A COMPARATIVE ANALYSIS BETWEEN THE FINANCIAL STRESS INDEX OF THE WHOLE FINANCIAL SYSTEM AND THE INDEX SPECIFIC TO ISLAMIC FINANCIAL MARKETS

Oussama Gafrej1 and Mouna Boujelbene Abbes2

1Oussama Gafrej, Ph.D. student, management science-finance, Faculty of Economics and Management of Sfax, University of Sfax, Sfax, Tunisia
2Mouna Boujelbene Abbes, assistant professor of finance, Faculty of Economics and Management of Sfax, University of Sfax, Sfax, Tunisia

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ABSTRACT

In this paper we develop an index of financial stress for the Islamic financial markets (IFMSI) and we compare it to the financial stress index (FSI) that has been developed previously. The methodology uses monthly basis data collected from financial markets of the Gulf Cooperation Council (GCC) region. The study period is between October 2006 and August 2018, which is regarded as a sensitive period in that region. The paper is structured around the following areas of focus: the measure of the impact of different events and external shocks in financial markets of the GCC countries, the examination of which financial system represented by FSI and IFMSI was less affected by region specific conflicts and exogenous shocks and the dynamic conditional correlation between both indices.

INTRODUCTION

The stress caused generally by an exogenous threat which is liable to influence any system, including the financial system. Thus, the extreme damage may lead to a financial crisis. A precise quantification of the financial stress is an action which is necessary to gain a better understanding to predict and to analyze the whole of the financial system. Studies conducted about the financial stress topic and the measures that ensure an adequate evaluation of systemic risk have been made especially after the global financial crisis. The financial stress index could be considered as a measure that enables us to estimate the extent of the crisis or the events’ impact.

In addition, The FSI allows us to study the contagion that occurs through the effect of events happened at a regional level or even on a global scale to the domestic financial system. Moreover, the construction of an index in a critical period that overtook many moving parts and events in a region that was also undergoing some fluctuations is greatly appreciated. The main objective of this paper is to combine the different components of the FSI that are included within an index for the Gulf Cooperation Council (GCC) region. Then we modify these variables to adopt with the specific nature of Islamic financial markets. As a result, we will obtain an index, which we have dubbed The Islamic Financial Market Stress Index (IFMSI). This modification allows us to make a comparative analysis to see which financial system suffered the most from the effects of the previous turbulences on the market.

The paper is structured as follows: In Section 2, we will give examples of the studies that illustrate methods and implements solutions to be associated to measure financial stress and the conceptualization of the FSI. In Section 3 we will present the data, the study period and the methodology in transforming and combining the variables to get an index to fulfill its function satisfactorily. Also, we will identify all components that have been met characteristics and efficiency to be considered to assess FSI, these variables will be presented with detailed examination and comprehensive way. In Section 4 we will

*Corresponding author: Oussama Gafrej
Oussama Gafrej, Ph.D. student, management science-finance, Faculty of Economics and Management of Sfax, University of Sfax, Sfax, Tunisia
interpret the level of the FSI in GCC region and then we make a comparison to the index that was implanted to meet Islamic financial market specificities. In section 5 we will estimate the DCC-GARCH models in order to investigate the dynamic conditional correlation between FSI and IMFSI in GCC region. We end up with Section 6 to provide a brief conclusion which quickly synthesizes key results of this paper.

The concept and the literature review of Financial stress index

In the work of Bardo et al. (2000) who have developed an index to measure the financial condition through 4 variables which are the banking sector failure rate, the non-financial business failure rate, the interest rate quality spread and the real interest rate. They were the first researchers to measure this phenomenon in the financial market. Previous works or studies treated the financial stress as a dummy variable which take two values 1 or 0 (1 if it is a period of crisis, 0 otherwise). If researchers continue to use the latter as a measure, they will never be able to calculate the different degrees of the crisis severity.

According to Illing and Liu (2003), the financial stress index (FSI) is based on three axes which are the expectations of financial loss, the risk and the uncertainty. Each of them could be measured through a calculation of variables from the whole financial system which comprises the banking sector, foreign exchange market, sovereign debt and equity crisis. The upward trend of FSI indicates that we witness a pre-crisis situation. Kaminsky and Reinhart (2002), evaluate financial markets in stress period based on the selected variables which are the domestic interest rate, the daily percentage change of the domestic currency against an anchor currency, the stock market return and the yield spreads between the sovereign bond and the US treasury bills.

The debate on the notion of financial stress index has shown its importance due to the global financial crisis. After this latest crisis, some authors have conducted several studies on this topic.

Beginning with the work of Cardarelli et al. (2009), focused on a constructive approach to build an appropriate index formed from four main lines covered by the banking sector (the beta of the banking sector, TED spread, Inverted term spread), the securities market (corporate spread, stock market return and volatility), foreign exchange (the volatility of the real exchange rate) and the cost of capital (the real cost of equity, debt and bank loans). This index is considered as an FSI of advanced economies.

Based on the methodology of the study of Cardarelli et al. (2009), Balakrishmen et al. (2009) have transmitted the FSI from advances to emerging economies by introducing a measure that takes account of the exchange market pressure, since the emerging countries were more sensitive in terms of the change in the exchange rate and the total reserves.

Moreover, Oet et al. (2012) construct a new index called Cleveland Financial Stress Index (CFSI) in which they added to the components of FSI two other market sectors which could affect financial markets over time. These two sectors are the real estate and securitization markets.

Haddad and Hakim (2016), have conducted a study that deals with the cost of financial integration in the GCC, they measure its impact using the financial stress index, the sub-indices was aggregated by the variance equal weighting. The chosen time period is including the period of the global financial crisis from January 2001 to April 2009. In addition, they explain the difference in terms of the method of calculation of FSI between advanced and emerging markets.

In recent years, several studies have focused on the financial stress index, Maryame (2010), Islami and Kim (2013), Vdovychenko and Oros (2014), Huotoni (2015) are some examples.

Methodology, data and variables

To construct the financial stress index (FSI), we follow the work of Balakrishmen et al. (2009) which developed an FSI specific to emerging economies. This index takes into account 3 financial sectors which are the banking sector, the exchange markets and the securities markets. The measures that reflect these 3 sectors include the exchange market pressure index (EMPI), the beta of banking sector (βs), the stock market returns (MSCIr), the stock market volatility (MSCIv) and the sovereign spreads (SS). These 5 components allow us to get the following formula:

$$FSI = \beta_s + MSCIr + MSCIv + SS + EMPI$$

The adoption of FSI to the specificities of Islamic financial markets is necessary to take particular account on this kind of market in some countries in which this industry is quite developed there. The contribution of this work is to establish an index where the components of FSI are replaced by their Islamic financial market counterparts. The following diagram explains the components of this index.

The EMPI remains unaltered because it measures the pressure of exchange markets in both indexes. Turning to other components, the following sub-sections will provide us with a brief explanation, the way in which we selected such components. The following formula will be proposed to present the calculation of the IFMSI:

$$IFMSI = EMPI + I\beta_s + MSCIslr + MSCIsv + SukS$$

Where EMPI is the exchange market pressure index, I\beta_s is the beta of the Islamic banking sector, MSCIslr and MSCIsv represent the Morgan Stanley Capital International (MSCI) Islamic Index return and volatility respectively, suks is the sovereign Sukuk Spreads.

METHODOLOGY

Following the collection and the measure of all components on a monthly basis, the variables are aggregated into a single index for each country using « variance equal weighting ». This method is widely used in the literature for ensuring that we do...
not give for the more volatile components an over-weighting. It is calculated by subtracting from the value of each component its mean over the period and then we divide it by its standard deviation.

The arithmetic mean of the measurements including FSI, IFMSI and the five sub-indices will be calculated to get a single index specific to each measure as that described above for providing a common measure for the GCC region.

This methodology allows us to make comparisons between the countries in the region and the financial markets via two entirely different financial industries in the light of their principles underpinning. Also, it is used to analyze and interpret the impact of financial stress from external shocks to the domestic economy across time and across countries. Moreover, it captures the response of these markets to certain events, it enables us to observe and predict the time-varying trend of the financial system.

Data
The data included in our two indexes (FSI and IFMSI) are monthly time series covering the period between October 2006 and August 2018 in Gulf Council Countries (GCC) including Bahrain, Kuwait, Oman, Qatar, Saudi Arabia and the United Arab Emirates (UAE). The monthly data are obtained from Datastream, Eikon (Thomson Reuters) and national central banks’ websites.

The study period is important and highly sensitive. There are obviously significant events during that period in which the most significant are the following: the global financial crisis of 2007-2008, the commencement of the Arab spring in January 2011 followed by the Syrian civil war since March 2011. From the second half of 2014 to January 2015 and from the fourth quarter of 2015 to January 2016, these two periods had witnessed significant drops in oil prices. In addition, it saw the beginning of Yemeni civil war and Qatar diplomatic crisis in March 2015 and June 2017 respectively.

Variables

The exchange market pressure index (EMPI)
The studies conducted by civic et al. (2013) and Moriyama (2010) have used the exchange market pressure index (EMPI) as a component of the financial stress index in MENA countries and Turkey respectively. As well as, the work of Balakrishmen et al. (2009), which introduced the measure of EMPI into the FSI.

As a result of these studies, the EMPI can be measured as follows

\[ \text{EMPI} = \frac{(\Delta \text{et} - u \Delta \text{et})}{(\sigma \Delta \text{et})} \]

\[ = \frac{-((\Delta \text{RES} t - u \Delta \text{RES} t))}{(\sigma \Delta \text{RES} t)} \]

Where \( \Delta \text{et} \) and \( \Delta \text{RES} t \) are the month over month variation in the domestic exchange rate against the US dollar and the total reserves minus gold respectively.

\( u \Delta \text{et} \) and \( \sigma \Delta \text{et} \) are the average and standard deviation of exchange rate variations. \( u \Delta \text{RES} t \) and \( \sigma \Delta \text{RES} t \) are the average and standard deviation of total reserves minus gold. The following figure explains the evolution of the exchange market pressure index (EMPI) in the GCC region during the study period.

The chart provides an analysis of one of the components of the financial stress index, which is the exchange market, measured by the EMPI during the period from October 2006 to August 2018. Overall, GCC countries were classified to the conventional peg exchange regime. Therefore, the fluctuation of the pressure in exchange markets was due essentially to the variation of total reserves minus gold. Obviously, the stress levels in GCC exchange markets were low during the study period except during the global financial crisis of 2007-2008, and during the period following Qatar diplomatic crisis that may lead the monetary authorities to recourse to currency reserves.

Stock market returns
The measure of the stress related to both indices (MSCIr, MSCIIslr) reflects the drop in market equity index levels. To measure that drop, we follow the work of Moriyama (2010) and we will multiply the real change returns’ of each index on a monthly basis by -1.

MSCI Islamic index return (MSCIIslr)
An Islamic financial market index constitutes a key indicator to determine the performance of the market where certain companies operate. These companies should satisfy two criteria. The first is a filtering mechanism based on the business activity of the company which consists of not accepting business activities that do not suit the Sharia principles such as conventional banking or insurance, activities related to tobacco, alcohol, non-Halal food and gambling, etc.

The second criterion is a filtering mechanism based on financial ratios. The following table sets out the financial requirement ratios applied in the main Islamic market indexes that currently exist.

<table>
<thead>
<tr>
<th>Criteria</th>
<th>DJIIM</th>
<th>S&amp;P500</th>
<th>FTSE</th>
<th>MSCI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total debt/Total assets or market capitalization</td>
<td>Less than 33%</td>
<td>Less than 33%</td>
<td>Less than 33%</td>
<td>Less than 33%</td>
</tr>
<tr>
<td>Cash and interest-bearing securities/ Total assets or market capitalization</td>
<td>Less than 33%</td>
<td>Less than 33%</td>
<td>Less than 33%</td>
<td>Less than 33%</td>
</tr>
<tr>
<td>Account receivables /Total assets or market capitalization</td>
<td>Less than 33%</td>
<td>Less than 33%</td>
<td>Less than 33%</td>
<td>Less than 33%</td>
</tr>
</tbody>
</table>
Due to the non-availability of updated data about the Dow Jones Islamic Market (DJIM), the Standard and Poor’s Sharia index (S&P 500) and the FTSE Sharia global equity index (FTSE), we will use the Morgan Stanley Capital International (MSCI) Islamic Index as an index that is designed for measuring both return and volatility in Islamic financial markets.

The following figure shows the evolution of MSCI index return and the MSCI Islamic index return in the GCC region.

The line graph compares the evolution of the stress associated to two kinds of stock market returns (MSCI Islr and MSCIr) over a period that lasts almost 13 years from October 2006 to August 2018. It is observed from the chart that the level of stress related to the stock market return for both indices which, has fluctuated from one period to another. But the most remarkable change takes place only in the period of the global financial crisis where MSCI Islr suffers very low levels of stress. On the contrary, MSCIr suffers an increased stress level. This observation may be explained by the importance of the filtering mechanism which based on the business activity and the financial ratios, which can help to avoid the excessive indebtedness and the virtual money (not backed by any assets).

**Stock market volatility**

Bollerslev (1986) introduces the GARCH model (Generalized Autoregressive Conditional Heteroscedasticity) by modifying the variance equation to get:

\[
\sigma^2 = \lambda_0 + \lambda_1 u^2_t - 1 + \lambda_2 \sigma^2_t - 1
\]

This equation is known as GARCH (1,1) in which the conditional variance depends on the lagged variance and error squared at a time (t-1).

The GARCH (1,1) could be extended to GARCH (p,q) model where p is the lagged error terms and q is the lagged conditional variance.

Based on the literature, GARCH (1,1) allows us to use a useful model to estimate the volatility of financial assets) model. In the same way, the GARCH (1,1) technique is applied to calculate the stock market volatility specific to each securities market (MSCIv) as well as the MSCI Islamic index (MSCI Islv) of GCC countries. We use Eviews as a statistical package to estimate GARCH (1.1). In the following, we present the evolution of stress that result from MSCI index and MSCI Islamic Index.

In the following, we present the evolution of stress of the volatility of stock market return and MSCI Islamic Index.

The chart illustrates how stock market volatility (MSCIv and MSCI Islv) can produce serious stress in the GCC region during the study period. Overall, the stock market volatility presents a low stress probably at most of the time with a low level of stress for MSCIv. The most significant changes for MSCI Islv and MSCIv were seen in the period of the global financial crisis. In 2018, we have observed a noticeable difference, where MSCIv is considerably increased, whereas MSCI Islv remains stable. This difference supports the idea that Islamic finance is less sensitive to external shocks.

**The beta of banking sector**

The beta coefficient (β) of the banking sector will be used as a component of the financial stress index. The main advantage of this measure is to know the total risk associated with the banking sector. It provides us with an appropriate measure of volatility in the whole banking sector within the market conditions. The beta coefficient (β) of the banking sector is the proportion of change in the banking sector index given a 1 percent change in the market return. The (β) is an input, taken from the Capital Asset Pricing Model (CAPM) which is used to determine the expected return of an asset based on financial theories.

When the beta coefficient is equal to 1, it means that the variation of the banking sector follows the same trend with the market returns, if a beta coefficient is equal to zero, that would mean that the banking sector returns does not react to any market variation.

A coefficient more than 1 shows that an increase in the market returns level follows a rise in the banking sector returns, but it goes up even more than market ones, for a coefficient below 1, the interpretation will be in a reverse manner.

The banking (β) can be calculated in the following manner:

\[
\beta = \frac{\text{cov}(r^M, r^B)}{\sigma^2_M}
\]

Where \(r^M\) and \(r^B\) represent the month over month banking sector and market portfolio. \(\sigma^2_M\) represents the variance of market returns.
Concerning, the Islamic banking sector, we have collected data of the majority quoted shares of Islamic banks in GCC stock exchanges. Also, we construct an index based on an equally weighted method. In the same manner, the same formula as that for the banking sector is used to calculate the Islamic banking.

The following chart shows the evolution of stress levels associated to the banking sector $\beta$ (Isl $\beta$ GCC and $\beta$ GCC).

![Graph showing stress levels in the banking sector]

**Fig 5 Isl $\beta$ GCC and $\beta$ GCC**

*Source: Authors' calculations*

The line graph illustrates the stress evolution resulting from the vulnerability of the banking sector to market conditions in the GCC region over the study period. For a certain period of time, we found that the two components which represent the same characteristics (Isl $\beta$ GCC and $\beta$ GCC), have followed the same trend and we noted this probably in most cases. And there are other times where Isl $\beta$ GCC and $\beta$ GCC varied inversely with the stress levels in the banking sector. This figure does not allow us to support the works relating to the capacity of Islamic banks to handle with the financial stress.

**Sovereign Spreads**

Sovereign spreads are an important component of the financial stress index, because it represents a probability of default in payment that a country fails to pay back its debts. According to Standard and Poor’s agency, 90 countries have defaulted since 1975. Also, many of them have defaulted several times, Bond holders may predict a sovereign debt crisis through a high bond yield mainly for short term bonds in which emerging countries offered a high bond yield as a risk premium.

In addition, bond holders may observe the sovereign risk through credit rating agencies such as Standard and Poor’s, Fitch and Moody’s in which each agency provides accurate information about the creditworthiness of sovereign borrowers. The assessment used by rating agency divided countries in categories from ‘AAA’ which indicates extremely strong credit quality to ‘D’ that indicates extremely delicate credit quality (Standard and Poor’s).

The reference measurement is usually the bond yield of specific countries minus the US Treasury yield with the same maturity. This component was obtained by calculating the government bond yields against the US yields, which allows us to obtain the following formula:

$$SSIt = Sy - USy it$$  \[6\]

Where $SS$ represents the sovereign spreads relating to each country, $Sy$ and $USy$ it represent the government bond yields and the US Treasury yield respectively on a monthly basis.

**Sukuk Spreads**

The issuance of sovereign Sukuk, which is equivalent to that of sovereign bonds in conventional financing is based on the Islamic contracts and differs from one to another. Similarly, we found some structure of Sukuk that combines two or more Islamic products under a single structure in order to improve the mobilizing of funds and to meet the increasing demand from investors. The Sukuk sovereign spread is determined by the following formula:

$$\text{Sukit} = \text{Suky} - \text{USyk}$$  \[7\]

The most commonly used types of Sukuk will be explored in detail in the following sub-sections.

**Musharaka Sukuk:** It is an investment Sukuk with an equal value certificate issued to use their outcome to develop or establish a business on the basis of Musharaka contract. The holders of Musharaka Sukuk become the asset owners of the project within the limit of their respective proportions. Sukuk Musharaka has some types such as temporary or continuing Sukuk. The management of such Sukuk may be either by the issuer or by someone else (special purpose vehicle « SPV »). The issuer is the participant called for the project and the Sukuk holders are the partners in the Musharaka contract. The income generated from the project will be distributed to the Sukuk holders according to the pre-distribution key. The losses will be sustained by the Sukuk holders of their capital contributions.

**Mudharaba Sukuk:** These securities issued to be operated on the basis of Mudharaba contract, in which the issuer will be considered as a manager (Mudharib). The Sukuk holders possessed the assets and the agreed quota, but at the same time, they will bear the loss, if occurred. Also, the issuer may be the SPV, which aims at ensuring the mechanism as trustee of the funds. In this case, the SPV and the Mudharib have to establish an enterprise on the basis of a Mudharaba contract in order to seek opportunities for value appreciation compared to the principal amount. The issuer (SPV) required offering a periodic return to investors.

**Murabaha Sukuk:** It is an equal value certificate issued to the investors to finance the purchase of merchandise (equipment and devices) on the basis of Murabaha contract. The Sukuk holders become the new owners of the commodity. The SPV sign a Murabaha contract with the purchaser on behalf of the investors. Before that, the issuer SPV uses the principal amount to own and receive the commodity before selling it. The Sukukholders are considered as the buyers of the commodity upon making a purchase and the principal amount of Sukuk issuance is considered as the cost price of the good. The profit of Sukukholders is the difference between the acquisition cost (the payment takes place on the spot basis) and the selling price of the property (the payments made in installments on a deferred basis).

**Istisnaa Sukuk:** The purpose of such Sukuk is to collect an amount for the construction of a building, and to manufacture a machine or equipment requested from an institution at a price, which exceeded the overall cost of operation. The Sukuk holders’ rights consist in paying the principal amount required to complete the production. The issuer of such Sukuk is usually the manufacturer (the vendor) and the Sukukholders are the...
buyers of the requested product. The maturity date shall be determined in accordance with the period necessary to manufacture the equipment, receive the full amount and distribute it to all Sukukholders.

**Salam Sukuk:** It is a capital ownership based on a Salam contract to finance the purchase of goods that will be received in the future. These goods were then marketed to clients. The return derived from the Sukuk is the profit resulted from the selling. Also, the Sukuk will be traded when the capital was converted towards goods (after the delivery and before the selling). In conclusion, the Salam Sukuk is considered as a key mechanism to attract financial resources to the government, companies and those who work in agricultural, industrial and commercial production because thanks to the value of future products, the producer can finance its production process.

**Ijara Sukuk**

It is defined as an equal value certificate which represents common-property of assets, economic benefits or services of investment project related to Ijara contract in order to transform them into tradable securities in financial markets. The Ijara Sukuk is considered as ownership of leased property owned by Sukukholders. The rental payments are distributed periodically to the holders in proportion to their holdings. In addition, it is the best known of all Sukuk structures thanks to its flexibility in terms of trading and issuing level and it provides to investors a stable and fairly stable return. In the following chart, we provide a clear illustration of the evolution of the stress caused by sovereign spreads as well as by Sukuk spreads.

![Fig 6 SS GCC and SukS GCC](image)

The provided graph delineates the differences between SukS and SS in GCC region during the study period. At the beginning of the study period, the chart above shows that levels of stress are higher compared to the period following that date. Concerning, the period that follows the initial time, we can infer that stress levels are low. Also, the trend of SukS has been stable compared with that to be found for SS. The stability of Sovereign “Sukuk” compared to sovereign bonds may be explained by the requirement to utilize the funds in a special project or any investment activity.

**Empirical results of FSI and IFMSI**

In presenting our results, we have attached importance on a comparison between the components of each index (FSI and IFMSI) for the region concerned. We present descriptive statistics and curves that allow evaluating the financial stress via the two indices by country and for the entire region. These points will be accurately presented in the following subsections.

**Descriptive Statistics**

<table>
<thead>
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<th>Tab 2 Descriptive statistics of FSI</th>
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<td><strong>BAH</strong></td>
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<tr>
<td>Mean</td>
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<tr>
<td>Median</td>
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<td>Max</td>
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<tr>
<td>Min</td>
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<tr>
<td>S.D</td>
</tr>
</tbody>
</table>

**Source:** Authors’ calculations

The table provides a descriptive statistics of the FSI of the GCC, compared with an average of the indexes that are included in the region. It is obvious from the table that Oman and Saudi Arabia had the highest level of the FSI with an index of 3.63 and 3.25 respectively. While, UAE had the lowest index, which equal to -1.47. In addition, it is remarkable from October 2006 through August 2018, that the average monthly index in Saudi Arabia was higher than other countries due to the fact of some political reasons and the variability of oil prices. With regard to the variation of FSI, it seems to be obvious that the standard deviation were almost close across countries. The value of standard deviation in Saudi Arabia was higher than in other countries. While, the variability that reflects financial instability was lowest in Kuwait. Overall, the FSI specific to the GCC region was 1.54 as a highest value versus -0.74 as a lower index.

<table>
<thead>
<tr>
<th>Tab 3 Descriptive statistics of IFMSI</th>
</tr>
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<tbody>
<tr>
<td><strong>BAH</strong></td>
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<tr>
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<td>S.D</td>
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</table>

**Source:** Authors’ calculations

The table shows a quick overview of the IFMSI for groups of countries in the GCC region. It provides the descriptive statistics of the IFMSI referring to the GCC region as a global index compared to the indices specific to countries included in the GCC region. Oman had the highest index of 2.01, on the other hand, the UAE had the lowest index of -1.60. The monthly data indicate that Bahrain had a high level of variability compared to other countries. Referring to the table, the IFMSI of GCC region is clearly more stable compared to the FSI of GCC region (as already observed in Table 2.2) in terms of the mean and the standard deviation.

**The evolution of FSI and IMFSI**

It makes more sense to compare the evolution of FSI and IFMSI in each country of the region. That is why in the following, we present some figures that take into account the state of financial stress per index and per country.
By comparing the FSI to the IMFSI per country, we can see that mostly the FSI maintains a higher level than the IMFSI. We observe that the global financial crisis had affected the IMFSI after a certain period of time of the commencement of the crisis. This could be explained by the high level of resistance of Islamic finance to external shocks thanks to its principals which is directly linked to the real economy and due to the deterioration of the economic situation that can be considered as the principal reason for the delayed impact. This observation is in line with the findings of al Qadi (2012) and is also seen after the period of the Arab spring and during the oil crisis in 2016. To conclude, the FSI and the IMFSI levels differ from one country to another depending on the extent of the economic diversity and the oil financial dependency.

To better understand, and the best way to interpret the increasing and the decreasing of the FSI and the IFMSI level, we compare in the following figure its state over time for the whole region.

The chart depicts the state of FSI and IFMSI in the GCC region during the period from October 2006 to August 2018. It is clearly seen from the chart, the different regional events, occurring at different times increase the level of stress in the GCC region. But, the global financial crisis remained until our days, the event which has the greatest effect on the whole financial markets in the region. In addition, IFMSI GCC remained at a lower stress level than FSI GCC except for particular cases. Globally, the region presents low financial stress indices if we compare our findings to previous studies conducted on other region of the world.

**Empirical estimations of dynamic conditional correlations between FSI and IMFSI**

One of the primary objectives of this paper is to know if there is any interdependence between two indices in the same country on the one hand and for the whole region in a global manner on the other hand. In addition, the DCC-GARCH models will be used to determine the conditional correlation between FSI and IMFSI for the whole period. In the following, we will define the DCC-GARCH. Next, we will estimate the time varying conditional correlation of the two indices in the GCC region. Then, a graphical presentation will be displayed for each country and for the whole region.

**The DCC-GARCH**

There are several approaches to estimate the correlation among different financial assets. Among these approaches, we could mention the model proposed by Bollerslev (1990), which is the constant conditional correlation (CCC). This model is considered as a linear combination of GARCH univariate model. Thanks to its simplicity, the CCC model was very popular in the empirical applications. However, the hypothesis of the constant conditional correlation may be relatively uncertain and invalid. Subsequently, another model proposed by Engle (2002), and Tsui and Tse (2002) to generalize the CCC-GARCH which is the dynamic conditional correlation (DCC).

**In fact, the DCC model is estimated by using univariate models and is written as follows:**

$$H_t = D_t R_t D_t$$  \hspace{1cm} (7)

Where $H_t$ is the variance covariance matrix in the DCC model, $D_t$ is the diagonal matrix of the conditional volatility and $R_t$ is the conditional correlation matrix.

The model DCC-GARCH enables us to estimate conditional volatilities through 2 stages. In the first stage, the mean of each asset will be embedded in a univariate GARCH model. Consequently, $D_t$ will be defined as follows:

$$D_t = \text{diag} \left( \frac{1}{2} \sigma^2_{i1}, \ldots, \frac{1}{2} \sigma^2_{k1} \right)$$  \hspace{1cm} (8)

Where $\sigma^2_{it}$ is the conditional variance that follows the GARCH univariate model and given by the equation as follows

$$\sigma^2_{it} = \alpha i + \sum_{p=1}^{p1} \alpha p \epsilon^2_{t+1-p} + \sum_{q=1}^{q1} \beta i, q \sigma^2_{i, t+1-p} \hspace{1cm} (9)$$

To ensure the stationarity and the non-negativity of the equation, it must be noted that the following restrictions should be verified $\alpha i, p > 0, \beta i, q > 0$ and $\sum_{p=1}^{p1} \alpha i, p + \sum_{q=1}^{q1} \beta i, q < 1$.

In the second stage, the univariate variance will be used to standardize the zero mean return which is supposed to follow a GARCH multivariate in order to show the time varying development of $R$ matrix. The latter will be then written as follows:

$$R_t = \text{diag} \left( \frac{1}{2} \sigma^2_{i1}, \ldots, \frac{1}{2} \sigma^2_{k1} \right)$$  \hspace{1cm} (10)
\[ Qt = (1 - \alpha - \beta) \bar{Q} + \alpha \delta_{t-1} \delta_{t-1} + \beta Q_{t-1} \]  
(11)

Where \( Qt \) is a positive symmetric matrix, \( \delta_{it} = \varepsilon_{it} / \sqrt{\hat{u}^2_{it}} \), \( \bar{Q} \) is the unconditional variance of \( \delta_{it} \), \( Q \) and \( \beta \) are scalar parameters which are not negative. \( \alpha \) and \( \beta < 1 \).

Both parameters are marked in Eviews software as theta (1) and theta (2) respectively.

As a result of the conditional correlation coefficient between assets i and j \( \rho_{ij} \) is expressed by the following formula:

\[ \rho_{ij} = \frac{(1-\alpha-\beta) \bar{q}_{ij} + \alpha \mu_{t-1} + \beta q_{ij,t-1}}{\left( (1-\alpha-\beta) \bar{q}_{ij} + \alpha \mu_{t-1} + \beta q_{ij,t-1} \right)^{1/2}} \]  
(12)

The following table presents the DCC-GARCH estimations for FSI and IMFSI in GCC region.

<table>
<thead>
<tr>
<th>Source: Authors’ calculations</th>
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| Theta (1) | 0.093184 |
| Theta (2) | 0.885418 |
| Log likelihood | 28.44584 |
| Avg. log likelihood | 0.099461 |
| Akaike info criterion | -0.243998 |
| Schwarz criterion | -0.016087 |
| Hannan-Quinn criterion | -0.151386 |

*Stability condition: theta (1) + theta (2) < 1 is met.

Figure 10 shows the evolution of dynamic conditional correlation for both indices per country. From the figure, we observed that DCC-GARCH models generate correlation coefficients with negative values in a certain period of time, except for Bahrain where all coefficients are positive. In addition, the correlation between FSI and IMFSI shows a different dynamic across countries, where the negative coefficients differ from one country to another according to the degree of the financial integration of each country.

**CONCLUSION**

Over a period of time, the financial integration has been growing regionally as well as at an international level. The adoption of a measure that takes into account all financial information requested about the systemic risk and fluctuation of financial markets become a fundamental requirement. However, in reality the necessary steps are taken place, researchers and institutions worldwide have played a significant role in the development of an effective indicator in particular the financial stress index. This index combines factors covering the specificity of the whole financial markets. On the other hand, the adoption of that index to the specificity of the Islamic financial markets (highly developed in a certain region) in not yet at the launch stage. This paper presents two indices of financial stress in the GCC region. The main objective of these two indices is to develop a clear vision about the conditions of financial markets in the region from two points of view in order to know which one is the more sensitive.
to regional and international events. The focus was placed basically on collecting data from a sensitive period in the region that has suffered a number of conflicts between countries that belong to the area and other countries. After being introduced to each component their Islamic finance counterparts, we compared one component to each other. In addition, we then compared the stress level related to the two indices. We found that FSI and IFMSI were affected by the events that we have listed above. The results indicate that the degree of sensitivity differs from one index to another. We observed that the IFMSI has a higher resistance to adverse external shocks compared to the FSI. Finally, we found that during certain period of crisis, the dependence between the two indices of financial stress becomes negative.

References


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