	Islamic Europe	Islamic Asia pacific	
Islamic Emerging markets	Before SFC	-	1.616	1.488	**2.055****	0.895	**2.386*****	1.133	0.998
	During SFC	-	1.271	0.983	0.853	0.678	1.029	**3.028*****	0.973
	After SFC	-	1.401	**1.787***	1.276	0.714	1.301	**2.116****	0.974
Islamic markets (G)	Before SFC	**4.179*****	-	**1.994****	**1.785***	1.091	**2.545*****	**6.786*****	0.972
	During SFC	**1.664***	-	**1.864****	**2.340***	1.414	1.507	**5.001*****	0.976
	After SFC	**1.942****	-	1.213	1.472	1.248	**1.882****	**9.824*****	0.990
Islamic Canada	Before SFC	**2.695*****	**3.142*****	-	0.803	1.146	1.257	**3.469*****	0.989
	During SFC	1.222	0.492	-	0.872	0.556	0.822	1.514	0.975
	After SFC	**4.178*****	**2.772*****	-	**3.043*****	**1.844****	**2.828*****	**7.579*****	0.996
Islamic UK	Before SFC	1.262	**2.215****	**2.242****	-	1.196	0.788	**1.626***	0.992
	During SFC	1.125	1.595	0.566	-	1.107	0.454	**2.315****	0.981
	After SFC	**1.627***	1.353	**2.035****	-	1.218	1.271	**3.841*****	0.982
Islamic US	Before SFC	**3.751*****	0.964	**1.697***	**2.782****	-	**4.015*****	**6.438*****	0.997
	During SFC	**1.670***	1.443	**1.949****	**2.037****	-	1.198	**2.772*****	0.994
	After SFC	**2.903*****	1.550	1.243	1.112	-	1.244	**12.861*****	0.992
Islamic Europe	Before SFC	**2.129***	**1.649***	**3.223*****	1.149	0.638	-	**2.556*****	0.996
	During SFC	**1.746***	1.567	0.491	1.345	0.667	-	**4.663*****	0.967
	After SFC	**1.789***	**1.603***	**2.001****	1.090	1.535	-	**5.947*****	0.988
Islamic Asia pacific	Before SFC	1.477	**2.025***	1.506	**1.799***	1.012	**2.604*****	-	0.953
	During SFC	0.927	1.263	1.414	**2.001****	**1.685***	**2.199****	-	0.932
	After SFC	1.111	**1.611***	1.361	**2.164****	**1.747***	**1.394**	-	0.941

Notes: Results in this table are the Fisher statistics attached to the Granger non-causality test. Asterisks *, ** and *** indicate that the coefficients are significant, at the 10%, 5% and 1%, respectively.
The period before SFC is spanning from 01/01/2001 to 31/05/2007.
The period during SFC is spanning from 01/06/2007 to 31/12/2009.
The period after SFC is spanning from 01/01/2010 to 18/01/2016.

Results of the Granger non-causality test (Table 4) confirm the preliminary findings of the Bai and Perron (1998, 2003) test and show grand positive interdependencies between the Islamic stock markets. Indeed, many causal links have been identified between these markets. Significant and always positive causal coefficients are synonym of informational inefficiency which is transmitted from one market to another. Nevertheless, one can notice a decrease in significant links during the financial crisis sub-period or at least a reduction in the causal coefficient value at this period. This finding allows us to conclude that Islamic markets have succeeded to relatively escape from the last Subprime crisis risky effects. This evidence has been explained in the literature by the fact that the Islamic equity markets are considered as "*sin stocks*" (Hong and Kacperczyk 2009) which are known to be more resilient in times of crisis, or "*recession-proof*". Moreover, Islamic equity indices frequently contain equities of small cap companies with low debt and may have growth potentialities when the trend is up (Hussein and Omran 2005). The performance differentials can also be attributed to the differences management style (Girard and Hassan 2008; Binmahfouz and Hassan 2012).

6. Conclusion

Informational efficiency is an important concept that reveals the effectiveness of the market investment policy. In recent years, the financial literature focused on the degree of informational efficiency on Islamic stock markets, which are actually considered as new provider of investment opportunities.

This paper joins the literature to test the hypothesis of weak efficiency on a sample of Islamic and conventional stock markets and to analyze the interdependencies in terms of informational efficiency of these two types of markets both in normal times and in financial crisis times. In fact, the attention has been focused primarily on modeling the weak efficiency, taking into account the evolutionary characteristics of Islamic and conventional stock markets. Indeed, we consider the argument that the weak efficiency of these markets evolves over time. Then, the interest is paid to determine the evolution of the interdependencies on three sub-periods (before, during and after financial crisis). Indeed, we adopted firstly, a technique of structural break dates existing in the time-varying predictability indices and second, we used the Granger (1969) non-causality test.

Our results show firstly that the weak efficiency hypothesis is relatively verified in the Islamic context than in the conventional one. This is a good indicator for regulators of these markets, since a greater efficiency naturally leads to an increase in investment. Second, empirical results show that structural breaks detected in the Islamic time varying predictability indices coincide with the Subprime crisis period which means that these markets are not totally immune against the effects of financial crises. Nevertheless, the results of the Granger non-causality test suggest that the Islamic stock markets have succeeded to relatively escape from important part of the last Subprime crisis harmful effects. This may encourage investment in this brand of markets and therefore allows sustaining economic growth.

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