Systemic Risk in Conventional vs Islamic Equity Markets

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Systemic risk in conventional vs. Islamic equity markets

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Abstract

We aim to compare the aggregate systemic risk in Islamic and conventional equity markets by introducing two dynamic risk measures. Accordingly, the level of the systemic risk in conventional markets is slightly higher than the risk in Islamic markets for most of the time. However, this difference is significant in less than 3% of the sample period. More importantly, there is no significant difference in the levels of systemic risk during the global financial crisis of 2008, suggesting that Islamic equity markets are not able to provide a lower market risk compared to their conventional counterparts in financial turbulent times.

Keywords: Systemic risk, Islamic finance, Conventional finance, Equity sectors, Dynamic Conditional Beta, Non-parametric tests

JEL: C14, C58, G01, G15, G32

$^*$The views expressed in this work are those of the authors and do not necessarily reflect those of the Borsa Istanbul or their members.

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1. Introduction

In financial markets, systemic risk is the risk of collapse of an entire market, as opposed to the risk associated with any one individual entity or sector of the market that can be contained therein without harming the entire system (Kaufman, 2000). Also known as the market risk, it affects the overall market, not just a particular stock or industry.

Although the subject has been of interest for a long time in modern finance literature, it has become more important than ever in the last decade due to the catastrophic events triggered by the late global financial crisis. In particular, anyone who invested in the equity markets in 2008 saw the values of their investments change (drop) because of this market-wide economic event, regardless of what types of equities they held.

Within this crisis period, in an environment where even the benefits of portfolio diversification have been questioned, market players and academicians started to search for remedies and renovation solutions for the systemic risk problem in conventional financial system. In this process, Islamic equity markets (i.e., Sharia compliant stocks) emerged as a viable alternative due to their seemingly resilient structure (Yilmaz et al., 2015).\(^1\) In particular, Sharia compliant stocks are low-leverage stocks with high asset backing, compared to their conventional counterparts, and it is widely believed that firms with low leverage have lower distress risk due to their reduced exposure to the credit market. This suggests that Islamic equities, due to this low leverage, should be associated with a lower beta to the market.\(^2\) In addition, several

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\(^1\) Sharia compliance excludes companies whose primary businesses are alcohol, pork-related products, conventional financial services, tobacco, entertainment (e.g., gambling, hotels, and pornography) weapons and defense. In addition, it strictly imposes the zero interest-based leverage. However, as the latter condition is hard to satisfy, a certain tolerance is required. Accordingly, to be compliant with Sharia rules, the following financial ratios must be lower than 33%: (i) total debt divided by trailing 24-month average market capitalization, (ii) the sum of a company’s cash and interest-bearing securities divided by trailing 24-month average market capitalization, and (iii) accounts receivables divided by trailing 24-month average market capitalization.

\(^2\) To find out how much systematic risk a particular security or sector carries, the very first thing to do is to look at its beta, which measures how sensitive that investment is compared to the overall market. Greater the beta is, more systemic risk the investment has.
studies in the literature (Black, 1976; Christie, 1982) show that firms with higher debt/equity ratios should have a stronger negative relation between current returns and stock volatility as compared to firms with lower debt/equity ratios. Therefore, Islamic equities are also expected to have low betas to the market in theory (Dewandaru et al., 2015).

Although there is a growing literature on Islamic equity markets in the last few years, previous studies mostly focus on the portfolio performance against the conventional equities (Al-Khazali et al., 2014; Jawadi et al., 2014; Ho et al., 2014); the dependency or the causality relationship between Islamic and conventional financial system (Ajmi et al., 2014; Shamsuddin, 2014; Hammoudeh et al., 2014); and comparison of their market efficiency (El Khalichi et al., 2014; Alvarez-Diaz et al., 2014; Sensoy et al., 2015). However, studies on the systemic risk in conventional vs. Islamic equity markets is almost none. In fact, to the best of our knowledge, the only study belongs to Dewandaru et al. (2015). Using 10 global sector data for Islamic and conventional equity markets, authors show that most of the Islamic sectoral indexes have significantly lower static betas with equal average returns as compared to their conventional counterparts, thus supporting the argument that lower financial leverage brings out lower beta, hence lower systemic risk. In our study, using the same sector data, we bring a time varying perspective to the subject. In particular, using the recently introduced state of the art methodology of Dynamic Conditional Beta (Bali et al., 2014) on Islamic equity markets for the first time, we reveal that the level of systemic risk in Islamic equity markets is generally lower compared to the conventional system, however, this difference is significant only for a short period of time. In fact, there is no significant difference in the levels of systemic risk during the global financial crisis of 2008, suggesting that Islamic equity markets do not provide a lower market risk compared to the conventional equity markets in financial turbulent times.

In the rest of this paper, Section 2 describes the data set and explains the methodology that we follow. Section 3 displays and discusses the empirical results. Finally, Section 4 contains a summary and some concluding remarks.
2. Data and Methodology

In this study, we consider all major conventional and Islamic sector indexes disseminated by the Dow Jones (Dow Jones indexes are chosen due to their reliability/credibility). This criteria gives us 10 indexes per conventional and Islamic equity markets. In particular, we consider the basic materials, consumer services, consumer goods, energy, financials, health care, industrials, technology, telecommunications, and utilities sectors. In addition, we use the Dow Jones global conventional and Islamic market indexes to estimate the individual sector betas for both type of equity markets. Our daily data spans the time period from November 9, 1998 to March 5, 2015; and is obtained from Bloomberg database. The starting point of our dataset is the earliest date that all 22 indexes were being calculated. For each index, daily changes to be used in our analysis are taken as log-returns. Moreover, we remove the days when more than half of the sector indexes are not calculated. The complete sector list and the corresponding tickers are given in Table 1.

<table>
<thead>
<tr>
<th>Sector</th>
<th>Ticker (C)</th>
<th>Ticker (I)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic materials</td>
<td>W1BSC</td>
<td>DJIBSC</td>
</tr>
<tr>
<td>Consumer services</td>
<td>W1CYC</td>
<td>DJICCY</td>
</tr>
<tr>
<td>Consumer goods</td>
<td>W1NCY</td>
<td>DJINYC</td>
</tr>
<tr>
<td>Energy</td>
<td>W1ENE</td>
<td>DJIENE</td>
</tr>
<tr>
<td>Financials</td>
<td>W1FIN</td>
<td>DJIFIN</td>
</tr>
<tr>
<td>Health care</td>
<td>W1HCR</td>
<td>DJIHCRC</td>
</tr>
<tr>
<td>Industrials</td>
<td>W1IDU</td>
<td>DJIHIDU</td>
</tr>
<tr>
<td>Technology</td>
<td>W1TEC</td>
<td>DJITEC</td>
</tr>
<tr>
<td>Telecommunications</td>
<td>W1TLS</td>
<td>DJITLS</td>
</tr>
<tr>
<td>Utilities</td>
<td>W1UTI</td>
<td>DJIUTI</td>
</tr>
<tr>
<td>Whole Market</td>
<td>W1DOW</td>
<td>DJIM</td>
</tr>
</tbody>
</table>

2.1. Dynamic conditional beta

The early studies on asset pricing make the assumption that the betas of the assets remain constant over time or over the estimation period. However, this may not be a plausible assumption because: (i) the relative riskiness of a firm’s cash flow is likely to vary over the business cycle; (ii) to the extent that the business cycle is induced by technology or taste shocks, the
relative share of different sectors in the economy fluctuates, causing significant time-series variation in the betas of firms in these sectors; (iii) during recessionary or expansionary periods, sensitivity of firms to the market may increase or decrease depending on the industries to which firms belong. Hence, betas typically depend on the information available at any given point in time and vary over time (Bali et al., 2014).

In our study, to get the time varying conditional beta for each sector, we start with the following mean equation:

\[ r_t = \mu + \epsilon_t \]  \hspace{1cm} (1)

where \( r_t = [r_{S,t} \quad r_{M,t}]' \) is the vector of daily log-returns of the individual sector \( S \) and the corresponding market \( M \), \( \mu \) is a vector of constants, and \( \epsilon_t = [\epsilon_{S,t} \quad \epsilon_{M,t}]' \) is the vector of residuals.

In the next step, we obtain the conditional volatilities \( h_t \) from the univariate GJR-GARCH(1,1) process.

\[ h_{S,t}^2 = \omega_S + (\alpha_S + \gamma_SI_{\epsilon_{S,t-1}<0})\epsilon_{S,t-1}^2 + \beta_S h_{S,t-1}^2 \]
\[ h_{M,t}^2 = \omega_M + (\alpha_M + \gamma_MI_{\epsilon_{M,t-1}<0})\epsilon_{M,t-1}^2 + \beta_M h_{M,t-1}^2 \]  \hspace{1cm} (2)

In this setup, \( E_{t-1}[\epsilon_t] = 0 \) and \( E_{t-1}[\epsilon_t \epsilon_t'] = H_t \), where \( E_t[\cdot] \) is the conditional expectation on \( \epsilon_t, \epsilon_{t-1}, \ldots \). The conditional covariance matrix \( H_t \) can be written as

\[ H_t = D_t^{1/2} R_t D_t^{1/2} \]  \hspace{1cm} (3)

where \( R_t \) is the conditional correlation matrix and the diagonal matrix of the conditional variances is given by \( D_t = diag(h_{S,t}, h_{M,t}) \). Engle (2002) models the right hand side of Eq.(3) rather than \( H_t \) directly and proposes the dynamic correlation structure

\[ R_t = \{Q_t\}^{-1/2} Q_t \{Q_t^*\}^{-1/2}, \]
\[ Q_t = (1 - a - b)Z + au_{t-1}u_{t-1}' + bQ_{t-1}, \]  \hspace{1cm} (4)

where \( Q_t \) is the dynamic covariance driving process, \( u_t = [u_{S,t} \quad u_{M,t}]' \) with \( u_{S,t} \) and \( u_{M,t} \) are the transformed residuals; i.e., \( u_{S,t} = \epsilon_{S,t}/h_{S,t} \) and \( u_{M,t} = \epsilon_{M,t}/h_{M,t} \); \( Z \equiv E[u_t u_t'] \) is the \( n \times n \) unconditional covariance matrix of \( u_t \); \( Q_t^* = diag(Q_t) \) and \( a, b \) are non-negative scalars.
satisfying $a + b < 1$. The final estimation is performed by maximizing the joint log-likelihood of the model given by

$$
L = -\frac{1}{2} \sum_{i=1}^{T} (n \ln(2\pi) + \ln |D_t| + \epsilon_t' D_t^{-1} \epsilon_t) - \frac{1}{2} \sum_{i=1}^{T} (\ln |R_t| + u_t' R_t^{-1} u_t - u_t' u_t)
$$

(5)

and the resulting model is called DCC. However, Aielli (2013) demonstrates that such model specification produces quite a high bias and the estimation of $Q_t$ by this way is inconsistent since $E[R_t] \neq E[Q_t]$. He proposes the following consistent model (cDCC) with the correlation driving process

$$
Q_t = (1 - a - b)Z^* + a\{Q_{t-1}^{1/2} u_{t-1} u_{t-1}' Q_{t-1}^{1/2}\} + bQ_{t-1}
$$

(6)

where $Z^*$ is the unconditional covariance matrix of $Q_{t}^{1/2} u_t$.

We estimate the time-varying conditional covariance matrix by the approach of (Aielli, 2013), which gives us the dynamic covariance between sector return $r_s$ and the market return $r_M$, and also the dynamic variance of the market return $r_M$. Finally, simple division yields to the time-varying conditional betas based on the mean-reverting cDCC model. For recent applications of dynamic conditional beta on stock markets, see Bali and Engle (2010); Engle et al. (2015).

3. Results

Figure 1 shows the dynamic conditional betas for each sector in Islamic and conventional equity markets. Although some of the sectors, such as industrials and consumer services (in both markets), display a relatively stable sensitivity to the market, the first thing to notice is that most of the betas wildly change in time. For example, in the beginning of our sample period, energy sector (in both markets) has a beta around 0.5 whereas this value reaches up to

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3The estimated parameters for the model are given in Table A.1 in the Appendix A. On the other hand, for space saving purposes and because of their irrelevance to our analysis, we did not present the descriptive statistics of the raw returns. However, they can be obtained upon request.
2.5 at the end. This shows the heightened sensitivity of the energy firms to the market in the last decade, probably due to the financialization of the energy commodities in the same period (Buyuksahin and Robe, 2014). Although the reasons are probably different, basic materials and utilities sectors (in both markets) also display similar structural shifts. On the other hand, technology beta (in both markets) reaches up to 3 during the tech bubble between the years 1999 and 2001, however, it has been fluctuating around 1 since the end of this bubble; whereas the telecommunications sector (in both markets) has a beta with a consistently decreasing trend in time.

Interestingly, the only clear visual difference in betas between conventional and Islamic markets is observed in the financials sector. However, although the beta of the financials sector in the conventional system is clearly greater than the same beta in Islamic equity markets through most of the time, they do not differ in levels during the global financial crisis of 2008, suggesting that financial firms that are Sharia compliant do not provide a lower market risk in turbulent times.

Overall, when these facts are taken into account, it is clear that sector sensitivity to the market is dependent on time, and the dynamic conditional beta model might be considered as superior to the constant beta approach in systemic risk analysis of financial markets.

3.1. Aggregate systemic risk in conventional vs. Islamic equity markets

As a proxy for aggregate systemic risk in conventional and Islamic equity markets, we construct two measures; i.e., (i) daily mean, and (ii) daily median of the corresponding sector betas; and Figure 2 displays how these variables change in time for both markets.

First, we notice that although the levels are close, the mean and median of conventional betas are often greater than Islamic betas. In fact, mean (median) of conventional betas is greater on 3863 (3649) out of 4413 sample days, referring to more than 87% (82%) of the sample period. However, for a formal conclusion, we have to test whether these differences are statistically significant. In order to do that, we adopt two different approaches. First, the

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4Indeed, non-parametric tests reveal that both the time average and time median of the financials sector beta in conventional equity markets are significantly greater than those in Islamic equity markets.
Figure 1: Dynamic conditional betas corresponding to different sector indexes from November 1998 to March 2015.
daily means of sector betas are compared based on a one-tail, two-sample $t$-test for differences in means. Further, the $t$-statistics are corrected for unequal variances whenever appropriate using the Satterthwaite (1941) approximation. Second, the daily medians of sector betas are compared based on the non-parametric Wilcoxon rank sum test\(^5\); and the results of the both tests are presented in Figure 2. The vertical lines in Figure 2 denote the days when there is a statistical difference in means and medians at 5% significance level. Accordingly, when there is a significant difference in these variables, it is the case that conventional betas have a greater mean and/or median. However, the test results reveal that the number of significant days are 22 and 108 for the means and medians respectively, which are less than 3% of the sample period in both cases. Moreover, Figure 2 shows that there is no significant difference in the levels of aggregate systemic risk during the global financial crisis of 2008 (including the near pre- and post-crisis periods), suggesting that Islamic equity markets are not able to provide a lower market risk compared to the conventional equity markets in financial turbulent times.

\(^5\)We also use non-parametric two-sample median test. Since the results are very similar to those found by Wilcoxon rank sum test, we do not report them in the manuscript.
4. Conclusion

The main objective of this study is to explore and compare the aggregate systemic risk profile of Islamic and conventional equity markets. In order to do that, we consider 10 global conventional and Islamic sector equity indexes covering 17 years of daily data, and focus on the sensitivity (betas) of these sectors to the market fluctuations on a daily basis. The major contribution made here is to take into account the time dimension using the state of the art dynamic conditional beta (DCB) methodology.

We reveal that most of the sector betas (in both markets) wildly change in time; including structural shifts, temporary changes and consistent trends. This fact supports the argument that sector sensitivity to the market depends on the information available at any given point in time and vary over time, and the DCB model might be considered as superior to the constant beta approach in systemic risk analysis of financial markets.

In most of the cases, we observe that conventional and Islamic betas of the same sector display very similar patterns in time. Interestingly, the only clear visual difference in betas between conventional and Islamic markets is observed in the financials sector. However, this difference disappears during the global financial crisis of 2008, suggesting that financial firms that are Sharia compliant may not provide a lower market risk in crisis periods.

For further analysis, we construct two proxies to measure the aggregate systemic risk in both conventional and Islamic equity markets. Accordingly, the level of the systemic risk in conventional markets is slightly higher than the risk in Islamic equity markets for more than 82% of the time. This result may first seem to support the findings of Dewandaru et al. (2015), who argue that most of the Islamic sectoral indexes have significantly lower static betas compared to their conventional counterparts, hence Islamic equity market carries lower systemic risk. However, our time varying approach reveals that the difference in aggregate systemic risk is significant in only less than 3% of the sample period for both of our proxies. More importantly, there is no significant difference in the levels of aggregate systemic risk during the global financial crisis of 2008 (including the near pre- and post-crisis periods), suggesting that Islamic equity markets are not able to provide a lower market risk compared to their conventional counterparts in financial turbulent times.
References


URL http://dx.doi.org/10.2139/ssrn.2089636


### Appendix A. Appendix

Table A.1: Mean and GJR-GARCH parameters for the return series, and the driving parameters of dynamic conditional beta (DCB) process.

<table>
<thead>
<tr>
<th></th>
<th>Mean and GJR-GARCH</th>
<th>DCB</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>( \mu ) ( \omega \times 10^4 ) ( \alpha ) ( \beta ) ( \gamma )</td>
<td>( \alpha ) ( \beta )</td>
</tr>
<tr>
<td>Market (C)</td>
<td>0.0003** 0.010*** 0.001 0.932*** 0.106***</td>
<td>– –</td>
</tr>
<tr>
<td>Basic Materials (C)</td>
<td>0.0005*** 0.032** 0.041*** 0.883*** 0.106**</td>
<td>0.038*** 0.955***</td>
</tr>
<tr>
<td>Consumer Services (C)</td>
<td>0.0003*** 0.007*** 0.039*** 0.919*** 0.076***</td>
<td>0.054*** 0.937***</td>
</tr>
<tr>
<td>Consumer Goods (C)</td>
<td>0.0002*** 0.009*** 0.012 0.925*** 0.091***</td>
<td>0.043*** 0.957***</td>
</tr>
<tr>
<td>Energy (C)</td>
<td>0.0004*** 0.012*** 0.027*** 0.935*** 0.056***</td>
<td>0.050*** 0.945***</td>
</tr>
<tr>
<td>Financials (C)</td>
<td>0.0003*** 0.007*** 0.009 0.936*** 0.093***</td>
<td>0.040*** 0.957***</td>
</tr>
<tr>
<td>Health Care (C)</td>
<td>0.0002*** 0.012*** 0.009 0.919*** 0.108***</td>
<td>0.042*** 0.948***</td>
</tr>
<tr>
<td>Industrials (C)</td>
<td>0.0005*** 0.016*** 0.004 0.897*** 0.197*</td>
<td>0.155*** 0.845***</td>
</tr>
<tr>
<td>Technology (C)</td>
<td>0.0004*** 0.006** 0.029 0.938*** 0.069***</td>
<td>0.064*** 0.893***</td>
</tr>
<tr>
<td>Telecommunications (C)</td>
<td>0.0002* 0.010*** 0.034*** 0.924*** 0.062***</td>
<td>0.043*** 0.939***</td>
</tr>
<tr>
<td>Utilities (C)</td>
<td>0.0002** 0.016*** 0.030*** 0.890*** 0.096***</td>
<td>0.044*** 0.946***</td>
</tr>
<tr>
<td>Market (I)</td>
<td>0.0003*** 0.010*** 0.009 0.931*** 0.094***</td>
<td>– –</td>
</tr>
<tr>
<td>Basic Materials (I)</td>
<td>0.0003*** 0.014*** 0.025*** 0.933*** 0.056***</td>
<td>0.034*** 0.961***</td>
</tr>
<tr>
<td>Consumer Services (I)</td>
<td>0.0002* 0.010*** 0.017** 0.930*** 0.089***</td>
<td>0.047*** 0.948***</td>
</tr>
<tr>
<td>Consumer Goods (I)</td>
<td>0.0002** 0.009*** 0.018** 0.918*** 0.098***</td>
<td>0.054*** 0.939***</td>
</tr>
<tr>
<td>Energy (I)</td>
<td>0.0003*** 0.016*** 0.032** 0.929*** 0.056**</td>
<td>0.049*** 0.948***</td>
</tr>
<tr>
<td>Financials (I)</td>
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<td>0.025*** 0.971***</td>
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<tr>
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<td>0.042*** 0.949***</td>
</tr>
<tr>
<td>Industrials (I)</td>
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<td>0.041*** 0.954***</td>
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<tr>
<td>Technology (I)</td>
<td>0.0004*** 0.010*** 0.022*** 0.933*** 0.078***</td>
<td>0.035*** 0.952***</td>
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<tr>
<td>Telecommunications (I)</td>
<td>0.0002* 0.008*** 0.039*** 0.933*** 0.042***</td>
<td>0.027*** 0.965***</td>
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<tr>
<td>Utilities (I)</td>
<td>0.0003*** 0.014*** 0.055*** 0.896*** 0.063***</td>
<td>0.028*** 0.969***</td>
</tr>
</tbody>
</table>

1. (C) and (I) refer to Conventional and Islamic respectively.
2. For the mean and GJR-GARCH equations, refer to Eq.(1) and Eq.(2) respectively.
3. For the driving process of DCB, refer to Eq.(6).
4. ***, ** and *** denote significance levels at 10%, 5% and 1% respectively.