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# *Shari'ah* Screening, Market Risk and Contagion: A Multi-Country Analysis[1]

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**Abstract:**

This study investigates the relationship and shock transmission between firm leverage and systematic risk within the *Shari'ah* stock screening rules among seven European countries with a sample of 689 firms for the period from 2008 Q2 to 2013 Q1. Due to the fact that high leverage augments systematic risk and accentuates the firm's vulnerability to shocks, *debt* screening is used to examine the sampled portfolios. As it imposes limits on debt, we examined the impact of such an ethical screening and a risk moderating principle on stock volatility, susceptibility to contagion and the implications for portfolio diversification. Using a vector autoregressive dynamic panel of multi-country framework, systematic risk is analysed by taking into account firm characteristics, country effects, and the heterogeneity across firms, thereby ensuring the robustness of results. Our findings suggest that the systematic risk changes with changes in the capital structure; the *Shari'ah*-compliant stocks are shown in most cases to carry less risk than conventional stock, while they do not necessarily out-perform in terms of return; during the global financial crisis. We conclude that during the global financial crisis, Islamic compliant stocks demonstrated lower values of systematic risk in the case of 'Low Debt' portfolios when comparison to 'High Debt' portfolios.

**Keywords:** Systematic risk, leverage, *Shari'ah* stock screening, financial crisis, contagion, dynamic GMM panel technique.

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## 1. Introduction

Rogoff and Reinhart (2010) advance that the root cause of modern financial crises has been excessive debt. In an attempt to substantiate this argument, understanding the level of corporate debt and volatility in relation to contagion under normal economic conditions and under shocks has been an important academic and policy concern. While there is considerable research on capital structure and its relation to systematic risk (financial risk and business risk), there appears to be no consensus regarding the measure of impact of leverage over the systematic risk for firms (Ben-Zion and Shalit, 1975; Castagna and Matolcsy, 1978; March and Shapiro, 1987; Bhandari, 1988; Engle and Ng, 1993; Weber, 2004). Moreover, little has been reported from the *Shari'ah* perspective, which takes into account the impact of the quantitative screening of debt. In achieving Islamic compliance, *Shari'ah* screening, as part of an array of financial principles stipulates that a portfolio and the financial composition of a company should consist of no more than 33% debt to ensure stability and moderate risk exposure. Considering the financial difficulties observed in the European markets, which can to a certain extent be attributed to heavy debt, this study tests the implications of such a prudent financial constraint on European stocks. The effects of *Shari'ah* constraints on European stocks are measured with reference to the following question: 'if the *debt* screening as part of *Shari'ah* compliancy had been applied to the European stock, what would have happened to systemic risk exposure?' Thus, this paper aims to contribute to the literature by focusing on *debt* stock screening, as to the best of our knowledge, such a method has not yet been tested in literature.

Analysing the relationship between leverage and systematic risk is important due to its impact on share valuation (Duett *et al*., 1996). However, only limited number of studies have focused on this relationship within the Islamic finance framework by applying the stock screening filters (quantitative and qualitative). A list and status of all sectors based on qualitative stock screening is provided in Appendix. In this study we examine the relationship between debt and beta that serves our measure of systematic risk within the *Shari'ah* debt screening framework. Our approach serves as an interesting channel for investigating systematic risk and price volatility behaviour within the normative principles of Islamic finance.

Among the key issues that we examine in this paper is the impact of the 33% debt threshold used in the screening of stocks according to *Shari'ah* principles, that has recognisable impact on the performance of compliant portfolios. Given that such an imposed threshold level limits financial leverage, one would expect screened portfolios to have lower beta (β). However, the existing literature is inconclusive; Omet and Al-Debi'e (2000), Rowe and Kim (2010), Tan *et al.* (2015), have documented that financial leverage and systematic risk (β) are not necessarily positively correlated. En passant we note beta is the sum of both operating and financial leverage and the 33% *Shari'ah* screening threshold only limits financial leverage and does not have any implications for the operating leverage constituent of beta. As such, relationship between the lower systematic risk (β) and volatility of a *Shari'ah* compliant portfolio cannot be taken as a priori. Purpose of our study is to contribute empirically whether *Shari'ah* compliant stocks due to their lower leverage also have a lower systemic risk as measured by beta.

In passing we note that according to *Shari'ah* principles, a single financial leverage threshold of 33% is used in *debt* screening regardless of whether the underlying industry or business risk would have an inherent bias. 'Capital structure theory' tells us that the optimal debt level should vary by industry according to its operating leverage in the sense that firms in high operating leverage industries should have low financial leverage and *vice-versa*. If companies attempt to maximize firm value by optimising their capital structure, then the use of a single threshold, as is done in *debt* screening, can be problematic. Specifically, if 33% is low financial leverage; then the companies selected would be high operating leverage companies that are keeping their debt ratios low. The implication here is that the *Shari'ah* compliant portfolio would consist of high business risk firms. As a result, even with limiting the debt threshold, the overall portfolio would still have a high systematic risk beta β, since the qualifying stocks would all have high operating leverage. Alternatively, it can also be argued that where the underlying business risk is low, the 33% threshold would pick companies that are not maximizing firm value because they have too little leverage. Those firms are not at optimal capital structure and it is of significant importance for a firm to determine its optimum level of debt (Goetzmann *et al*., 2005).

The last two arguments imply that a *Shari'ah* compliant portfolio may not necessarily be mean-variance optimal. The use of a single threshold across all firms can lead to a selection of high business risk firms whose optimal capital structure requires debt below 33% or low risk businesses that are under leveraged. As such, there is no *a priori* reason to believe that the *Shari'ah* screening procedure would always lead to low systematic risk portfolios.

Consequently, based on the threshold of 33% level of debt, this study analyses whether systematic risk changes with changes in the capital structure of the firm in cases both of low debt (LD) and high debt (HD) firms within seven European countries. In addition, the behaviour of the combined portfolio of low debt and high debt (LD + HD) is analysed in a portfolio analysis. Firms, that have been qualitatively screened and which have a capital structure of less than 33% in accordance with the first quantitative criteria of *debt* stock screening, are '*good*' candidates for consideration as compliant stock.

Regarding the contagion effect, it is interesting to investigate whether low debt has less of a negative impact during shocks. Volatility increases during crisis periods by driving contagion into inter-related capital markets, which become more correlated during turmoil conditions. In the periods of contagion, firms with higher leverage become more vulnerable to markets and financial risks (*see:* Ahmad *et al*., 2013; Duncan and Kabundi, 2013, Hwang *et al*., 2013, among others).

Based on this given context, this study is focused on the following three objectives:

(i) measuring the impact of leverage on systematic risk (also known as sensitivity to market risk);

(ii) examining how applying *Shari'ah* stock screening to levered and unlevered betas (computed at the country level for the seven countries) could bring more micro-stability to the European capital market; and

(iii) analysing such an impact for the global financial crisis period, since we expect it to be amplified (addressed in section 5.5).

We thus consider three portfolio strategies: (i) LD (low debt) portfolio; (ii) HD (high debt) portfolio; and (iii) combined portfolio of LD and HD, for investigating the behaviour of levered and unlevered betas in the seven countries, as a combined group of countries and also as individual countries. The capital structure of each portfolio and the level of debt (measured as debt over total assets) are incorporated into this analysis and applied to each set of 20 quarters: (from 2008 Q2 to 2013 Q1). This data interval was selected to encompass the Global Financial Crisis of 2008 (GFC) period. We then employed continuous wavelet analysis (wavelet transform coherency: WTC), which focuses on different stock-holding periods or investment horizons of the investors, to levered and unlevered betas. This allows us to investigate the lead-lag relationship between systematic risk and specific factors such as leverage, sovereign debt and firm size in the portfolio with a special focus on the impact of the global crisis on financial risk.

Our study is one of the first to analyse the impact of leverage on *Shari'ah* screened stocks (both qualitative and quantitative), and our methodology is in line with the Islamic boards of the Financial Times Islamic Index Series (FTSE International Limited, 2007) and the Morgan Stanley Capital International Islamic Index Series (MSCI, 2007).

We show that there is a direct correlation between systemic risk and capital structure and that *Shari'ah* compliant stocks (with debt ratio less than 33%) are found to carry less risk than their conventional counterparts. In addition, during the 2008 global financial crisis, *Shari'ah* compliant stocks showed lower systematic risk, which particularly so for low-debt portfolios in comparison to high-debt portfolios within country cases as well as across the sampled countries. Overall our findings suggest that there is a positive and significant correlation between leverage impact and systematic risk and that systematic risk is augmented by leverage. Furthermore, based on our sample we find a significant positive correlation between debt and sensitivity to market risk and systematic risk is driven by the debt level. This is in line with *Shari'ah* compliance process. We also find the debt level plays a substantial role in the shorter-term shock transmission for levered and unlevered betas (compared to the longer-term shock), especially during periods of financial crisis, as in the recent global financial crisis. Summarising, our findings provide further evidence that debt screening imposed in *Shari'ah* compliant portfolio can be effective in controlling systematic risk. Our findings have important implications for investors, the stability of the stock market in terms of moderating systemic risk as well as for regulators. For example, regulators, accordingly, should be able to develop necessary structures and standards on reducing excessive debt in the stock market. As for investors, in line with the findings of this study, profit-and-loss sharing type equity structures encouraged by Islamic finance may be more appealing in terms of low leverage and higher stability.

The remainder of the paper is arranged as follows: A brief empirical literature review on systematic risk and leverage is presented in Section 2 in order to provide an empirical framework for this study. Section 3 presents details of *Shari'ah* screening and its impact on stock and portfolio behaviour in relation to leverage, which aims to provide the main substance and context for the research. Section 4 explains the research methodology and data collection process, Section 5 presents the results and discusses and analyses the findings. Lastly, Section 6 concludes and reflects on the findings whilst exploring potential policy implications.

## 2. Empirical Studies on Systematic Risk and Leverage

Common stock risk has been classified into two components: the systematic risk (unavoidable risk) and the unsystematic risk (avoidable through diversification). There is a considerable body of literature on the sensitivity to market risk. The salient research on the impact of leverage on systematic risk[2] is discussed below.

There have been numerous studies on systematic risk and leverage. For example, Hamada (1972) found that leverage can be used to explain 21 to 24% value of the common stock β. Lev (1974) discovered an empirical relationship between a firm's operating leverage and the market β. Ben-Zion and Shalit (1975) found firm size, leverage and other variables to be the significant determinants of a firm's β. Similarly, Castagna and Matolcsy (1978) upheld that debt-to-equity ratio, debt-to-total assets ratio, interest coverage bore significant correlations with the systematic risk. Bhandari's (1988) research suggested that the 'debt to equity' ratio is positively correlated with the expected common stock returns. Thus, an asymmetric response of equity systematic risk to past stock performance can be transmitted through the variance asymmetry channel. Barclay and Smith (1995) in their empirical study on volatility and debt

[2] Measuring systematic risk is related to the works on basic portfolio model by Markowitz (1952, 1959) and the capital asset pricing model by Sharpe (1964) using an average β value of the stocks comprised in the portfolio.

structure found that firms chose shorter debt maturity if they had higher asset volatility; however, they did not study the effects of systematic and idiosyncratic risks.

Jie and Zhang (2011) used the Capital Asset Pricing Model (CAPM) based on the Fama-French (1993) three-factor model and the Carhart (1997) four-factor model[3]. They examined whether the observed negative relation between leverage changes and stock returns reflected these stocks' different cross-sectional loadings on systematic risk factors. The alphas from the regressions represented the risk-adjusted returns of the portfolios and they expected the alphas to be similar across all portfolios. Although the factor models could not explain the negative correlation between the changes in leverage ratio and next-quarter stock returns, a firm's capital structure choice might depend on other firm characteristics not captured by these factors. More recent evidence suggests, however, that a firm's debt maturity changes over the business cycle, as identified by Erel *et al.* (2011). They showed that new debt issuances shifted towards shorter maturity and more security during times of poor macroeconomic conditions. Mian and Santos (2011) suggest that the effective maturity of syndicated loans is pro-cyclical, especially for credit worthy firms. In a more recent study, in exploring the relationship between systemic risk and debt maturity, Chen *et al.* (2012) found that firms with high systematic risk would favour longer debt maturity and the maturity structure for firms with higher asset beta would be relatively stable over the business cycle. Finally, it should be borne in mind that the lower the leverage, the lower the market sensitivity. This is documented in many previous studies such as March and Shapiro (1987) and Weber (2004).

## 3. *Debt* Screening and *Shari'ah* Stock and Portfolio Behaviour in Relation to Leverage

The Islamic capital market has its own set of legal and ethical rules shaping its operations, which are mainly provided by AAOIFI (Accounting and Auditing Organization for Islamic Financial Institutions). Accordingly, along with the prohibition of interest, low and moderate risk investments should be encouraged (Ashraf and Khawaja, 2016; Causse, 2009, 2010; Jouini, 2009), while excessive levels of debt, uncertainty (*gharar*) and unnecessary risk positions at the level of any

[3] three-factor plus the momentum factor

investment should be avoided. It also encourages greater social responsibility, moral values, and sustainable finance, all of which contribute towards stability in the markets (Al-Suwailem, 2012). Among these principles, the debt ratio limitation at the threshold level of 33% is considered one of the main criteria in the Islamic stock and portfolio screening.

Despite the fact that it is well established in the literature that the risk of low debt firms (or portfolios) is lower than that of high debt firms (or portfolios), the impact of the cut-off debt level of 33% used in *Shari'ah* stock screening on the return and risks has not been investigated yet. Thus, we can argue that the effect of the debt level cut-off rate of 33% on the firm's behaviour is still unclear due to the lack of empirical evidence regarding this issue, which this study aims to address.

One key argument is that a single financial leverage threshold of 33%, used in *Shari'ah* screening regardless of the underlying industry or business risk, can have an inherent bias. According to 'capital structure theory', the optimal debt level should vary by industry depending on its operating leverage, while *Shari'ah* screening utilises a single financial leverage threshold of 33% despite the underlying industry or business risk. Therefore, a *Shari'ah* compliant portfolio may not necessarily be mean-variance optimal. Subsequently a unique cut-off level of debt of 33% may lead to a selection of firms having low risk businesses that are under leveraged or high business risk firms whose optimal capital structure requires debt below 33%. Thus, there is no upfront reason to believe that the *systematic* screening procedure will always lead to a low total risk portfolio.

*Shari'ah* compliant portfolio selection and its asset allocation have some specific features and conditions to be observed. The firms have to meet the qualitative and quantitative criteria according to the screening guidelines. For example, an Islamic equity fund manager will have a choice of investing in different industrial sectors by constructing portfolios only with firms that have shares that are qualitatively screened and have their level of debt ratio below a certain threshold determined in accordance with *Shari'ah* stock screening guidelines (AAOIFI standards number 21). Thus, optimizing the portfolio becomes complicated when equity has to be excluded due to its non-compliance with the screening criteria, in this instance, if its level of debt exceeds the debt level ratio of 33%, we can expect two consequences:

(i) This will reduce the investment universe of firms in which investors may take position and hence create higher systematic risk for the same level of expected returns by shifting the mean-variance efficient frontier (MVEF) to the right as supported by Johnson and Neave (1996).

(ii) This will exclude, *de facto*, those very risky firms that have a higher probability of financial distress and bankruptcy risks, and hence will improve the total risk over the whole market pulling the MVEF back to the left, which can help reach superior portfolios and adduce additional efficiency (Obaidullah, 2006).

Empirical evidence on negative screening produced mixed results. While Humphrey and Lee (2011) found that negative screening increased portfolio risk and reduced diversification, Lee *et al.* (2010) found that an increased screening may lead to a reduction of stock-selection returns albeit with lower systematic risk.

Therefore, it can be concluded that the trade-off concept within the *Shari'ah* stock screening, as stringent quantitative ratios can increase the quality of the assets, but drastically reduce the size of the investment universe and *vice versa*. Maximizing investment in compliant shares means accepting a trade-off between avoiding potential risky firms and expanding the universe of firms in which it is possible to invest.

## 4. Empirical Methodology and Data

This section presents the empirical methodology and describes the variables used in the empirical model, which also present the details of data collection and selection process.

### 4.1. The econometric models for systematic risk

In line with Olibe *et al.* (2008), we adopt the following model in an attempt to develop an empirical model for systemic risk:

$$\beta_{it} = \alpha_{it} + a\,\beta_{it-1} + \lambda 1_{it}\ D_{it-1} + \lambda 2_{it}\ \text{DMY} + \lambda 3_{it}\ \text{DMY x}\ D_{it-1} + £_{t.i} \left(\frac{\text{SALES}}{\text{ASSETS}}\right)_{it} + \varphi_{i.t}\ MTB_{it} + \psi\ \text{MarketCap}_{it} + \text{b}\ ROE_{it-1} + \text{c ExRate}_{mt} + \text{d D2GDP}_{mt} + \gamma_{t.i} \ln SIZE_{it} + \varepsilon_{it} \quad \textbf{(1)}$$

where:

$i,t$ and $m$: the firm $i$ at the quarter $t$ in the market $m$ (as a country)

$\alpha_{it}$: the intercept which is free to vary over time

$\beta_{it}$ and $\beta_{it-1}$: systematic risk of the firm $i$ at the quarter $t$ and quarter ($t$-$1$)

$D_{it-1}$: total debt divided by total equity (as capital structure) measured at the end of quarter ($t$-$1$)

DMY: is the dummy variable equal to 1 if the $\mathrm{D2TASSETS} \leq 33\%$; otherwise zero

$\lambda 2_{it}, \lambda 3_{it}$: the coefficients for the intercept and the interaction effect between the level of debt and the capital structure

$\left(\frac{\mathrm{SALES}}{\mathrm{ASSETS}}\right)_{it}$[4]: Total sales over total assets as a proxy for international exports

$MTB_{it}$: Market-to-book will be replaced by its proxy 'price to book value'

$\mathrm{MarketCap}_{it}$: Market capitalisation of the firm

$ROE_{it-1}$: Return on equity of the firm

$\mathrm{ExRate}_{mt}$: The exchange rate for the currency of country *m* against USD

$\mathrm{D2GDP}_{mt}$: The country level of debt over its GDP in percentage

$SIZE_{it}$: The weight of the firm based on the size of the sample using total assets

We added exchange rate and country debt level to take into account the currency and sovereign debt effects (ExRate + Sovereign Debt to GDP).

The paper applies relatively advanced panel techniques based on dynamic GMM (Generalized Method of Moments) both difference and system. To achieve robust modelling, as can be seen above, a set of variables on firm characteristics and two other variables at the country level, such as exchange rate and the sovereign debt, were added.

We computed the quarterly $\beta_{it}$ by using daily stock market return and market stock index for each quarter. The systematic risk of the firm *i* and the quarter *t* is computed as follows:

$$\beta_{it} = \frac{\mathrm{Covar}(r_{it}, r_{m,t})}{\mathrm{Var}(r_{m,t})} \quad \textbf{(2)}$$

This provides us with a time series of total beta of each firm for the same period of time. The beta portfolio $\beta_{pt}$ and the quarter *t* is computed based on the following formula:

$$\beta_{tp} = \Sigma\, w_{i,t}\beta_{it} \quad \textbf{(3)}$$

We have opted for the unbalanced data since not all of the market capitalisation and 'price to book value' were available for all the firms and countries. In order to obtain a clearer view of the impact of firm size, we referred to the weight of each firm, which is based on its total assets against the total assets of all the firms in the sample.

[4] $\left(\frac{\mathrm{SALES}}{\mathrm{ASSETS}}\right)$: *FATA* was the degree of international diversification defined as foreign assets scaled by total assets in the model Olibe *et al.* (2008). We have replaced the *FATA* variable by $\left(\frac{\mathrm{SALES}}{\mathrm{ASSETS}}\right)$ because the sales are considered as a proxy for international exports;

There are, however, two limitations pertaining to the use of the variance: (i) the asymmetry is not well captured by the variance (co-variance) and; (ii) the asymmetric distribution variance might not be a good measure. Despite these limitations, we still can draw certain conclusions, since we are investigating the leverage effect on the systematic risk behaviour based on a comparison between low debt and high debt portfolios and not as absolute values for a stand-alone investment.

### 4.2. Modelling financial risk versus business risk or Beta components

The financial risk versus business risk or beta components are given in the equation below making the separation between levered and unlevered betas for a firm:

$$\boldsymbol{\beta_{L,t+1} = \beta_{a,t+1} \left[ 1 + (1 - T) \frac{D_t}{E_t} \right]} \qquad \textbf{(4)}$$

where:
$\beta_L$ = Levered beta for the equity in the firm
$\beta_a$ = Unlevered beta of the firm (*i.e.,* the beta of the firm without any debt)
$T$ = Marginal tax rate
$\frac{\boldsymbol{D_t}}{\boldsymbol{E_t}} = \boldsymbol{\phi}$, Debt-to-Equity ratio (market value)
Based on the equation (3), we derive the following equation:

$$\boldsymbol{\beta_{a.t+1} = \left( \frac{\beta_{L.t+1}}{(1+\lambda\, \phi)} \right)} \qquad \textbf{(5)}$$

where:
$\phi = \frac{D_t}{E_t}$ and λ = (1 –T)

We notice that this model shows a positive correlation between the two betas ($\beta_{a,t+1}$ and $\beta_{L,t+1}$). A simplified formula of levered beta called the Practitioner's model (Ruback 1995; Fernandez 2003) uses only the capital structure and is given as follows:

$$\boldsymbol{\beta_{a,t+1} = \left( \frac{\beta_{L.t+1}}{(1+\ \phi)} \right)} \qquad \textbf{(5.1)}$$

In this model, the obtained levered beta is higher than the Damodaran formula because the term (1 – T) has been removed. However, this model (equation 5.1) is not used in this study. Kalev and Zolotoy (2012) used a model that takes into account the systematic risk (beta debt) in relation to the lagged debt of the firm. It is based on a multivariate generalization of Hamada's (1972) formula for levered CAPM beta. It shows that Hamada's (1972) result can be extended to any linear factor model, and in particular to the Fama–French three-factor model. According to Fernández (2004), the relationship between systematic risk, beta debt and unlevered beta provided by Kalev and Zolotoy's model is valid only for a company that maintains a fixed book-value leverage ratio. It assumes that the unlevered beta is always higher than the beta of debt; consequently, the levered beta is higher than the beta of debt. Their model represents one possible channel through which stock equity risk ($\beta$) can be affected by past stock returns and for distinguishing between levered and unlevered beta ($\beta$). The Damodaran formula is obtained from the Fernández model by assuming the debt beta as zero. In this paper, we use the Damodaran (1994) model (equation 5), which provides levered beta that is always higher than unlevered beta ($\beta_{a,t+1}$). Investigating the changes in levered beta and debt beta helps us to analyse the change in shock transmission. This qualitative analysis constitutes a proxy to study the beta debt. Since we do not need to conduct a direct analysis of the beta debt, the Fernández formula is not used in this study, as it omits the taxation effect (1-T).

### 4.3. Data selection

We have analysed data from eight countries with a larger sample of firms for the period from 2008 Q2 to 2013 Q1. The data have been collected from Reuters Datastream. *Shari'ah* non-compliant sectors such as Interest based banks, producers of alcohol *etc.* were excluded. The final sample includes 689 firms from seven countries (Austria, France, Germany, Italy, the Netherlands, Poland and Spain) based on data availability. Table 1 shows the breakdown of the retained firms in their respective countries. It should be noted that all the firms have been screened qualitatively, then the debt threshold of 33% filter has been applied. The aggregate information shows the number of firms segregated between low and high debt using the threshold ratio of 33%.

**Insert Table 1 here**

We started with a sample of 3596 firms distributed over seven countries. This sample was then filtered to exclude the missing values of the parameters (such as: total Equity = "NULL", Total Assets= "NULL" or Market Capitalisation = "NULL").[5] The aggregate information in Table 1 shows the number of firms segregated between low and high debt using the threshold ratio of 33%.

For each firm we collected total debt and total equity on a quarterly basis. Data on the daily share values were extracted, from which we calculated the quarterly mean return,

[5] MySQL software was used to organise and filter the data.

quarterly standard deviation and systematic risk. We used the statistical definition on the daily values of the return of both the firm and the country taken from the Dow Jones stock market to compute the quarterly systematic risk for each firm, following which we analysed the same for each country. We then divided the filtered sample into High Debt - HD (total debt to total assets (D2TASSETS) > 0.33) and Low Debt - LD (D2TASSETS <= 0.33).

As depicted in table 1, we could not select a period of time greater than five years. In fact, by working on the quarterly basis, the majority of firms display the debt ratio swinging up and down around the threshold. For example, we have only 24 high debt firms in Poland but zero low debt firms for the same period of time. This is due to the missing values of the most important parameters. On the other hand, there is no problem obtaining a good sample for the high debt firms ((D2TASSETS) > 0.33). The largest sample consists of 181 high debt and 161 low debt firms from Germany. Since the econometric model co-mingles both high and low debt portfolios, a dummy variable has been used to distinguish between the two.

## 5. Results and Interpretation

In this section the relationship between capital structure and systematic risk is analysed by using both difference and system GMM. Consecutively, we investigate the levered and unlevered betas for the seven countries as one portfolio that is segmented into three portfolio strategies of LD, HD and the combined (LD + HD). The same analysis is applied at the country level.

It should be noted that the total assets (expressed in US$) for all the LD portfolio countries is equal to US$76,77 trillion, while the total assets for the HD portfolio countries is equal to US$87,42 trillion. The size ratio of HD to LD is equal to 11.39. However, in the case of the Netherlands (country number 5) the total assets for LD is higher than the HD (2.69 times more), while the opposite is true for all the other countries. In the case of Germany (country 3) the ratio is more than 20 times in favour of high debt firms (HD/LD total assets = 20.79).

We conclude the analysis by looking at the effect of the GFC-2008 on betas and their lead-lag cross correlation using the continuous wavelet coherency.

### 5.1. Systematic risk

In fulfilling the first objective by measuring the impact of leverage on systematic risk, we applied difference GMM and system.[6] We have defined the GMM specification as 'predetermined but not strictly exogenous'. Therefore, the variables are classified into the following three categories: (i) endogenous; (ii) predetermined but not strictly exogenous; (iii) strictly exogenous, which are depicted in Table 2.

**Insert Table 2 here**

System GMM does not assume normality and it allows for heteroscedasticity in the data. We applied the two-step estimation in order to obtain the robust Sargan test (based on the robust Hansen J-test), which is not available in one-step estimation (Roodman, 2009). In so doing, in order to investigate the relationship between the capital structure and the systematic risk, we conducted both one-step and two-step estimations based on various tests (see Table 3.a). As can be seen in Table 3.a, the failure to reject the null hypotheses in Sargan tests (or Hansen J-test) and AR2 test indicates that the instruments used are valid. This is based on the 'two-step robust' with 'no collapse' sub-option for systematic risk, using both the constant dummy and 'interactive dummy' variables.

Any one of these four estimations can be chosen but we selected the third estimation, which is GMM- 2 Steps robust with the sub-option 'no-collapse' (NC) with Lags 6 and 7 (see Table 3.a Model 3), as this estimation presents the highest T-ratio for the 'Weight' variable (T-ratio for 'w' equal to 2.99), and because firm size is one of the five common risk factors affecting the firm's return (Fama and French, 1993; 2012). Overall, our results were similar for most of the scenarios suggesting that the findings reported above were robust.

[6] GMM in our analysis with an option called 'robust option' and sub-options of 'non collapse' and 'collapse'. The 'collapse' sub-option allowed the system to reduce the number of instruments. thus lowering the 'size' of the sample. By experimenting with different lag options and sub-options, we optimised the likelihood of obtaining accurate results. Subsequently, for consistency and serial correlation, we applied the diagnostics for realizing the optimality of the instruments. The most important point to ascertain is the validity of the instruments. To ensure that the instruments used were still valid (Yalta and Yalta, 2012), the second order serial correlation related to the differenced residuals or Arellano and Bond test (AR2) and the Sargan or Hansen J-test should not have their null hypotheses rejected. .

## 5.2. Interpretation and discussion of analysis

In the previous section we tested the null hypothesis for AR2 (Arellano and Bond, 1991), which is in line with the validity of the instruments used based on the second order serial correlation related to the differenced residuals.

The econometric model as expressed in equation 1 is based on capital structure (debt/equity) and the level of debt (total debt to total assets), and we found that these two variables were positively correlated. Hence, by analysing the capital structure, we could infer the same conclusion for the level of debt. In this estimation we added a dummy variable. Thereby, for the lagged capital structure variable we used the interrelated dummy variable in relation to the level of debt, expressed as total debt over total assets of the firm.

Table 3.a provides the dynamic panel data estimators using GMM for the systematic risk (beta) versus capital structure. The four estimations of GMM- 2 Steps robust with the sub-option 'no-collapse' (NC) (Model 1 to Model 6) appear to present interesting results. Model 3 with Lags (6 7) seems to be the most pertinent estimation since the T-ratio is the highest one (equal to 2.99). It is well established that size has a large impact on the value of systematic risk. For this reason, we consider this the best estimation (see Model 3 in Table 3.a) on which to build our discussion. As the results demonstrate, only the coefficient of the weight (total assets of the firm over total assets of the sample) appears more likely to be estimated precisely in the case of Model 3 with no restrictions on the instrument set for 268 over-identifying restrictions and with 243 instruments in total.

**Insert Table 3.a here**

The results suggest that the debt effect on systematic risk or β exists due to both firm level and market effects, and that the weight has the strongest impact; while the lagged systematic risk effect also carries the same impact as the capital structure (lagged beta and lagged capital structure are both negatively correlated with beta). In particular, a change of 1% of lagged value of beta will induce a change of 0.2% in the value of beta. The lagged 'return over equity' $\mathrm{ROE}_{it-1}$ is also negatively correlated. However, the exchange rate does not seem to be statistically significant. This is quite intuitive, if we consider the fact that the European stock markets are highly integrated, with the Euro zone playing a big role. The impact of the exchange rate will, therefore, have little effect on the change of beta at the level of the firm within the European market.

As for the lagged leverage effects, the correlation is positive for both low debt and high debt portfolios, while the interactive dummy variable (related to the level of debt) is statistically insignificant. However, the dummy variable has decreased the value of the estimated constant in terms of the absolute value. More precisely, the systematic risk value drops by 24% from 0.4996 (constant value in the third model estimation) to 0.3793 (since the dummy variable is equal to -0.1203 for firms with a ratio of 'debt-to-equity' less than 33%). This result is obtained for both low debt (304 firms) and high debt firms (385 firms). It should be noted that the firms with a low level of debt have small capitalization compared to those with a high level of debt (in fact the size ratio of HD portfolio is more than 11 times higher than LD). Nonetheless, we found no difference for the interrelated dummy variable which otherwise would have impacted on the capital structure (level of debt as 'debt-over-equity').

The sovereign debt effect seems to have no statistically significant impact on systematic risk, β. This is because a quarterly change in the sovereign debt will not affect the systematic risk of the firm on the stock market.

In the next section, we further explore the impact of a financial crises by splitting the portfolio into pre and post financial crises whereby we capture the structural breaks to determine the cut-off points.

### 5.3. Structural breaks

In this section we examine quarterly data to determine endogenously the most important dates on which structural breaks occurred simultaneously for all firms aggregated in one portfolio (LD+HD) and then separately for HD and LD. We analyse the presence of these breaks using the capital structure variable in order to study its effect on the systematic risk in the European stock markets. In order to achieve this, we made use of the test developed by Zivot and Andrews, and the result are depicted in Figure 1, which indicates the most probable break-points in the data. To find the structural breaks, we consider the total sample of studied firms as consolidated in three portfolios: LD, HD and combined (LD+HD).

**Insert Figure 1 here**

We were able to derive some key conclusions from the results obtained from this test: Firstly, regarding the mean reversion properties of these series, we concluded that we can reject the $H_0$ hypothesis for the three studied series at 5% significance level. Interestingly, both series for 'all firms' (LD+HD) and HD firms were seen as containing a structural break point at 2010 Q1 while the LD series shows a structural break point at 2011 Q4.

Searching for the source of structural breaks in each time series, the results suggest that a one-time break related to the European Central Bank (ECB) package has an impact on HD firms. This regulatory measure is aimed at bringing more liquidity to the European markets as occurred at the end of 2009 and the beginning of 2010. It is well known that ECB policy shifted in interest rate management and quantitative easing packages whereby significant decreases in interest rates were permitted. A one-time break with an impact on the LD firms we examined is detected in the 2011 Q4 suggesting the possible impact of the peak of severity of the European sovereign debt crisis.

Lastly, it is important to recognize that the results are derived from endogenously determining the presence of a single structural break. However, it can be argued that the data may contain more than one structural break which could result in a lack of robustness to the test (Lee and Strazicich, 2003). This could be the case in the LD series, which seems to exhibit two other structural breaks. However, we have limited this analysis to the most significant one, as mentioned above.

In the estimations, therefore, we included the two structural breaks in our analysis by adding two different dummy variables (DUM_HD and DUM_LD) with the objective of capturing the structural breaks that were potentially affecting the behaviour of HD and LD firms. This allowed us to analyse the pre-break and post-break samples to reveal evidence about the effect of these two breaks. The two dummy variables (DUM_HD and DUM_LD) were added.

Table 3.b provides the most pertinent estimation of the dynamic panel data estimators using GMM for the systematic risk (β) versus capital structure. Among the four estimations of GMM- 2 Steps robust, only the one with the lag (4 4) with the sub-option 'no-collapse' (NC) is pertinent as it is shows a significant impact of the lagged beta in line with our previous results. The three estimations with different lags: (1 1), (4 6) and (6 6) were discarded because they demonstrated no impact of the lagged β (their T-ratio for lagged β was lower than 2 and respectively equal to 0.58, 1.85 and 0.50).

**Insert Table 3.b here**

In line with the previous results, the systematic risk, β, is positively correlated with the lagged systematic risk and the weight of the firm in the portfolio (T-ratio = 3.98). It is negatively correlated with the lagged capital structure (as T-ratio = 1.93 is near to 2) and the price to book market (T-ratio = 3.40).

Turning to the impact of both structural breaks measured through the two dummy variables (DUM_HD and DUM_LD), the correlation is significant and negative for LD (the coefficient estimate is equal to 0.0468) portfolio, while it turns out not to be significant for the HD portfolios. The dummy variable of LD has decreased the value of the estimated constant of β in terms of the absolute value.  Compared with the HD portfolio, the systematic risk value decreases by approximately 12% from 0.3855 to 0.3387 (constant value).

The structural break which occurred during the European sovereign debt shock (2011 Q1) decreased the value of β for LD compared with HD. This confirms the fact that a financial shock reinforces the position of systematic risk of LD firms (with a 'debt-to-equity' ratio less than 33%) in the European stock market. Therefore, investors may have opted for less risky firms during the Greek crisis. This strengthens the fact that *Shari'ah* compliant firms can have a lower systematic risk than non-compliant firms.

In summary, the results indicate that the systematic risk for LD firms is almost always less than the HD firms and that the difference in absolute value is quite significant

(24%). The European sovereign debt has reinforced the position of LD firms in terms of systematic risk, β, by a drop of 12% compared to HD firms. However, the first structural break due to the first shock of the European sovereign crisis (2010 Q1) has not affected the systematic risk of both LD and HD firms in the European market. We believe that this is because at the beginning of the shock, the Greek economy was considered too small to be able to influence the systematic risk of the firms in the European stock market as a whole. This is in line with the *Shari'ah* perspectives based on the debt stock screening set at the threshold of 33% maximum.

Moreover, the size of the firm (expressed as the weight within the whole portfolio) and the lagged value of ROE were seen to be positively correlated with systematic risk, while the 'price to book value' was negatively correlated with systematic risk. This is in line with the theory. However, intuitively, the lagged idiosyncratic systematic risk of a specific stock is expected to have a significant bearing on its own current value.

### 5.4. Levered and unlevered beta analysis

Based on portfolio theory, we tested the model and its implications in order to examine the link between systematic risk and debt in both cases: levered and unlevered betas using equations 2 and 5. In order to do so, we computed betas (levered and unlevered) for the three portfolios: LD, HD and combined. First, we investigated the seven countries. We then we analysed data from each individual country, before adding the capital structure of each portfolio and the level of debt (debt over total assets) for each of the 20 quarters: from 2008 Q2 to 2013 Q1 in order to encompass the GFC-2008 period.

Figure 2.a shows six graphs showing the change in levered and unlevered betas for the three portfolios, while Figure 2.b illustrates the change in capital structure and debt to total assets for the same portfolios over the same 20 quarters.

**Insert Figure 2.a here**

**Insert Figure 2.b here**

In Figure 2.a, we can see that the HD and the combined portfolios have the same behaviour in terms of changes and trend for both levered and unlevered betas. The HD portfolio shows a slightly higher value of levered beta than the combined portfolio. This is caused by the impact of financial risk (due to high level of debt) of the HD portfolio being slightly higher than the combined portfolio. In fact, the latter category contains LD firms which make systematic risk slightly lower than the beta of the HD portfolio. The opposite is the case with unlevered beta for the same two portfolios since the unlevered beta is seen to be free from the financial risk related to the leverage effect. This enables the combined portfolio to benefit from the positive impact of the lower systematic risk of those firms in the LD portfolio.

The unlevered beta for the LD portfolio in Figure 2.b is very low and different from the two previous ones (HD and combined portfolios in Figure 2.a). This can be explained by the absence of debt impact on the unlevered beta. The levered beta of the LD portfolio has lower values than the levered beta for the HD and combined portfolios. It presents bigger changes which are depicted by the two peaks from the large shocks: the first one just after the GFC-2008 and the second during the European sovereign debt crisis. As can be seen, the second peak is of longer duration (18 months) than the first (12 months). We believe that one of the factors behind this was the fact that international investors perceived the US market to be less risky than the European market during this period. Our findings display the total assets (as a proxy for capitalisation) of the LD portfolio as 2.5 times smaller than that of the HD portfolio, which contradicts the common idea that small capitalisation firms have higher systematic risk compared to bigger firms.

**Insert Figure 2.c here**

Figure 2.c shows that capital structure and 'debt to total assets' for the LD portfolio remain very low (around 10%) and quasi constant showing less sensitivity to the change in debt and financial risk in the market. Nevertheless, both HD and combined portfolios present larger changes in the trend of capital structure ('debt to equity') with a spike reaching 120% following the same trend as the levered beta. The same two portfolios also have a quasi-constant value of 'debt to total assets' (D2TA). This implies that the firm's equity may decrease, while at the same time, the debt of the firm remains constant along with 'debt to total assets'. In fact, the 'total assets' of the firm are more likely to stay quasi unchanged in the short term, from one quarter to another.

Notably during financial shocks, even with sufficient liquidity, firms have more difficulty in increasing their debt, while it is easier to decrease their equity by buying back their own shares on the stock markets. The buying back of shares supports their share prices as the per-share earnings go up. Accordingly, many corporations have become more strategic with the timing of their share buybacks. We have seen that this occurs specifically when the share prices fall, especially following shocks. By purchasing the shares at this time, the firms can limit price decline. However, this finding needs to be supported by further research.

### *5.4.1 Country level analysis for levered beta*

In this section, we compute the levered beta for LD, HD and a combined portfolio for each individual country in order to analyse the impact of the level of debt on systematic risk. At the country level, the 33% threshold does not seem important. Even if there is a difference between the countries in terms of the size of samples, the analysis allows us to draw some interesting conclusions and to rank the countries according to their level of systematic risk between different periods of time. Thus, Table 4 as illustrated in Figure 3 panels depicts the results for levered β per country for High Debt and Low debt for their values as min, max and delta max-min.

**Insert Table 4 here**

Our findings show that in major countries, high debt firms are riskier than low debt firms in terms of levered β (see Figures 3.a., 3.b., 3.c, and 3.d). except in the case of the Netherlands where this result is partially reversed (see Figure 3.e) showing lower β for high debt firms compared to low debt firms in 55% of cases. This abnormal finding could be due to the domestic stimulus by the government of the Netherlands to support its capital market, which directly benefits the big firms. However, more study is required to understand the different behaviour of the LD and HD portfolios in the case of the Netherlands. Meanwhile, as the theory would suggest. the combined portfolio experiences a levered β level between those of the HD and LD portfolios in each of the countries including the Netherlands (see Figures from 3.a to 3.e). These combined portfolios also present a quasi-same level of systematic risk as the HD portfolio. excluding the Netherlands (see Figures 3.a., 3.b., 3.c and 3.d).

**Insert Figure 3.a here**

**Insert Figure 3.b here**

**Insert Figure 3.c here**

**Insert Figure 3.d here**

The Netherlands' combined portfolio (with 82 firms) bears less systematic risk compared to the HD portfolio, thus demonstrating the benefit of adding the LD portfolio debt to the HD portfolio. It also shows its positive impact in lowering the combined beta compared to Italy (with 43 firms) or Germany (with 308 firms), where the beta of the combined portfolio is practically equal to the beta of the high debt portfolio (the low debt portfolio has no effect on the combined portfolio).

**Insert Figure 3.e here**

Since it is only Poland and Spain that solely have HD portfolios,[7] we can see from figures 2.f and 2.g that the Spanish portfolio shows higher systematic risk than the Polish portfolio with one exception in the first quarter of 2013 which we consider here as an outlier.

Figure 3 panels (illustrating data of table 4) shows that France has a higher risk related to the HD portfolio in comparison to six other countries (decreasing as follows: France, Netherlands, Germany, Italy, Austria, Spain and Poland), but conversely Germany displays a higher risk for the LD portfolio. Based on the results, it would appear that one of the best portfolio strategies is to avoid investing in HD firms in France and LD firms in Germany but to invest in combined portfolio firms in the Netherlands. This is due to the fact that the latter provide higher maximum change in levered beta as a difference between the minimum and the maximum values which represent systematic risk.

[7] Figures related to Poland and Spain are not presented in this manuscript in order to save space.

In the case of the HD portfolio, Poland increasingly shows lower risk in comparison to the Netherlands, Italy, Germany, Austria, France and Spain. Whereas, for the LD portfolio, Austria displays the minimum levered beta when we compare it with the maximum levered beta of Italy, France, Germany and the Netherlands. However, the leverage effect on systematic risk is weaker in the Austrian market for the LD portfolio and in Spain for the HD portfolio which allows the two markets to be more stable since the marginal systematic risk is lower (figure 4). The findings, hence, broadly support previous evidences that low debt firms show less systematic risk than high debt firms in major countries. The only exception is the case of the Netherlands which has produced mixed results.

**Insert Figure 4 here**

### 5.5. Contagion effect on levered and unlevered betas and wavelet coherence

This section addresses the third objective by analysing the impact of *Shari'ah* stock screening applied to levered and unlevered βs during the recent global financial crisis. The sensitivities to market risk (levered and unlevered betas) are computed at the country level for the seven countries. This section, hence, analyses the short term impact of leverage on systematic risk of common stocks within seven European countries. We focus specifically on the period of the global financial crisis of 2008 (GFC). Within this context, we investigate the impact of the lower level of debt as suggested by *Shari'ah* stock screening. This should reduce systematic risk of common stocks and, therefore, is useful to the risk averse financial managers and investors who seek to invest in firms with lower beta value.

Financial contagion happens when there are many near crises happening simultaneously. Nevertheless, this may not be sufficient to explain the cause of the contagion, which has to be ascertained through causal links. External regional shocks and global shocks affecting several countries can have common threads in the case of causal connections. This common cause is independent from shocks, with the exclusion of the case of the financial crisis. By using a wavelet method, Ranta (2013), we found that several times in the last twenty-five years, contagion was a major factor in the major world markets and strong signs of contagion could be seen during the global financial crisis of 2008-2009.

This analysis uses wavelet coherence as follows: (a) as a robustness test to choose the most important variables to be considered in the dynamic panel technique model, and (b) to analyse the co-movement and the shock transmission in the European markets. It is generally used to isolate the effects generated mainly by short term contagion shocks from the fundamental-based contagion shocks. Wavelet techniques and particularly wavelet coherence have been used by many authors, including Rua and Nunes (2009), Ranta (2013), Reboredo and Rivera-Castro (2014), Saiti *et al*. (2015) and Dewandaru *et al*. (2016).

If we use other tests such as Markov switching (regime changes), we may not be able to verify the different frequency domains which are considered as a major added value of the wavelet technique. Some changes in the correlations, that could otherwise be missed with ordinary correlation analysis, could be discovered by using wavelet techniques (Rua and Nunes, 2009; Ranta, 2013). Moreover, the wavelet coherence used in our study fits the analysis of co-movement between economic variables. While debate and disagreement continue on the subject, with the introduction of multi-resolution analysis, a novel approach to this issue can be achieved.

In this section, the continuous wavelet transform (CWT) is applied to investigate the cross-correlation between the levered and unlevered betas in relation to capital structure and debt. This enables us to analyse the lead-lag relationship between the variables studied. CWT allows for analysing time series from the two perspectives of frequency and time domain simultaneously, which also helps to capture localized intermittent periodicities. Since this is a very well-known technique in quantitative finance, we have applied it without providing further theoretical foundation or methodological explanation.

We follow Forbes and Rigobon's (2002) definition of excess cross-correlations in our study of the European markets in order to make a comparison between correlations at different time scales by extracting time-frequency features. We focus on the lead-lag relationship between βs and the other variables: 'capital structure' and 'debt to total asset'. We use the wavelet transform coherence (WTC) between the pairs as presented in figures 5 and 6.

We have computed the systematic risk for the seven countries on a weekly basis to provide relatively high frequency data (326 weeks) for the WTC model. While the systematic risk changes from one week to another, the debt to total assets remains the same for each quarter. In addition, to illustrate the value added of this analysis, we have adopted high frequency data by using weekly data starting from week 1 (w1= 02/01/2007) to week 326 (w326= 26/03/2013). The WTC model finds regions in time frequency spaces where the two-time series co-vary, but do not necessarily have high power. The model of the WTC selection process for the two portfolios, namely LD and HD using β from weekly returns yielded results ranging from week 1 (w1= 02/01/2007) to week 320 (w320= 26/03/2013).

Figures 5 and 6 (5 graphs from 5.a to 5.e and 3 graphs from 6.a to 6.c) present the wavelet coherence between the levered and unlevered β and the studied variables. The shortest time scale in the figures is one week. In the graphs, the 5% significance level against red noise is shown as a thick contour (displayed as a black parabolic line). The relative phase relationship is shown as pointing arrows (- Right: in-phase; - Left: anti-phase). The co-movement is expressed through high coherency (red areas), which show strong local correlation and low coherency (blue areas) indicating low correlation. The cross-wavelet coherency is therefore able to determine the varying characteristics of the relationship between the levered and unlevered βs and the other parameters in the time–frequency domain. This enables us to analyse the short-term and long-term shocks of contagion.

We can draw some significant conclusions from Figure 5; as can be seen, the wavelet coherence figures provide a prominent descriptive analysis of contagion. Based on an increase of a short time-scale cross-correlation (Forbes and Rigobon, 2002). Figures 6 depicts a slight indication of contagion at several periods of time and the short time scales vary between different financial shocks in the European markets. Our data also shows many small areas of high-coherency starting from the first quarter of 2009, namely Q4. (quarter number 4) until the third quarter of 2011 (quarter number 14). The first result depicts a high correlation between levered and unlevered β that begins one quarter after the start of the global financial crisis. This large area highlights the negative effects of both GFC-2008 and the Euro-zone crisis of 2010. The year 2010 could be linked to the second stage of the GFC-2008, which was followed by major global instability. Specifically, a shock channel with simultaneous increase can be observed through co-movement, mainly at higher frequency-bands (below 4 quarters, namely one year) between levered and unlevered betas.

We can see that for unlevered beta, the LD portfolio generally exhibits completely different behaviour compared with beta for both HD. Overall, we see a change in the trend in the cross-correlation between levered and unlevered beta (Figure 5.a) showing evidence of short term shock transmission with a structural break starting from the second quarter of 2010 (just after the quarter number 9). This may be due to the Euro-zone crisis. The contagion effect due to leverage seems to be related to both short-run market linkages and fundamental-based linkages in which case the level of debt could be one of the major factors contributing to this turmoil in the capital market.

**Insert Figure 5.a here**

**Insert Figure 5.b here**

**Insert Figure 5.c here**

**Insert Figure 5.d here**

**Insert Figure 5.e here**

It appears from Figure 5.a that the 'debt to equity' for LD versus HD present different phase angles depending on time and for the scale less than 12 weeks (1 quarter). This means that this variable for the two portfolios (LD versus HD) is subject to shocks in the short run with a specific change in correlations for different points of time. However, this behaviour stays the same from week 80 up to week 250, quarter number 6 to 20 (starting from 2010Q1).

**Insert Figure 6.a here**

**Insert Figure 6.b here**

**Insert Figure 6.c here**

The trends in Figure 5 show different red areas encompassing the two big shocks: GFC-2008 and 2010 period of the Euro-zone crisis. The high correlation areas are bigger with larger scales for the pair of levered beta HD and 'debt to total assets' HD than for the pair of levered beta LD and 'capital structure' LD (*see:* Figures: 5.d and 5.e). Consistently, the size and shape of the red area is larger in the case of the HD portfolio compared to the LD portfolio for both pairs. This suggests that in the case of levered beta for the LD portfolio, the shock transmission based on the leverage effect is less important compared to HD portfolio when considering 'debt to total assets'. This shows that HD portfolios are more sensitive to shock transmission through the leverage effect.

Figures 5.c and 5.d show clearly that, in the case of the HD portfolio, the behaviour of unlevered beta for both 'capital structure' and 'debt to total assets' is different. The red area, in terms of shape and size, is bigger for 'debt to total assets', thus indicating a higher sensitivity to unlevered beta. Consequently, the contagion through unlevered beta is higher with 'debt to total assets' as a more conducive channel. The increase in correlation occurs mainly within a very short period (at the beginning of the quarter 1) to the fourth quarter, however it increases when there is a longer time period (around quarter 4 to quarter 13 -2008Q2). Moreover, the breakpoint between a changing short time-scale correlation and an approximately constant long time-scale correlation varies around quarter 7 (Week 144 - 06/10/2009; 2009-Q4) and quarter 13 (Week 235 - 05/07/2011; 2011-Q2). Therefore, it can be said that the wavelet coherence method is vital in terms of detecting the span effect of the European sovereign debt crisis as a huge channel of contagion transmission, which cannot be seen through a classical method analysis. We also find that during high cross-correlations, levered beta (idem for unlevered beta) is in-phase and positively correlated with 'debt to total assets' for LD, while the opposite occurs for HD. The first outcome is in line with the theory that a firm with low debt will see its systematic risk increase with an increase in debt, while the second outcome, quite surprisingly, indicates that a firm with debt of more than 33% will see its systematic risk decrease with the decrease of debt.

More generally, figure 5 panels and figure 6 panels show a shock transmission channel with a simultaneous increase that can be observed through co-movement mainly at relatively higher frequency-bands (below 12 months) between levered beta (idem for unlevered beta) and both 'capital structure' and 'debt to total assets'. The levered β of HD is leading the debt to total asset only during a short period (the period of the crisis until the second quarter of 2009 for the scale around 4 weeks), while there is no significant lead/lag relationship between levered beta (respectively unlevered beta) of LD and the debt to total asset.

We have therefore examined contagion among the seven major European markets and found some changes in the correlations of shorter time scales which increase significantly for longer time scales. These correlations remain approximately the same with a breakpoint at a specific point of the time scale. We can, therefore, conclude that contagion has been a major factor within the seven European markets and that this occurred several times during the period of the two shocks: GFC-2008 and the Euro-zone sovereign debt crisis.

### 5.6. Summary of analysis

The three econometric techniques employed in the analysis of the results are the dynamic GMM; portfolio theory to compute systematic risk for levered and unlevered betas; and the wavelet coherence based on the pairs test. The first and the third techniques are appropriate for nonparametric data. The assumptions for parametric data are not relaxed for the second case. Each technique is employed to determine whether a change in the level of debt changes the systematic risk. The first GMM technique indicates that a higher level debt (above 33% threshold) is associated with a higher degree of systematic risk output. It should be noted that our results are in line with the findings of Lev (1974), Hamada (1972), Ben-Zion and Shalit (1975), Castagna and Matolcsy (1978) and more recently with the findings of Chen *et al*. (2012).

Our findings also show that systematic risk correlates positively both with the size of the firm and lagged value of ROE, while 'price to book value' correlates negatively with systematic risk. In the case of the second technique (portfolio theory), we found some evidence that higher debt is associated with a higher degree of levered and unlevered betas. Furthermore, this analysis has enabled us to rank markets according to their stability and systematic risk with regard to HD and LD strategies. The third technique (Wavelet coherence) provides evidence for short-term shock transmission with a structural break during GFC-2008 as well as the following two years. These show a higher severity of the contagion effect one quarter after GFC-2008 and during the Euro zone crisis, due to high leverage. This seems to be related to both short-run market linkages as well as having a high level of debt as one of the fundamental-based linkages.

## 6. Conclusions and Implications

Our study has assessed firm's risk exposure within the capital structure theory by analysing the impact of firm's debt on systematic risk in the case of: low debt (LD) and high debt (HD) firms. The findings suggest that (i) the systematic risk (β) of the firm changes with changes in the capital structure and the estimates depend on the two levels of debt (less than 33% and more than 33%); (ii) the Islamic-compliant stocks (seen from the debt level ratio) are shown in most cases to carry less risk than conventional stock, while they do not necessarily out-perform in terms of return; (iii) during the global financial crisis, *Shari'ah* compliant stocks show lower values of systematic risk (β) in the case of LD portfolios compared with HD portfolios. This feature is particularly present among portfolios (LD versus HD) within the same country and for almost all countries in the study. Our findings broadly suggest that the leverage effect is significantly and positively associated with systematic risk and that leverage augments systematic risk. This has implications for micro-stability with regard to *Shari'ah* stock screening.

We adopted a panel GMM framework which allowed us to control simultaneously for country and firm characteristic effects, while taking into account heterogeneity across firms. The outcome suggests that systematic risk for LD firms is usually less than the systematic risk for HD firms, which is in line with the financial theory. Our findings show a significantly positive correlation between debt and sensitivity to market risk. Importantly, the GMM analysis of the whole panel, combining firms with a low and high level of debt, suggests that the systematic risk behaves differently depending on the level of debt (debt over total assets) as recommended by *Shari'ah* stock screening guidelines. The value drops by 24% (from 0.49966 to 0.37932) for firms with a ratio of 'debt to equity' of less than 33% compared with firms with a ratio more than 33%. The firm's size, the lagged ROE and the lagged value of beta are positively correlated with the systematic risk, while the latter is negatively correlated with the 'price to the book value', which is consistent with the theory. However, sovereign debt and exchange rates appear to have no significant impact on the systematic risk.

Systematic risk analysis across countries has mostly shown that, in general, LD portfolios have less systematic risk than both HD and the portfolios for the same countries. Moreover, France has shown higher risk related to the HD portfolio in comparison with the other six countries, while Germany has shown higher risk related to the LD portfolio. Conversely, Austria has shown the lowest systematic risk in the case of low debt firms. This allows for ranking of the seven markets according to their level of stability in terms of systematic risk (levered and unlevered betas).

The third technique based on wavelet coherence (which focuses on different stock-holding periods or investment horizons of the investors) has shown that the level of debt plays a substantial role in the shorter-term shock transmission for levered and unlevered betas (compared to the longer-term shock), especially during periods of turmoil.

Overall, our findings, within the identified sample, are broadly consistent with the capital structure theory in which a firm's level of debt in *Shari'ah* stock screening can control for the systematic risk of a portfolio. This can play a significant role in investors' decision-making and outwardly in terms of the micro-stability of the stock market in terms of lowering systematic risk.

The approach followed in this study is based on the ratio of the first criteria of *Shari'ah* stock screening and can be extended to the other *Shari'ah* screening ratios for capital market listed firms in all the studied countries. The GMM analysis in this study could be extended to more heterogeneous countries rather than focusing solely on the seven European countries. It would also be of interest to examine other parameters such as the total volatility and the Sharpe ratio in relation to *Shari'ah* stock screening criteria within the same approach and by adding other macro-economic variables at the country level.

In terms of policy implications, evidence of how systematic risk is affected by the firm's leverage is relevant to managers, investors and regulators alike. From our findings, at the regulatory level, regulators may consider issuing standards on reducing the level of (excessive) debt in the stock market to be followed by all listed companies regarding the detrimental impact of excessive debt on business viability. Even though this measure could be useful, it would be insufficient on its own because of other negative factors, namely the influence of bad news, herd behaviour, *etc*.

The second policy implication would be at the investor's level: higher leverage tends to increase systematic risk and decrease market micro-stability. This makes equity investment in the firm riskier without providing a higher return. Therefore, investors may choose not to participate in any new recapitalization of a listed firm if the latter would not be able to reduce its leverage. This may open up a new way to partnership that is based on *musharakah* (balanced partnership between the investors and the entrepreneurs) within the *Shari'ah* compliant firms in the stock market. In addition, investors may re-consider their current positions by investing more in *Shari'ah* compliant companies since these firms are not heavily involved in high leverage and therefore provide more stability with a reasonable return. Future research related to the *sukuk* index as a benchmark may also be considered.

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# Tables

**Table 1**
Breakdown of low and high debt firms in relation to their countries

| Code | Country | Name | Initial Sample | Filtered Sample | Low Debt Sample | High Debt Sample |
|---|---|---|---|---|---|---|
| 1 | AU | Austria | 132 | 116 | 28 | 35 |
| 2 | FR | France | 856 | 74 | 32 | 38 |
| 3 | GM | Germany | 1172 | 455 | 181 | 161 |
| 4 | IT | Italy | 364 | 99 | 12 | 33 |
| 5 | NL | Netherland | 219 | 98 | 51 | 47 |
| 6 | PL | Poland | 637 | 68 | 0 | 24 |
| 7 | SP | Spain | 216 | 75 | 0 | 47 |
| Total | | | 3596 | 985 | 304 | 385 |

**Table 2**
Classification and definitions of variables

| **Name of the Variables Included in the Model** | **Abbreviation** | **Exogeneity Status** |
|---|---|---|
| Systematic risk | $\beta_{it}$ | Strictly Endogenous |
| | | |
| Lagged Total debt divided by total equity | $D_{it-1}$ | Predetermined but not strictly exogenous |
| | | |
| Market capitalisation of the firm | $MarketCap_{it}$ | Strictly Exogenous |
| Lagged Systematic Risk | L1.Beta | Strictly Exogenous |
| Price to Book Value or Market-to-Book | price2bv or $MTB_{it}$ | Strictly Exogenous |
| Foreign Exchange EUR/US$ | forex_q | Strictly Exogenous |
| Country sovereign Debt to GDP Ratio | d2gdp_q or $D2GDP_{mt}$ | Strictly Exogenous |
| | | |
| Weight of the firm based on the size of the sample using total assets | W or $SIZE_{it}$ | Predetermined but not strictly exogenous |
| Lagged Capital Structure | L1.Capstruct | Predetermined but not strictly exogenous |
| Lagged Return on Equity | L1.ROE or $ROE_{it-1}$ | Predetermined but not strictly exogenous |
| Lagged Sales to Total Assets | L1.s2ta | Predetermined but not strictly exogenous |
| Dummy Variable equal to 1 if theD2TASSETS ≤ 33%; otherwise zero. | dmy_d2ta | Predetermined but not strictly exogenous. |
| Interactive Dummy Variable = $Cap\_Strut\ x\ dmy\_d2ta$ | inter_dmy_d2ta | Predetermined but not strictly exogenous |
| Dummy Variable for the first structural break | DUM_HD | Predetermined but not strictly exogenous. |
| Dummy Variable for the 2nd structural break | DUM_LD | Predetermined but not strictly exogenous. |

**Table 3.a**

Dynamic panel data estimators using GMM for beta risk versus capital structure: (*) Estimations are computed with 95% Confidence Interval ($p < 0.05$)

| | **Model 1** | | **Model 2** | | **Model 3** | | **Model 4** | |
|---|---|---|---|---|---|---|---|---|
| Beta | Coef. | t | Coef. | t | Coef. | t | Coef. | t |
| Lagged Systematic Risk | .2490 | 3.93 | .1449 | 1.85 | **.2008** | **2.50*** | .1225 | 1.60 |
| Lagged Capital Structure | .0002 | 1.03 | .0023 | 2.16 | **.0027** | **2.54*** | .0015 | 2.21 |
| Interactive Dummy | -.0090 | -0.49 | -.0061 | -0.62 | -.0119 | -0.90 | -.0134 | -1.01 |
| Dummy Variable | -.1284 | -4.34 | -.1337 | -3.77 | -.1203 | **-3.68** | -.1563 | -4.45 |
| Foreign Exchange EUR/US$ | .0119 | 0.66 | .0159 | 0.50 | -.0018 | -0.07 | -.0109 | -0.26 |
| Lagged Return on Equity | .00002 | 1.15 | .0002 | 2.20 | **.0003** | **2.60*** | .0002 | 2.26 |
| Weight | 418.32 | 3.28 | 442.22 | 2.79 | **384.83** | **2.99*** | 439.97 | 2.53 |
| Debt to GDP Ratio | -.0015 | -1.75 | -.0017 | -1.68 | -.0014 | -1.53 | -.0012 | -0.99 |
| Lagged Sales to Total Assets | -.0040 | -1.10 | -.0969 | -1.54 | -.1158 | -1.85 | -.0995 | -1.41 |
| Price to Book Value | -.0003 | -7.45 | -.0006 | -4.27 | **-.0007** | **-3.62*** | -.0003 | -1.44 |
| Market Capitalisation | -3e-06 | -1.47 | -3e-06 | -1.57 | -2.3e-06 | -1.30 | -3.4e-06 | 1.50 |
| _cons (Constant) | .3529 | 7.79 | .4900 | 5.77 | **.4997** | **5.99*** | .5330 | 5.31 |
| AR(1) – { z or P> z } | -6.40 | .000 | -5.67 | .000 | -5.80 | .000 | -5.67 | .000 |
| AR(2) – { z or P> z } | 2.21 | .027 | 0.85 | **.395** | 0.92 | **.360** | 0.65 | **.517** |
| Sargan test of overid Chi2 | 732.4 | .00 | 405.2 | .00 | 561.6 | .00 | 418.89 | .00 |
| Hansen test of overid Chi2 | 270.4 | .001 | 209.6 | .003 | 268.6 | .045 | 193.69 | .004 |
| GMM Hansen Ex. G. Chi2 [1] | 183.6 | .00 | 123.5 | .000 | 182.5 | .037 | 127.42 | .00 |
| GMM Diff. (H0= exo.) Chi2 [2] | 86.8 | .00 | 86.07 | .329 | 86.1 | .329 | 66.27 | .754 |
| iv Hansen Ex. G. Chi2 [3] | 671.94 | .00 | 203.0 | .003 | 258.8 | .066 | 183.98 | .006 |
| iv Difference (H0: Exo.) Chi2 [4] | 810.63 | .901 | 6.57 | .255 | 9.73 | .083 | 9.71 | .084 |
| Nb. Instruments\| Nb. Obs | 216 | 5528 | 168 | 5528 | 243 | 5528 | 156 | 5528 |

**Table 3.b**

GMM for Beta–Sensitivity to market risk versus capital structure including structural breaks: All the estimations are computed with 95% Confidence Interval ($p < 0.05$)

| Variables | Beta | Lagged Systematic Risk | Dummy Variable | Weight | Price to Book Value | Dummy for LD | _cons |
|---|---|---|---|---|---|---|---|
| 2-step Robust NC (4 4) | Coef. | .2084 | -.1787 | 294.76 | -.0003 | -.0468 | .3856 |
| | t | 2.31 | -1.93 | 3.98 | -3.40 | -3.01 | 4.89 |

el Alaoui, AbdelKader Ouatik; Bacha, O. I; Masih, M. & **Asutay, Mehmet** (2016). "Shari'ah Stock Screening, Sensitivity to Market Risk and Contagion: A Multi-Country Analysis", *Journal of Economic Behavior & Organization*, DOI: 10.1016/j.jebo.2016.10.023.
Please refer to the published version at the JEBO (2016)

**Table 4**

Levered $\beta$ per country for high debt and low debt (min. max and delta max-min)

| Countries | Levered Beta per country, HD | | | Levered Beta per country, LD | | |
|---|---|---|---|---|---|---|
| | Min HD | Max HD | Delta | Min HD | Max HD | Delta |
| Austria | 0.020 | 0.05 | 0.030 | 0 | 0.01 | 0.010 |
| France | 0.032 | 0.082 | 0.050 | -0.003 | 0.032 | 0.035 |
| Germany | 0.028 | 0.065 | 0.037 | 0.014 | 0.048 | 0.034 |
| Italy | 0.015 | 0.060 | 0.045 | 0.000 | 0.025 | 0.025 |
| Netherland | 0.008 | 0.068 | 0.060 | 0.001 | 0.062 | 0.061 |
| Spain | 0.030 | 0.046 | 0.016 | | | |
| Poland | 0.005 | 0.038 | 0.033 | | | |

# Figures

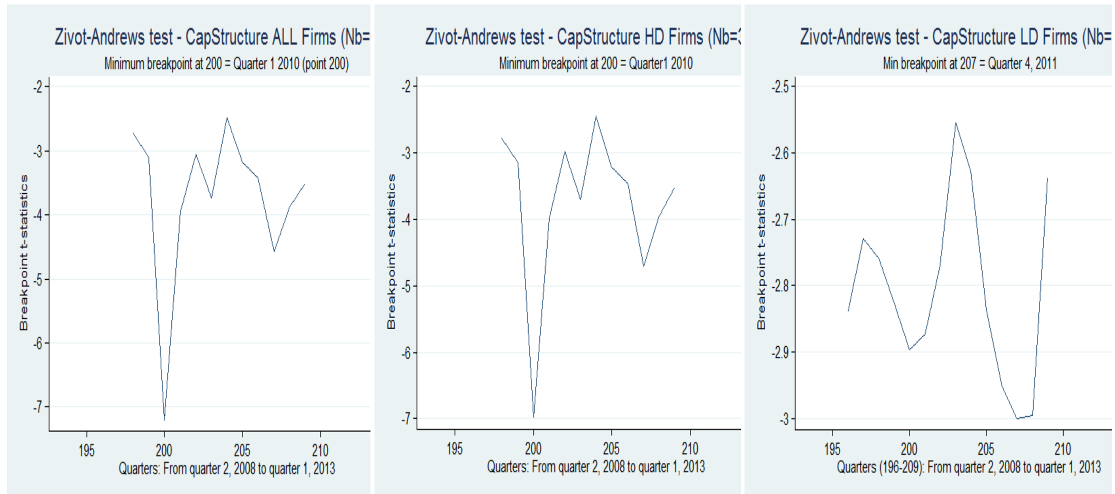


**Fig. 1.** Zivot-Andrews Test for Structural Break – Lagged Capital Structure (HD+LD), HD and LD firms

el Alaoui, AbdelKader Ouatik; Bacha, O. I; Masih, M. & **Asutay, Mehmet** (2016). "Shari'ah Stock Screening, Sensitivity to Market Risk and Contagion: A Multi-Country Analysis", *Journal of Economic Behavior & Organization*, DOI: 10.1016/j.jebo.2016.10.023.
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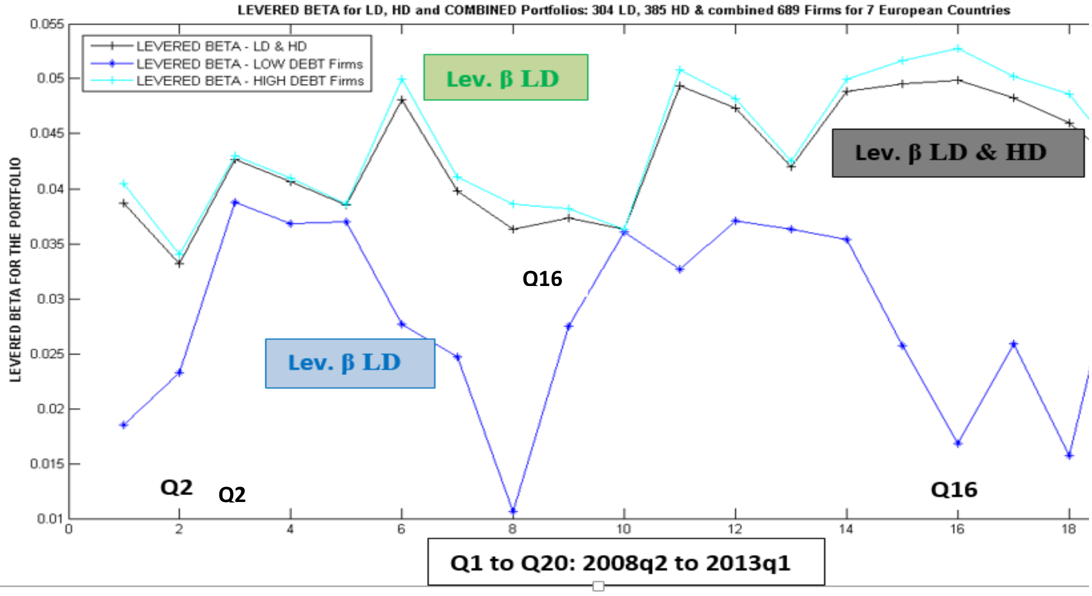


**Fig. 2.a.** Levered β LD, HD and Combined LD+HD (689 firms)

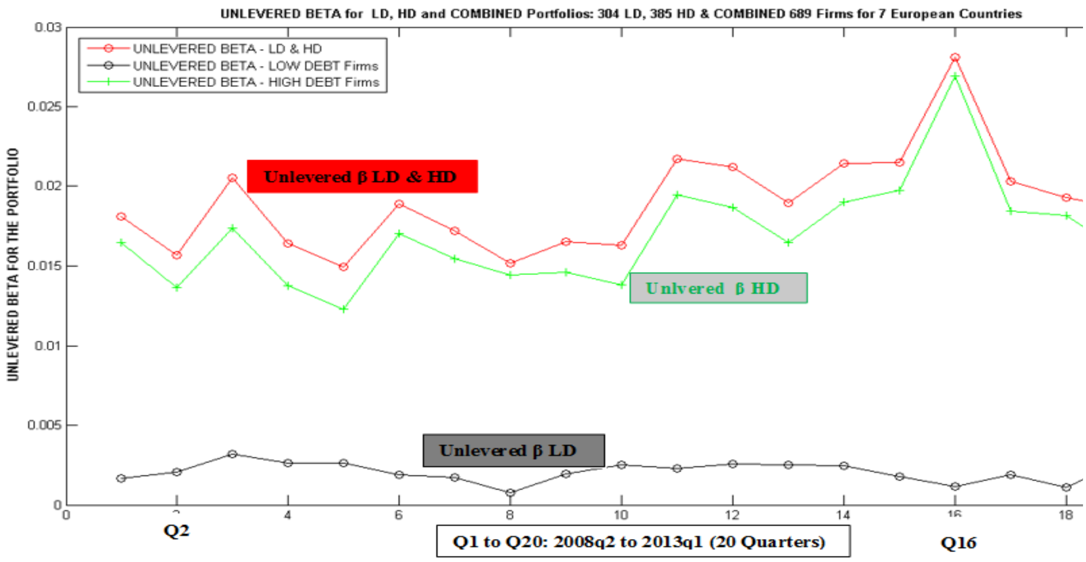


**Fig. 2.b.** Unlevered β LD, HD and combined LD+HD - All firms

el Alaoui, AbdelKader Ouatik; Bacha, O. I; Masih, M. & **Asutay, Mehmet** (2016). "Shari'ah Stock Screening, Sensitivity to Market Risk and Contagion: A Multi-Country Analysis", *Journal of Economic Behavior & Organization*, DOI: 10.1016/j.jebo.2016.10.023.
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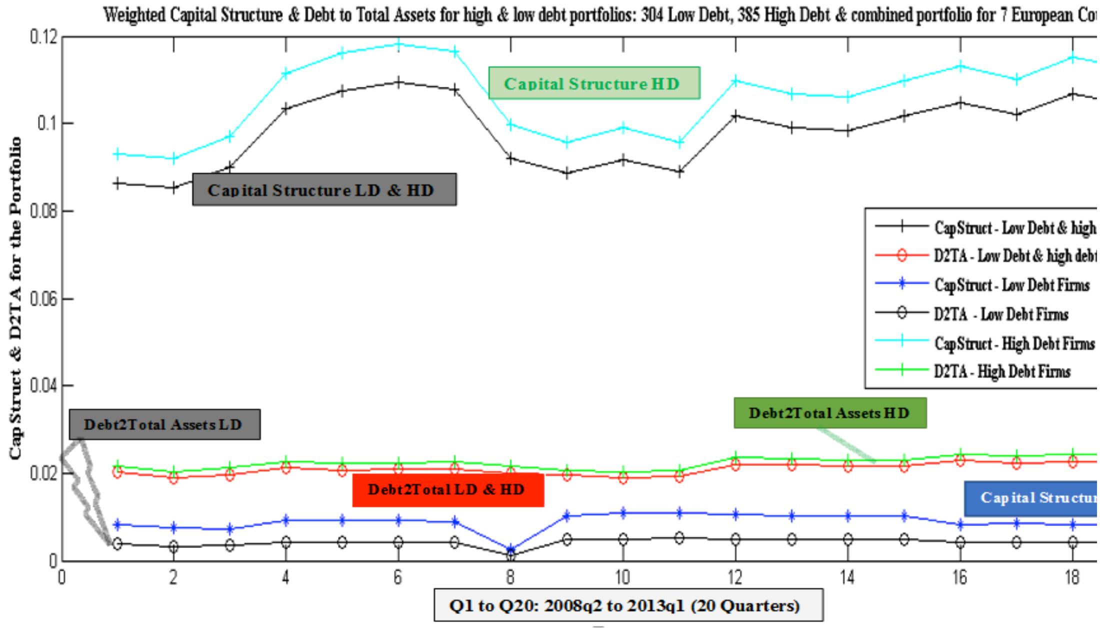


**Fig. 2.c.** Weighted Capital Structure and Debt to Total Assets for HD, LD and

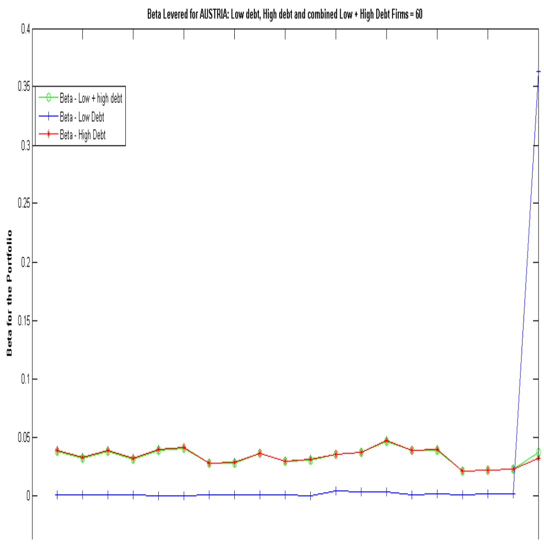


**Fig. 3.a.** $\beta$ Austria for LD, HD - Combined

el Alaoui, AbdelKader Ouatik; Bacha, O. I; Masih, M. & **Asutay, Mehmet** (2016). "Shari'ah Stock Screening, Sensitivity to Market Risk and Contagion: A Multi-Country Analysis", *Journal of Economic Behavior & Organization*, DOI: 10.1016/j.jebo.2016.10.023.
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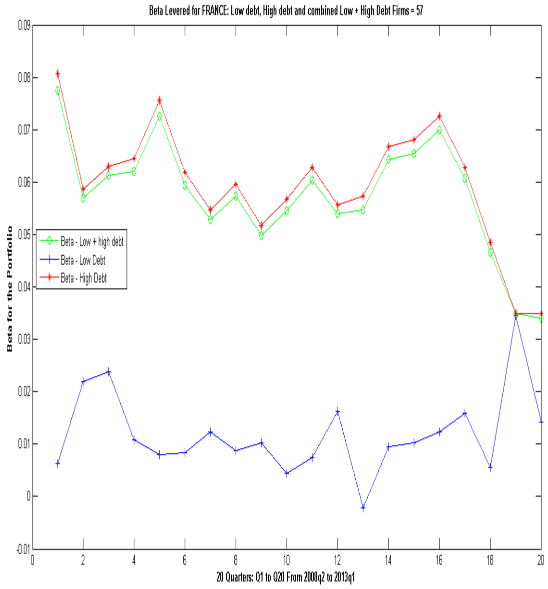


**Fig. 3.b.** $\beta$ France for LD, HD – Combined

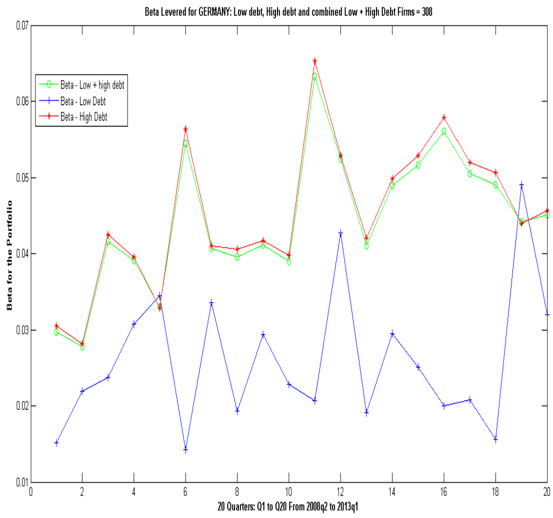


**Fig. 3.c.** $\beta$ Germany for LD, HD – Combined

el Alaoui, AbdelKader Ouatik; Bacha, O. I; Masih, M. & **Asutay, Mehmet** (2016). "Shari'ah Stock Screening, Sensitivity to Market Risk and Contagion: A Multi-Country Analysis", *Journal of Economic Behavior & Organization*, DOI: 10.1016/j.jebo.2016.10.023.
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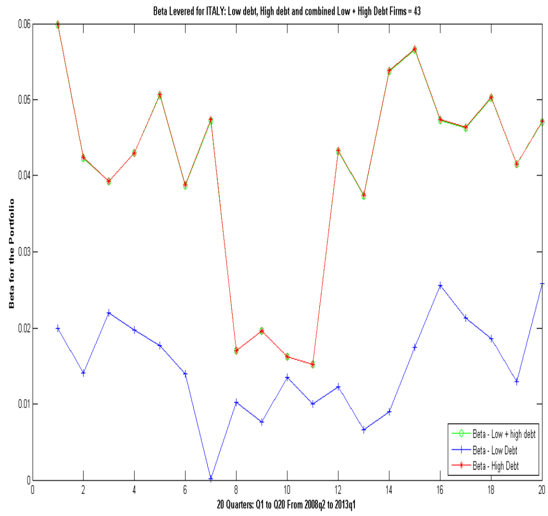


**Fig. 3.d.** $\beta$ Italy for LD, HD - Combined

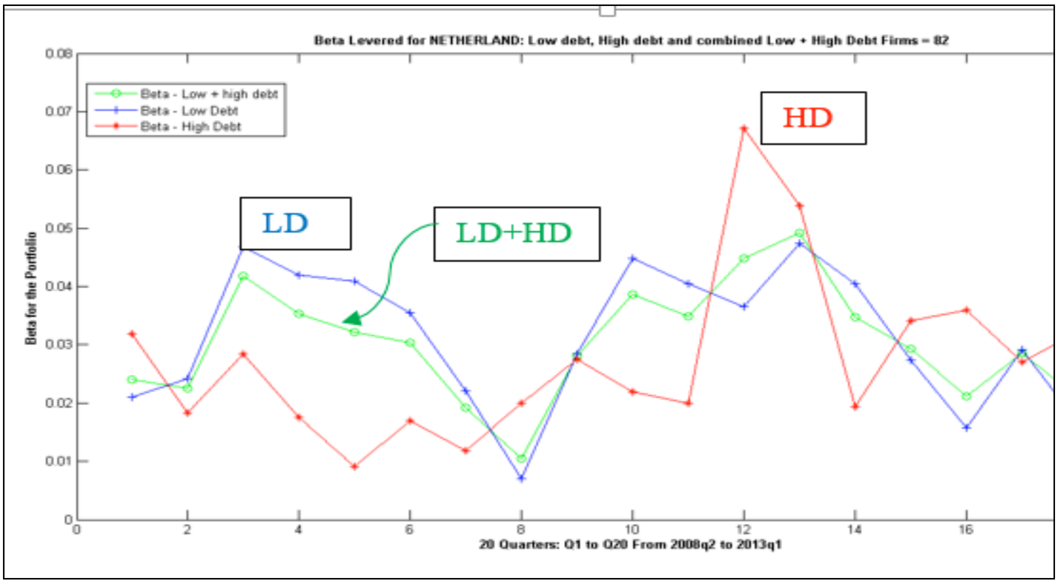


**Fig. 3.e.** $\beta$ Netherland for LD, HD - Combined

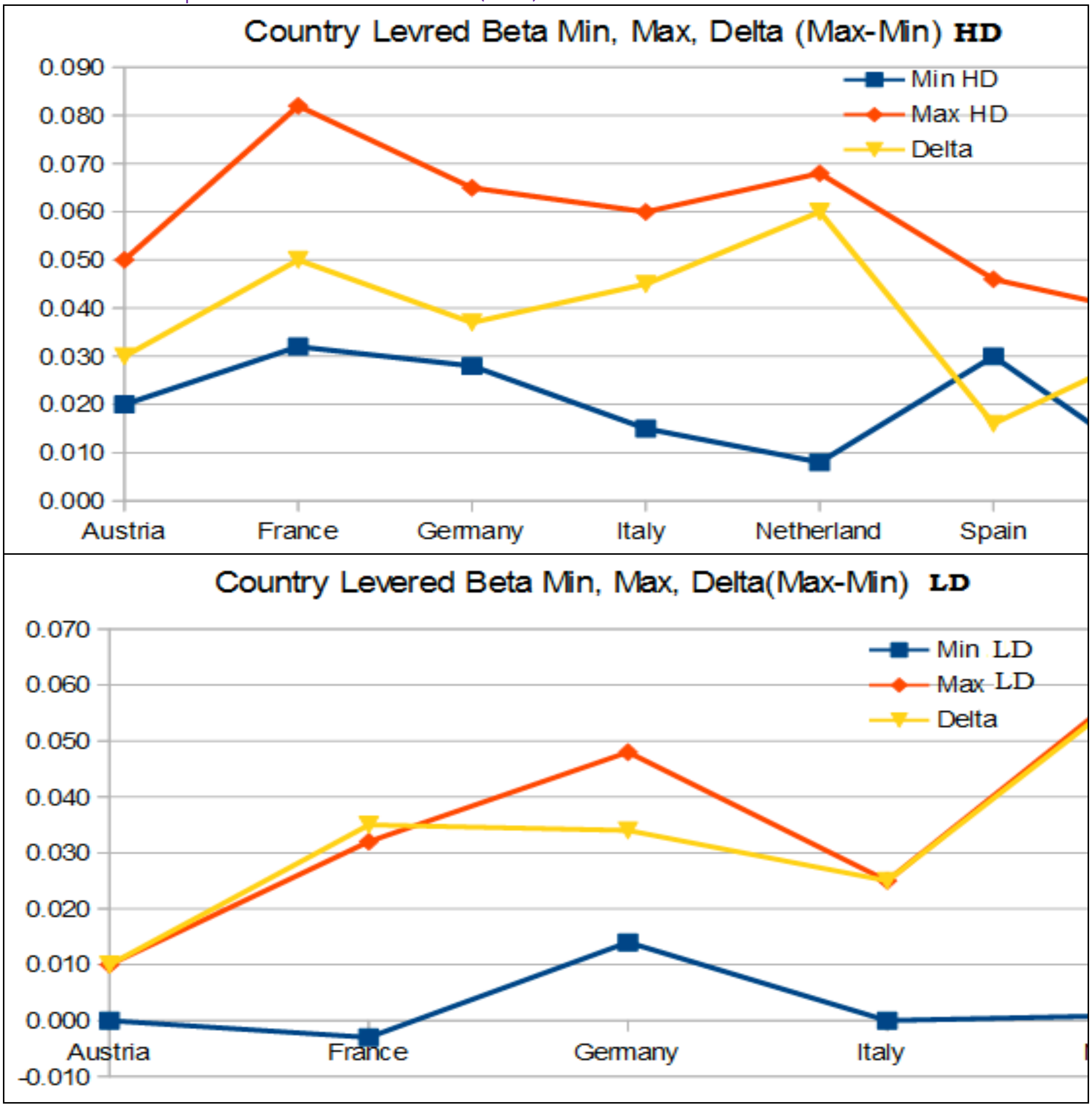


**Fig. 4.** Levered $\beta$ per country for HD and LD

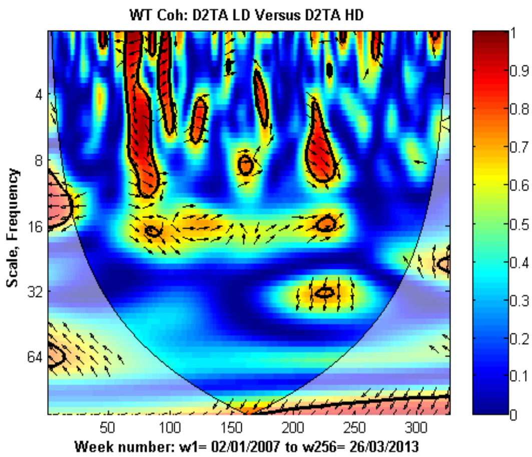


**Fig. 5.a.** WTC: Debt to Total Assets LD *vs* Debt to Total Assets HD, The black parabolic line (a thick contour) shows the 5% significance level; Red areas indicate strong correlation, Blue

areas indicate low correlation, Co-movement is expressed through high coherency with red colour, Phase relationship is shown as pointing arrows: Right: in-phase, Left: anti-phase.

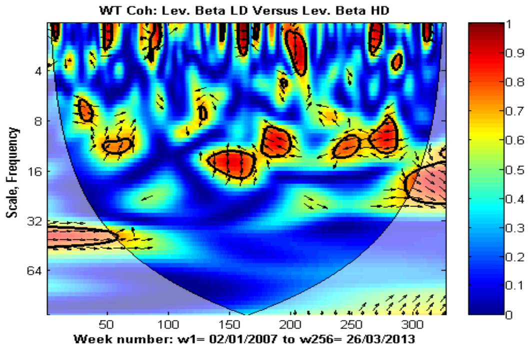


**Fig. 5.b.** WTC - Levered β LD *vs* Levered HD

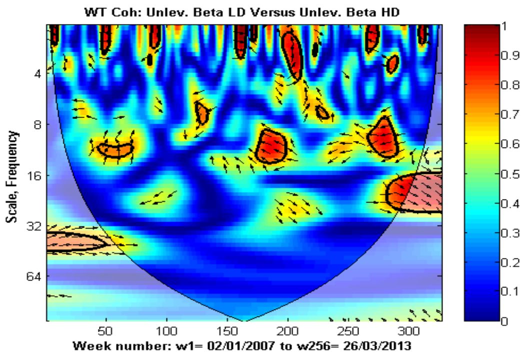


**Fig. 5.c.** WTC - Unlevered β LD *vs* unlevered β HD

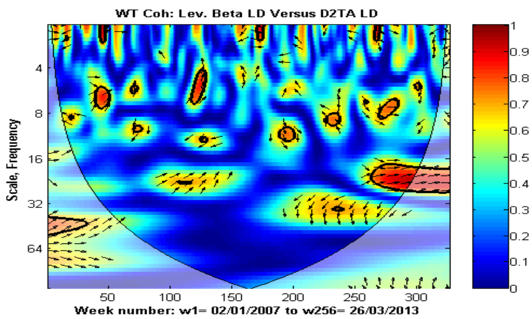


**Fig. 5.d.** WTC - Levered β LD *vs* Debt to Total Assets LD

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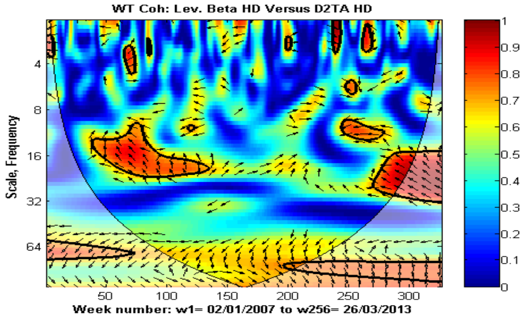


**Fig. 5.e.** WTC - Levered β HD *vs* Debt to Total Assets HD

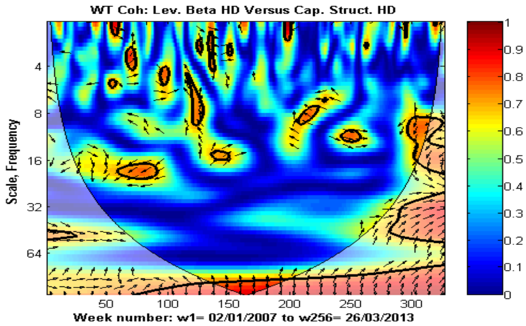


**Fig. 6.a.** WTC - Levered β HD vs Capital Structure HD, Red areas indicate strong correlation**,** Blue areas indicate low correlation**,** Co-movement is expressed through high coherency with red colour, Phase relationship is shown as pointing arrows: Right: in-phase, Left: anti-phase.

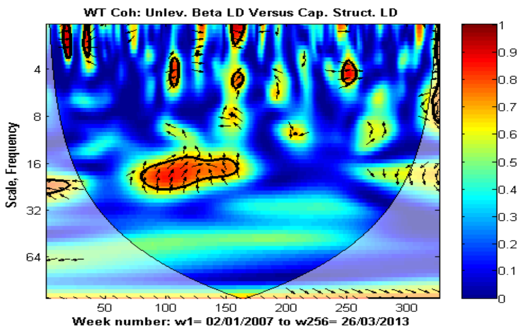


**Fig. 6.b.** WTC - Unlevered β LD *vs* Capital Structure LD

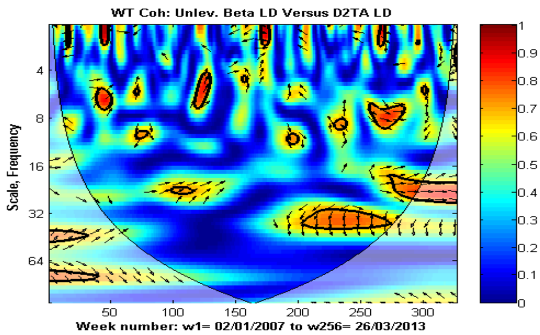


**Fig. 6.c.** WTC - Unlevered β LD *vs* Debt to Total Assests LD

## Appendix

### List and Status of All Sectors based on Qualitative Stock *Shari'ah* Screening

| List of sectors (Excluded and Included) | Status |
|---|---|
| Banks, Beverages, Equity Investment Instruments, Equity Warrants, Financial Services, Fixed Line Telecommunications, Food and Drug Retailers, Food Producers, Leisure Goods, Life Insurance, Media, Non-Equity Investment Instruments, Nonlife Insurance, Other Equities, Other Warrants, Real Estate Investment and Services, Real Estate Investment Trusts, Suspended Equities, Tobacco, Travel and Leisure, Unclassified, Unquoted equities. | Excluded |
| Aerospace and Defence, Alternative Energy, Automobiles and Parts, Chemicals, Construction and Materials, Electricity, Electronic and Electrical Equipment, Fixed Line Telecommunications, Forestry and Paper, Gas, Water and Multi-utilities, General Industrials, General Retailers, Health Care Equipment and Services, Household Goods and Home Construction, Industrial Engineering, Industrial Metals and Mining, Industrial Transportation, Mining, Mobile Telecommunications, Oil and Gas Producers, Oil Equipment and Services, Personal Goods, Pharmaceuticals and Biotechnology, Software and Computer Services, Support Services, Technology Hardware and Equipment. | Included |