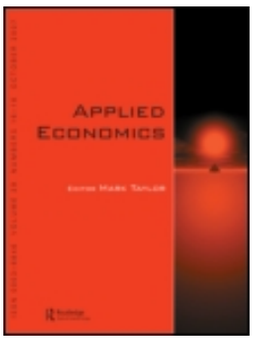

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Are Islamic finance innovations enough for investors to escape from a financial downturn? Further evidence from portfolio simulations

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Does Islamic finance constitute a promising solution for the current global financial crisis and are Islamic financial innovations enough to reassure investors, stabilize financial systems and provide them with a means of escaping from financial downturns? This article addresses these questions while investigating the dynamics of Islamic and conventional stock prices over the last few years. In particular, we apply Multivariate Vector Autoregressive (VAR) tools to test the interaction between conventional and Islamic financial products, and implement the Granger causality test to specify the dependence orientation of feedback between Islamic and conventional stock prices. Our article differs from previous work on the topic in that it develops portfolio simulations to determine whether Islamic finance can supplant conventional finance by generating investment and diversification opportunities during periods of crisis. In addition, we develop optimal portfolio strategies and investment proportions for conventional and Islamic funds to ensure the best resource allocation. Our main findings are: (i) the impact of the current crisis on the Islamic finance industry is less marked than on conventional finance, (ii) investment in Islamic products generates high returns, (iii) portfolios that include Islamic products reduce systemic risk and generate significant diversification benefits, (iv) the US crisis has led to significant changes in resource allocation through changes in investment choices.

Keywords: Islamic finance; portfolio simulations; financial crisis

JEL Classification: G01; G11; C32

I. Introduction

The recent global financial crisis (2008–2009) led to large losses for investors, stock markets and banks, a credit crunch and a global liquidity crisis in developed and emerging countries (Foster and Magdoff, 2009). Despite considerable expansionary fiscal policies, the financial downturn rapidly led to a considerable reduction in investment and consumption and a

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significant rise in unemployment (Shiller, 2008; Afonso and Sousa, 2011, 2012; Agnello and Sousa, 2011, 2012; Agnello *et al*., 2012). Economic growth is negative and/or stagnant and public deficits and government debts have reached all time highs in many countries. This has led to an economic recession in the US and in several European economies, with some countries such as Greece virtually bankrupt. It has raised serious questions about banking, investment choices, portfolio choices, arbitrage, trading, resource allocation, risk management, risk aversion and the whole financial capitalist system (Aglietta, 2009; Aglietta and Rigot, 2009). Hence, to limit the effects of the global financial crisis, central banks have not only revised their interest rates several times, particularly in 2008–2009, but they have also tried to inject money to stimulate liquidity, make use of new monetary instruments such as Quantitative Easing, and tried to save the banking systems, since the interest rate is very low (Arouri *et al*., 2011).[1] At the same time, numerous summits (G8, G20, etc.) have been organized, and policymakers and economists are continually calling for more regulations and controls on risk and rating agencies. Conventional financial products have been strongly criticized for the excessive risk introduced into the financial systems by the implementation of innovative financial products such as hedge funds and derivatives, toxic financial products and sophisticated financial instruments.

Overall, this crisis led to diverse and heterogeneous reactions from investors and policymakers who rejected conventional measures of financial market regulations, control, audit, intermediation, communication, governance, trading, risk management, financial innovations, and also financial globalization and the opening up of international capital markets. Consequently, as suggested by Aglietta (2009), there is an urgent need for the industry to overhaul and rethink its finance system, restructure the financial markets and modernize and reorganize the way they work. In this context, some specialists argue that in such turbulent times, we must rethink finance by reducing risk, reassuring investors and seeking greater stability in the financial markets. To do this, we need to go back to the principles and rules of an earlier era when speculation was moderate and risk was strictly controlled. Jouini (2009) suggested that Islamic finance offers an alternative means of finance that operates within the contours of the new constraints.

Islamic finance is based on the principles of Islamic Law called the *Sharia*, which, by definition, develops an interface for investment and products that limits excessive risk positions, controls trading and reduces the effects of speculation. It is especially interesting in that it could reassure the financial markets and investors through the development of instruments underpinned by far greater social responsibility, ethical and moral values, sustainable finance and banking, etc. Furthermore, the regulations pertaining to Islamic products incorporate several important differences compared to conventional finance. These include the prohibition of interest rates when lending money to households, as well as a ban on investment in businesses to do with alcohol production, pork-related products or ammunition. Islamic fund investors are encouraged to invest in assets that comply with Islamic Law. A second important principle is the prohibition of speculation and excessive risk. Thus, according to Islamic finance ideals, banks should share their profits and losses with investors. In practice, this involves developing low-risk and modest return instruments such as *Murabaha* or secure, short-term commodity and trade finance, and structured medium-term investments (Causse, 2009, 2010a, b).

Overall, in these turbulent times, such ethical and moral positions and rules can make Islamic finance more attractive than traditional finance as it protects investors from the high risks associated with conventional financial products. In particular, with its new and less risky innovations, Islamic finance can constitute an interesting refugee for investors as it provides a favourable investment climate with moderate risk and secure financial conditions (Jouini, 2009).

Historically, Islamic finance was first developed in the Gulf Council Countries during the 1990s, and has since expanded at around 12% a year, displaying exceptional growth and encouraging several western investment banks to offer *Sharia*-compatible, added-value niche services (Causse, 2009). Furthermore, various Islamic financial products have now reached the US, European, Middle Eastern and Asian-Pacific markets. Several banks and financial institutions in developed and emerging countries have begun to review their legislation and regulations in order to adopt these products. A number of academics, professionals and policymakers also consider Islamic finance as an interesting finance alternative, suggesting that its products might be more efficient and could outperform conventional finance products in the future (Srairi, 2009; Jawadi *et al*., 2011).

The present article investigates this issue through a study of the interdependence of conventional and Islamic indexes during the US crisis in three major regions: Europe, the US and the World. The topic is particularly interesting as it enables us to investigate investment strategies and diversification opportunities within two types of financial funds and in three different regions. The question is of particular interest in view of the global financial crisis that has led to significant losses and has destroyed investors' trust in financial markets and funds. Our study could thus have considerable implications for investors and policymakers in the revision of their investment strategies and risk management decisions that might now include a new class of financial products: Islamic funds. In particular, our exploration offers further evidence of new resource allocation opportunities and optimal portfolio management strategies through a mix of conventional and Islamic funds.

The study used Vector Autoregressive (VAR) models to reproduce the short-term dynamics and interdependence between conventional and Islamic stock returns, while Granger causality tests enabled us to determine the reaction of conventional prices following a shock that affected the Islamic finance industry. Portfolio simulations were also carried out to check for diversification opportunities associated with Islamic financial products. This issue is particularly interesting and promising as the findings could help us to define optimal investment, portfolio and resource allocation, helping to reassure investors in the present turbulent times.

The article is organized as follows. The second section will briefly present the data and set out the main

[1] See Sousa (2010, 2012a) for wealth effects and macroeconomic impacts of these central bank actions and measures.

statistical properties. The key results associated with VAR modelling and causality tests are discussed in Section III. Section IV presents the main findings linked to portfolio simulations, while the last section sums up our main findings.

II. Data and Descriptive Statistics

The data consists of the conventional and Islamic stock indexes for three major regions: Europe, the USA and the World. For conventional indexes, we used the MSCI closing prices that we obtained from the Morgan Stanley Capital International database (*MSCI World*, *MSCI Europe* and *MSCI United States*), while the *FTSE TII Global Islamic Index*, the *FTSE TII Europe Islamic Index* and the *FTSE TII America Islamic Index* are used as measures for Islamic indexes for the World, Europe and the US, respectively. Islamic stock indexes were obtained from the International Datastream. Data is daily and is available for the period from 14 August 2006 to 30 June 2008, enabling us to assess the contribution of Islamic fund investments before and after the subprime crisis. The whole series is expressed in logarithmic terms to reduce variance.[2]

First of all, we checked the stock index stationarity using Dickey–Fuller (1981) and Phillips–Perron (1988) unit root tests. Both of them concluded that the series of stock prices are integrated of order one ($I(1)$).[3] We therefore focused on the series of stock returns that we approximate through the first difference of stock prices in logarithm. While plotting both conventional and Islamic stock returns for each region in Fig. 1, we noted two interesting results. On the one hand, Islamic returns seem to be less volatile than conventional returns, suggesting that Islamic funds are more secure than the latter and therefore more appropriate for investors from a high risk aversion perspective. On the other hand, even though the latter period is characterized by significant volatility, probably due to the global financial crisis, the degree of volatility varies according to the region, and is less marked for Europe.

Third, we computed the main descriptive statistics of stock returns and reported the correlation matrix in order to check their statistical properties and investigate the linkages between conventional and Islamic funds (Tables 1 and 2). In particular, we compute these statistics for two subsamples: 14 August 2006–16 July 2007 and 17 July 2007–30 June 2008 as well as for the whole period under consideration in order to capture the impact of the subprime crisis on Islamic and conventional financial industries. Our results also provide several interesting findings.

While the normality hypothesis is significantly rejected for the whole series and for the sample before the subprime crisis, the Jarque–Bera test does not reject the null hypothesis of normality for the second sample for the US and World markets, suggesting further evidence of strong mean-reversion and correction for stock prices after the crisis and therefore less inefficiency. The SD for stock returns shows low values for the Islamic indexes notably after the crisis, indicating less risk for Islamic funds, particularly in Europe and the USA. This is in line with our previous intuition when analysing the dynamics of conventional and Islamic financial indexes. Moreover, the analysis of stock return averages shows that Islamic funds supplant conventional funds, particularly after the crisis. However, negative signs for average stock returns for the second sub-period highlight the impact of the US crisis on conventional and Islamic investments.

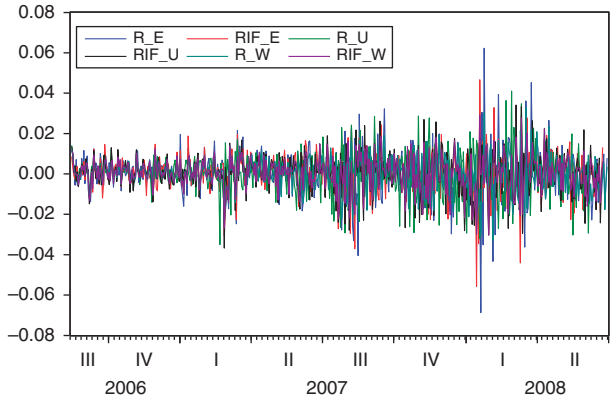

Fig. 1. Stock returns for conventional and Islamic indexes

The analysis of the correlation matrix also provides interesting findings. First, we note strong linkages between Islamic finance indexes, which can be due to the fact that they display several similarities and that they all rely on *Sharia* principles. Second, we note a significant decrease in stock index correlations for both conventional and Islamic prices. This may reflect the effect of the subprime crisis that led to considerable losses for stock markets and conventional financial assets. Furthermore, the reduction in co-movements between conventional indexes may be justified by the fact that the US market – the first market concerned by the crisis – lost its leadership role. Finally, negative correlation between conventional and Islamic stock returns over the second sample can be seen as an indication of further diversification opportunities. This also means that the inclusion of Islamic funds with conventional financial assets can reduce systematic financial risk and improve resource allocation and portfolio performance (Elfakhani and Kabir, 2005; Raphie, 2006; Fikriyah *et al*., 2007; Abderrezak, 2008).

In order to improve the investigation of the interaction dynamics between conventional and Islamic stock returns and check their linkages within the context of the financial crisis, as well as explore the feedback effects between conventional finance and the Islamic finance industry, we modelled short-term stock returns using a VAR model.

III. VAR Modelling

To apprehend the stock return dynamics and check the nature of the relationships between conventional and Islamic

[2] It is important to note that while the period under consideration enables us to investigate the contribution of investment in Islamic funds before and after the subprime crisis, this cannot apprehend the nature of investment opportunities after the impact of Lehmann's collapse or the EU sovereign debt crisis. Such issues could be the focus of future research work. We would like to thank the anonymous reviewer for this suggestion.

[3] We have not reported the results of the unit root tests to save space, but they are available upon request.

Table 1. Descriptive statistics for stock returns

	R_E	*RIF_E*	*R_U*	*RIF_U*	*R_W*	*RIF_W*
Panel A: Sample 1 – 14 August 2006–17 July 2007						
Mean	0.001	0.0007	0.0006	0.001	0.0009	0.001
SD	0.007	0.006	0.006	0.006	0.005	0.005
Skewness	−0.399	−0.410	−1.13	−0.925	−0.712	−0.623
Kurtosis	3.82	4.72	7.32	6.99	5.23	4.93
Jarque–Bera	13.21	36.43	238.3	194.1	70.06	53.05
Probability	0.00	0.00	0.00	0.00	0.00	0.00
Panel B: Sample 2 – 17 July 2007–30 June 2008						
Mean	−0.0005	−0.0007	−0.0005	−8.31E−05	−0.0004	−0.0001
SD	0.014	0.012	0.012	0.012	0.010	0.010
Skewness	−0.117	−0.344	0.002	−0.181	−0.074	−0.241
Kurtosis	6.01	4.84	3.42	3.10	3.41	3.12
Jarque–Bera	89.33	37.85	1.75	1.40	1.89	2.43
Probability	0.00	0.00	0.41	0.49	0.38	0.29
Panel C: Whole period						
Mean	0.0003	4.1 E−05	5.2 E−05	0.0004	0.0002	0.0004
SD	0.011	0.010	0.010	0.009	0.008	0.008
Skewness	−0.294	−0.513	−0.259	−0.409	−0.316	−0.441
Kurtosis	8.00	6.41	4.90	4.44	4.70	4.23
Jarque–Bera	502.57	250.95	77.05	54.65	65.43	45.63
Probability	0.00	0.00	0.00	0.00	0.00	0.00

Notes: *R_E*, *R_U* and *R_W* denote the benchmark stock returns for European, the US and World markets, respectively while *RIF_E*, *RIF_U* and *RIF_W* denote the Islamic Finance stock returns for the same countries under consideration.

Table 2. Correlation matrix

	R_E	*RIF_E*	*R_U*	*RIF_U*	*R_W*	*RIF_W*
Panel A: Sample 1 – 14 August 2006–16 July 2007						
R_E	1.00	0.58	0.07	0.34	0.84	0.58
RIF_E		1.00	0.18	0.57	0.49	0.81
R_U			1.00	0.24	0.10	0.17
RIF_U				1.00	0.53	0.86
R_W					1.00	0.65
RIF_W						1.00
Panel B: Sample 2 – 17 July 2007–30 June 2008						
R_E	1.00	−0.05	0.04	0.11	0.82	0.02
RIF_E		1.00	−0.01	0.51	−0.03	0.80
R_U			1.00	0.02	−0.03	0.00
RIF_U				1.00	0.06	0.85
R_W					1.00	0.01
RIF_W						1.00
Panel C: The whole period						
R_E	1.00	0.08	0.05	0.16	0.83	0.15
RIF_E		1.00	0.04	0.53	0.08	0.80
R_U			1.00	0.07	0.01	0.04
RIF_U				1.00	0.17	0.86
R_W					1.00	0.16
RIF_W						1.00

stock returns, we tested linear causality effects using the Granger test and then estimated a VAR model with two equations that jointly described the dynamics of conventional and Islamic indexes for each region under consideration. VAR modelling has the advantage of capturing the dynamics for Islamic and conventional indexes and reproducing the reaction of Islamic (resp. conventional) funds following a shock that affected conventional (resp. Islamic) funds.

Granger causality test

This test aims to determine the presence of causal relationships between conventional (resp. Islamic) prices and Islamic (resp. conventional) indexes. A rejection of the null hypothesis in this test (absence of causal relationships) is not in line with an efficient capital market hypothesis as it implies that the inclusion of information concerning conventional

Table 3. Granger causality test

Null hypothesis	*F*-statistic	Probability
Panel A: Europe		
RIF_E does not Granger cause *R_E*	1.24	0.28
R_E does not Granger cause *RIF_E*	1.58	0.20
Panel B: The USA		
RIF_U does not Granger cause *R_U*	0.27	0.76
R_U does not Granger cause *RIF_U*	0.31	0.72
Panel C: The World		
RIF_W does not Granger cause *R_W*	1.35	0.25
R_W does not Granger cause *RIF_W*	0.94	0.39

(resp. Islamic) prices can help improve the forecasting of Islamic (resp. conventional) future indexes. The test is carried out in both directions for the three regions under consideration and its results are reported in Table 3. According to our results, no causal relationship is significant in the double direction for the three regions. This is in line with the weak correlations reported in Table 2 and can be justified by the difference in their financial systems and regulations. Interestingly, we carried out this test for the two sub-periods mentioned above and the null hypothesis is rejected only in the US case.[4] This result is *a priori* in line with the diversification opportunity of Islamic funds mentioned through the analysis of correlation matrix. For example, one can expect that the combination of conventional and Islamic funds would allow investors to expect higher returns and/or less risk.

Next, we investigate the short-term interdependence between stock returns, using a bivariate VAR model for each region.

Short-term investigation using a VAR model

We now turn our attention to the short-term dynamics of conventional and Islamic stock markets using VAR models. VAR models are a generalization of the univariate Autoregressive (AR) model introduced by Sims (1980). Their main advantage is to provide a multivariate representation including several variables that enable the interactions between the latter to be reproduced, as well as their responses following a shock affecting any variable within the system. A VAR model corresponds to

$$y_t = \mu_t + \sum_{i=1}^{p} B_i y_{t-i} + \varepsilon_t \quad (1)$$

where $y_t = (y_{1t}, y_{2t}, \ldots, y_{pt})'$ is a $(p \times 1)$ vector of endogenous variables, $\varepsilon_t \rightarrow N(0, \sum_{\varepsilon})$ is a p-dimensional independent and identically distributed (i.i.d) error process with mean 0 and covariance matrix $\sum_{\varepsilon}$.

The variables included in the VAR systems correspond to lagged stock returns of conventional and Islamic prices. For each region, we carried out a bivariate VAR model where the first equation reproduces the dynamics for the conventional stock returns, while the second refers to that of Islamic stock returns. Such specifications enabled us to apprehend the lead–lag effects between conventional and Islamic prices. Thus, to specify the linkages between conventional finance and Islamic funds, we retained a VAR specification with two equations noted VAR(2). The p-order of a VAR model is determined using information criteria and autocorrelation functions. After checking that the variables included in the VAR models were stationary, we estimated the VAR models and reported the main results in Table 4. Using information criteria as well as a Likelihood Ratio (LR) test to test a VAR($p+1$) against VAR(p), we retained $p=4$ for Europe and the World, and $p=1$ for the USA.[5]

Next, we moved on to the estimation of VAR models that we report in Table 4. The estimation results offer several interesting findings. First of all, the autoregressive coefficients alternate between positive and negative, suggesting that stock markets are still under correction for both regions. Second, while conventional returns do not explain Islamic stock returns, confirming the Granger Causality tests, our findings reproduce significant dependence of conventional returns on Islamic returns. This suggests strong evidence of short-term dependency of conventional to Islamic funds, indicating that a part of conventional index performance is perhaps in Islamic fund contribution. This is not unexpected as several French banks such as *Société Générale* and *BNP Parisbas*, for example, introduced new financial products that share similar properties to Islamic funds. That is, the impact of Islamic funds on conventional indexes is particularly interesting because it can provide investors with better risk control and management. They can also expect higher returns if they include Islamic funds in their portfolios as mentioned by Jouini (2009). Such dependency effects are not significant for the USA, however, but they are positive and significant for Europe and the World.

Furthermore, we can note the relative weakness of the VAR model to significantly apprehend statistical properties for Islamic indexes in particular. Indeed, empirical results of VAR models are more significant for conventional indexes. At least two explanations may be retained. On the one hand, conventional and Islamic markets do not share the same properties (regulations, risk, evaluation, infrastructure, risk management, financial asset evaluation and remuneration) and therefore it is understandable that their dynamics cannot be effectively captured using similar specifications. On the other hand, VAR modelling is not appropriate to capture asymmetry, non-normality, or nonlinearity that seems to be inherent in stock price dynamics as suggested by Table 2. Moreover, the relative difference between VAR estimations and the Granger causality test may be due to the fact that the period under consideration is somewhat short.

Obviously, we do not expect to find conventional and Islamic financial industries to be completely independent, but, as suggested by Causse (2009), it seems that interest in Islamic

[4] We do not report the results of Granger test for the sub-periods to save space. They are however available upon request.
[5] Such specifications seem to be unchanged for both of the samples considered, suggesting stable lead-lag effects between conventional and Islamic industries. This may be due to the fact that the period under consideration is relatively short, whereas significant changes to the relationship between these two financial industries probably require much more time.

Table 4. VAR estimation

	R_E	*RIF_E*
Panel A: Europe		
R_E(−1)	−0.23*	0.06
	[−5.80]	[1.50]
R_E(−2)	0.04	−0.03
	[0.94]	[-0.83]
R_E(−3)	−0.10*	−0.02
	[−2.72]	[−0.46]
R_E(−4)	−0.07*	−0.02
	[−1.99]	[−0.60]
RIF_E(−1)	−0.006	−0.12*
	[−0.14]	[−2.68]
RIF_E(−2)	0.07**	0.064
	[1.73]	[1.38]
RIF_E(−3)	0.39*	−0.065
	[8.94]	[−1.38]
RIF_E(−4)	0.58*	−0.006
	[12.90]	[−0.14]
C	0.0002	−4.14E−05
	[0.55]	[−0.08]
R-squared	0.34	0.03
F-statistic	30.00	2.08
Log-likelihood	1555.2	1523.2
	R_U	*RIF_U*
Panel B: The USA		
R_U(−1)	−0.13	0.02
	[−2.85]	[0.38]
RIF_U(−1)	−0.01	−0.11
	[−0.29]	[−2.46]
C	3.61E−05	0.0004
	[0.07]	[1.08]
R-squared	0.02	0.01
F-statistic	4.20	3.05
Log-likelihood	1501.4	1521.2
	R_W	*RIF_W*
Panel C: The World		
R_W(−1)	−0.14*	0.02
	[−3.41]	[0.43]
R_W(−2)	0.04	−0.05
	[1.23]	[−1.17]
R_W(−3)	−0.13*	−0.02
	[−3.64]	[−0.54]
R_W(−4)	−0.10*	−0.06
	[−2.88]	[−1.30]
RIF_W(−1)	0.03	0.10*
	[0.91]	[2.17]
RIF_W(−2)	0.002	0.03
	[0.06]	[0.84]
RIF_W(−3)	0.45*	−0.06
	[12.40]	[−1.46]
RIF_W(−4)	0.45*	0.008
	[10.72]	[0.14]
C	−0.0002	0.0003
	[−0.68]	[0.86]
R-squared	0.40	0.03
F-statistic	39.52	1.60
Log-likelihood	1748.7	1630.2

Note: *R_E*, *R_U* and *R_W* denote the benchmark stock returns for European, the US and the World markets, respectively, while *RIF_E*, *RIF_U* and *RIF_W* denote the Islamic finance stock returns for the same countries under consideration. Values between [·] are the *t*-ratios.
* and ** denote significance at 5 and 10% levels, respectively.

funds was more strongly activated following the subprime crisis. To check this hypothesis, in the next section we develop a portfolio simulation within conventional and Islamic funds before and after the subprime crisis, as well as for the whole period. This is particularly interesting to directly assess the opportunities associated with investment in Islamic financial assets.

IV. Portfolio Simulations

The simulation exercise consisted of testing the contribution of Islamic funds to improve the portfolio management within the context of the recent global financial crisis. In particular, we tested whether the composition of portfolios with conventional and Islamic funds could enable investors to increase their expected returns and/or to reduce the systemic risk associated with investment in the stock markets. To this end, we have developed portfolio simulations over two sub-periods: 14 August 2006 to 16 July 2007 and 17 July 2007 to 30 June 2008. These sub-periods were designed to distinguish stock market dynamics before and after the US crisis, and we reproduced the impact of the subprime crisis on resource allocation and portfolio choice.[6]

Formally, we made use of a mean-variance approach and focused on the correlations between conventional and Islamic funds. This enabled us to evaluate the investment opportunities in Islamic funds before and after the US crisis and to provide evidence of the perspective associated with Islamic products. To this end, we retained, on the one hand three different scenarios:

- S_1: The portfolio includes 25% of Islamic funds and 75% of conventional funds.
- S_2: The portfolio includes 50% of Islamic funds and 50% of conventional funds.
- S_3: The portfolio includes 75% of Islamic funds and 25% of conventional funds.

This allowed us to evaluate the contribution of the investment in Islamic products while taking into account the risk aversion of investors to Islamic funds, the degree of development of the Islamic industry in the region, and the openness of the latter to Islamic investments. Indeed, the development of Islamic investments varies according to the regions, and the preference for Islamic funds also varies according to investors and financial systems (Jawadi *et al.*, 2011). On the other hand, we propose endogenously determining the investment proportions associated with the investment in conventional and Islamic financial assets. Indeed, while the first approach is informative about Islamic fund investment performance, the choice of proportions for investment in conventional and Islamic funds is somewhat random. However, within the second approach, we propose endogenously determining investment proportions so that investors will be able to select financial assets (conventional or Islamic)

[6] Jawadi *et al.* (2011) also investigate the performance of Islamic funds with regard to conventional funds before and after the crisis and show how Islamic products supplanted conventional assets to some extent after the US crisis.

Table 5. Portfolio simulations

$E(R_A)$	$\sigma(R_A)$	$E(R_B)$	$\sigma(R_B)$	$rA \cdot B$	$E(R\backslash S_1)$	$\sigma(R\backslash S_1)$	$E(R\backslash S_2)$	$\sigma(R\backslash S_2)$	$E(R\backslash S_3)$	$\sigma(R\backslash S_3)$	Ratio
Panel A: Europe											
Sample 1: 14 August 2006–16 July 2007											
0.00077	0.006895	0.001123	0.007433	0.582196	0.00103475	0.00672595	0.0009465	0.00637311	0.0008	0.006	0.85
Sample 2: 17 July 2007–30 June 2008											
−0.000803	0.012833	−0.000729	0.014622	−0.050153	−0.0007475	0.01127067	−0.000766	0.00948244	−0.0007	0.010	0.64
Panel B: The USA											
Sample 1: 14 August 2006–16 July 2007											
0.001001	0.006665	0.000668	0.006609	0.239369	0.00075125	0.00559462	0.0008345	0.00522468	0.0009	0.005	0.79
Sample 2: 17 July 2007–30 June 2008											
−0.00024	0.012093	−0.000579	0.012917	0.026982	−0.00049425	0.0102261	−0.0004095	0.00896548	−0.0003	0.009	0.69
Panel C: The World											
Sample 1: 14 August 2006–16 July 2007											
0.001015	0.005723	0.000925	0.005366	0.653235	0.0009475	0.00507606	0.00097	0.00504152	0.0009	0.005	0.93
Sample 2: 17 July 2007–30 June 2008											
−0.00026	0.010144	−0.000658	0.010259	0.019806	−0.0005585	0.00814897	−0.000459	0.00728475	−0.0003	0.008	0.71

Notes: $E(R\backslash S_i)$ and $\sigma(R\backslash S_i)$ denote the expected return and the SD of the portfolio according to scenario i, $\forall I = 1, 2, 3$. The ratio refers to the portfolio risk in relation to the risk level associated with the conventional index.

and choose portfolios that offer them either higher expected returns or less systemic risk.

Formally, we compose a portfolio of conventional and Islamic funds. We note p_i the proportion associated with Islamic funds and $1-p_i$ that of conventional funds to be included in the portfolio. The expected return associated with the portfolio corresponds to

$$E(R) = p_i \times E(R_A) + (1 - p_i) \times E(R_B) \quad (2)$$

where R_A, R_B and R denote respectively the stock return for the Islamic price, the conventional index and the portfolio under consideration, $i = 25\%$, 50% and 75% with respect to S_1, S_2 and S_3. $E(\cdot)$ denotes the expectation operator.

The variance equation of the risk associated with this portfolio is given by

$$\sigma^2(R) = p_i^2 \times \sigma^2(R_A) + (1 - p_i)^2 \times \sigma^2(R_B) + 2 \times \rho_{A,B} \times p_i \times (1 - p_i) \times \sigma(R_A) \times \sigma(R_B) \quad (3)$$

where $\sigma^2(R)$, $\sigma^2(R_A)$ and $\sigma^2(R_B)$ denote the variances for the portfolio, the Islamic fund and the conventional fund, respectively. $\rho_{A,B}$ refers to the correlation measure between the Islamic and the conventional returns.

Thus, we first evaluate the investment opportunities in Islamic funds while computing the expected return and variance for this portfolio using the above mean-variance equations under the three above-mentioned scenarios. We carry out simulations for two sub-periods as well as for the whole period so as to highlight the contribution of investment in Islamic funds. This is also particularly interesting to understand how such alternative finance and investment strategies can affect resource allocation and portfolio choice.

The main empirical results associated with portfolio simulations are summarized in Table 5. The analysis of these results yields several useful findings. First of all, while the stock returns for both indexes in the different regions are positive for the first sample, they are somewhat negative in the second, suggesting that the recent US real estate and financial crisis resulted in significant corrections for both funds as mentioned in Section II. Second, for the three regions under consideration, we noted a significant decrease in the correlation between conventional and Islamic indexes after the crisis, suggesting that the latter affected conventional and Islamic funds differently. It could also imply a shift in the position of Islamic funds *vis-à-vis* conventional products, and in investors' preferences regarding financial assets. It would appear that Islamic funds, long considered as ethical, moral and less risky financial products, are indeed safer for investors.[7] According to our findings, for example, Islamic funds show lower SDs than conventional products before and after the crisis for the three regions under study, implying less risk for investors adopting these new financial assets. Consequently, the decrease in these relationships and the negative correlation for Europe may suggest further new diversification opportunities. Third, the analysis of the diversification opportunities through the inclusion of Islamic funds in the portfolio using the mean-variance approach provides interesting and promising implications. Indeed, we show that investment in Islamic funds can help to reassure investors as they can expect higher returns as well as more controlled risk. However, as the development of Islamic finance varies according to regions, these opportunities are also variable, and rational investor preference toward diversification scenarios may consequently also vary according to the region as suggested by Jouini (2009).

[7] For more details about changes in investor's preference, see Sousa (2012b), who explores the nature of preferences of the representative investor to emphasize the role of wealth shocks in explaining time-variation in portfolio composition. Also, Sousa (2012c, d, e) recently investigated the linkages between asset wealth, labour income, stock returns and government bond yields, and provides evidence of changes in investor's choices and preference.

In particular, regarding the expected return criterion, Scenario 3 supplants the first two scenarios for the World and the US region as it generates higher returns pre- and post-crisis. For Europe, the preference for Scenario 1 can be justified by the late arrival of Islamic funds into the financial system (Causse, 2009; Jouini, 2009). Thus, while heavy investment in Islamic funds could imply high returns for investors in the World and the US region, it appears that European investors are less wary and appear to prefer the smooth openness of Islamic products. Finally, with regard to the principle of risk minimization, the simulation results are more informative. The second scenario appears to be preferred by investors in all three regions under consideration as it enables them to significantly reduce the systemic risk associated with their portfolios. In particular, our findings show that the risk reduction offered by investment in Islamic funds is active for both samples and regions, but that it was more significant after the US crisis.

Indeed, before the US crisis, risk reduction varied from 7% (for the World) to 15% (for Europe) and 21% (for the US region), while it reached far higher levels after the crisis: 29% for the World, 31% for the US region and 36% for Europe. This finding is extremely interesting as it provides further evidence of new investment and diversification opportunities. Such an investment strategy is highly appropriate for investors looking for safe havens where they can invest their money with less risk and uncertainty.

As noted before, however, such results are relatively limited as they are conditioned by the hypotheses associated with the above scenarios. In order to explicitly evaluate the investment opportunities of Islamic funds, we propose developing an optimal portfolio and generating optimal solutions (p^*). To do this, we resolve the following optimization framework associated with the minimization of portfolio variance:

$$\begin{aligned}\text{Min}\,\sigma^2(R) = {} & p^2 \times \sigma^2(R_A) + (1-p)^2 \times \sigma^2(R_B) \\ & + 2 \times \rho_{A,B} \times p \times (1-p) \times \sigma(R_A) \times \sigma(R_B), \\ & \text{under the constraint: } p + (1-p) = 1 \end{aligned} \quad (4)$$

We can easily show that

$$\frac{\mathrm{d}\sigma_R^2}{\mathrm{d}p} = 0 \Rightarrow p^* = \frac{\sigma_{R_B}^2 - \rho_{AB}\sigma_{R_B}\sigma_{R_A}}{\sigma_{R_B}^2 + \sigma_{R_A}^2 - \rho_{AB}\sigma_{R_B}\sigma_{R_A}} \quad (5)$$

Accordingly,[8] we computed the optimal investment proportions associated with the arbitrage between conventional and Islamic funds and we reported the main results in Table 6, where p^* and $(1-p^*)$ denote the investment proportions in Islamic and conventional funds respectively.

For the above optimal portfolio, we derived the appropriate specifications and noted different implications. Indeed, not only do we derive the optimal proportions of investment associated with optimal portfolio while minimizing the expression 3, but we also compute them for the three regions under consideration before and after the crisis. Our main findings provide interesting results that we report in Table 6. On the one hand, we highlight the fact that the optimal investment proportion in Islamic funds varies according to regions, reflecting the heterogeneous development process of Islamic finance in these products. On the other hand, we note that the optimal investment proportions in Islamic funds over the second sample increase for all regions, confirming the increased appetite of investors after the crisis to invest in Islamic funds and the attractiveness of Islamic financial innovations. In particular, such proportions have increased by 67% for Europe, 23% for the US and 138% for the World. Furthermore, one can note that the spread in optimal investment proportions between the regions under consideration decreased significantly after the US crisis, providing further evidence of a general orientation towards these new financial assets and indicating a strong emergence of Islamic financial assets. The optimal proportions for the second subperiod of even more than 50% for the three regions seem, however, to continue to be closer to those of conventional funds, implying an equitable repartition of investment and similar resource allocation between conventional and Islamic financial assets. This not only reflects the doubt associated with this 'young' alternative finance, but also the intensity of the confidence crisis induced by the latest global financial crisis. Finally and obviously, the significant decrease in optimal investment proportions for conventional funds appears to illustrate the actual failure of conventional finance. Indeed, the latter decreased by 35% for Europe, 17.5% for the US and 37% for the World.

Table 6. Optimal portfolio

Region	p^*	$1-p^*$
Sample 1: 14 August–16 July 2007		
Europe	0.35	0.65
The USA	0.42	0.57
The World	0.21	0.79
Sample 2: 17 July 2007–30 June 2008		
Europe	0.58	0.42
The USA	0.53	0.47
The World	0.50	0.50

V. Conclusion

This study investigates the investment opportunities associated with Islamic funds during the financial crisis. In particular, it explores whether Islamic finance innovations and ethical values could provide investors with new diversification benefits, particularly given the large losses induced by the recent global financial crisis and the reduced demand for conventional financial assets. Empirical portfolio simulations for three major regions (the US, Europe and the World) over two sample covering periods before and after the crisis provide strong evidence in favour of Islamic funds as they allow investors to expect higher returns and lower risk. This implies that during turbulent times, socially responsible investment and ethical finance are required to reassure investors and stabilize financial markets. Moreover, the derivation of the investment proportions for optimal portfolios shows that investors reoriented their investments to such new financial

[8] We would like to thank the anonymous reviewer for his/her suggestion regarding the derivation of an optimal portfolio.

products implying an increase in Islamic fund investment of 67% for Europe, 23% for the US and 138% for the World. A natural extension of this study would be to investigate the performance of individual Islamic funds against traditional funds to clarify the characteristics of Islamic financial assets to include in portfolios, as well as the propagation mechanisms between conventional and ethical instruments.

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