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Alternative finance : what are the advantages?

Rosette Khalil

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Thesis submitted for assessment with a view to obtaining the Doctoral degree in Economics

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General introduction

Many financial crises show the opposite faces of the conventional financial system. In this context, in the 18th century, Bernard Mandeville (1714) highlights the evils of the capitalist-liberalism system that can hinder economic growth. In his book "The Fable of the Bees, private, public benefits", he focuses on the importance of the collective goods system.

In the past four decades, several consecutive crises known as the October crashes (The Black Tuesday (October 29), the Great Crash, October 1987 and October 2008) have attacked the conventional financial system. From the mentioned crashes, the 2008-2009 international financial crisis was the most severe. There was a severe collapse in the stock markets that were attacked by a "speculative bulimia". During 2007, the subprime crisis was transformed into a liquidity crisis which was reflected by the negative effects on the credit rate. This effect was known as the "credit crunch". Under those circumstances, many firms mainly small and medium ones started decreasing their investment which resulted in the shrinking of the international trade. Moreover, the general price level of primary materials increased which led to a decrease in the purchasing power of lower-middle classes from Haiti to Philippines. According to Murphy (2008), the total transactions in the swaps market reached around USD 55 trillion. Knowing that the supposed credit default swaps (CDS) in the United States was 4 times less than the amount reached. Simon (2008) argues that there was a lack of regulation and documentation concerning the pricing of these CDS as a big portion was dealt online or through the phone.

During the period between 2008 and 2009, the Euronext, Tokyo and New York Stock Exchanges were severely affected as there was a decrease from Euros 3,794 billion to 1,676 billion, from USD 4,158 billion to 2,563 billion and from USD 14,574 billion to 8,700 billion respectively. In addition to that, commercial banks were the most affected by the negative consequences. For instance, from December 2007 to March 2010, Natixis bank and Citi Bank

were affected due to the strong engagement in loan securitization as net inventories had decreased from Euros 29.8 billion to Euros 4.9 billion and from Euros 150 billion to Euros 13 billion respectively.

According to Monica and Tridico (2014), the negative impacts of the financial crisis show that when capital markets become inefficient, economic fluctuations can lead to an increase in public debt and can become an obstacle to economic growth. Many huge companies and States were attacked by the negative consequences of the crisis. For instance, Iceland was not able to manage its public debt and was menaced by a sovereign default.

The position of classical finance during and after the last international financial crisis has demonstrated the importance of values and ethical standards in the efficiency of the financial system. Accordingly, many global market participants and policy makers who considered the conventional system as dishonest and avaricious were increasingly paying attention to the potential of the alternative-complementary financing system including the ethical Islamic financing system. Equally important, the vulnerability, the information asymmetries and the volatility in the traditional financial markets can disrupt the financial system which can support the position of alternative investments. For instance, many German investors who took vulnerability into consideration; especially during the last international crisis, started diversifying portfolios by adding alternative products. According to Dymski and Kaltenbrunner (2014), European investors started searching for lending and payment systems which were less volatile than the traditional one that is characterized by consecutive crises. Nowadays, Western economies are impressed by the emergence of alternative channels away from the conventional markets. For instance, in 2016, more than USD 8.1 trillion was invested in socially responsible investment portfolios.

Concerning the importance of financial lending for small businesses, it has been proven that the financial funding for start-up enterprises can have positive effects on economic growth. At first glance, Joseph Schumpeter (1912) gives high importance to the financial system and especially the banking system in his research. Miguel De Cervantes said "Urgent necessity

prompts many to do things". During the international financial crisis, small and medium enterprises (SMEs) started suffering from global credit shortage. The vulnerability of the SMEs pressed conventional banks to adopt strict prudential rules in which they started losing their position as first external financiers. During the crisis, small enterprises were snowballing leverage which led to a contraction in banks' balance sheets. Accordingly, these severe constraints discourage the persistence and resilience of new projects which could not have enough tangible assets as guarantees. Moreover, as firms are indispensable to increase the level of employment, diversified funding options should be put to maintain its durable investments and to minimize as possible their market position. Thus, after many SMEs have battled to assure loans from traditional banks and credit unions, the financial landscape started changing for the benefit of alternative lenders. In 2015, alternative financing started expanding significantly to be one of the most supporting financing for SMEs by 2016. According to the Advocacy teams, these firms started suffering from global credit shortage. As an illustration, 80 percent of loan applications serving small businesses were dropped. This post-recession pressed small businesses to strive for funding support through new financing windows which benefit in return by filling the financial void. In the same context, it is important to note that over the past two decades, the global financial market has seen the emergence of new alternative financial industries such as the Islamic investment, the socially responsible investment and cryptocuurencies.

Nowadays, Islamic finance in general and Islamic banking in specific are considered as one of the fastest-growing industries of the international financial system especially after the 2008-2009 financial crisis. Recently, the Islamic financial market became a vital and flourishing market. Hence, many inter-governmental organizations such as the International Monetary Fund and the World Bank have been expanding efforts to reconstruct market performance by enhancing ethical basics. Moreover, in 2015, a Memorandum of Understanding (MoU) was signed by and between the World Bank and the General Council for Islamic Banks and Financial institutions to improve the level of awareness of Islamic products and to set up a solid and resilient system. As for the position of Islamic finance in the global financial system, two points of view exist. The first point of view considers Islamic finance as a substitute for conventional

finance. However, the second one classifies it as a complementary to the conventional finance system.

Nevertheless, according to Mohieldin et al. (2011), Islamic finance and mainly the Islamic banking system is essential to meet Muslim clients' demand who refuse illegal services such as interest. This means that the simple existence of Islamic finance can help increase the saving rate which can guide economic growth. In this context, Miller and Modigliani (1958) assert that ethical alternative banking could be less risky and thus it is preferable in terms of economic growth. This crisis of confidence in conventional banks is a devastating crisis. By contrast, according to Chapra (2008), Islamic financial institutions are less affected by financial crises than conventional institutions. The case of Islamic banks is pretty different. In general, Islamic banks are more protected by their Islamic standards mainly by the prohibition of leverage and speculative transactions. To begin, being based on Profit Sharing Principle (PLS) has many benefits in the financial strategies. First, the partnership principle can build an efficient risk management strategy and can lead to the selection of strong project. According to Chapra (2008:12-16), the Profit Sharing Principle (PLS) is related to the real economy which can limit the speculative behavior and thus lead to efficient resource management. Second, the partnership principle permits the funding of small and medium enterprises (SMEs) and to reduce exceptional expenses and poverty. (See Appendix Figure 2) In this context, Iqbal and Molyneux (2005) present the innovative role of Islamic banks in SMEs financing, in risk management and diversification between creditor and entrepreneur. The effective regulation and supervision in Islamic banks can have positive effects on economic stability by reducing the problem of "moral hazard". Third, there is a limitation to the real sector. According to Islamic business law, asset-backed financing has to be certified. Conventional securitization (akin to sales of debts) is forbidden in Islam. Accordingly, debt markets, accused of failing, are excluded from Islamic services. Thus, Islamic transactions depend on the real economy thereby savings will be invested in well-productive sectors. Fourth, the prohibition of speculation under Islamic standards is a fundamental stone to reduce the negative effects. The requirement of an asset possession prevents "short-selling". For instance, many believed that the Islamic contract "Murabaha" (see section 2, chapter one) is similar to the conventional mortgage contract.

However, there is a difference between the two contracts. The conventional mortgage contract has high speculative and leverage effects compared to the Islamic mortgage. In addition, in the case of conventional mortgage, the client will purchase the asset and will be the only one responsible for the price fluctuations. Nevertheless, in the case of "Murabaha", there is risk-sharing between the bank and the creditor. Another important criterion of Islamic banks that can hold subprime effects down is the restricted debt ratio as it is not allowed to finance heavily indebted projects. In Islamic banks, household debt ratio is approximately 33 percent compared to 120 percent in American Conventional banks. To conclude, Islamic banks were relatively more resilient to the last international financial crisis than conventional banks which can reflect their solidity.

Therefore, many Western countries especially in North Africa, USA and UK were incented to develop their Islamic financial services. In October 2008, Pope Benedict XVI argued: "*Only the Word of God is the foundation of all reality*". The Vatican, in 2009, put in evidence on how the impacts of the crisis led to a crisis of confidence in the financial system. The liquidity problems were a direct cause to extend Islamic financial services. As an alternative to the conventional financial system, an ethical Islamic system can support and reconstruct the reputation of the conventional system during crises. To put it differently, under the Islamic system, there is a maximal trust level and tendency to maintain a climate of confidence within their households. Thus, Islamic fundamentals will not only stimulate clients but also bring clients closer to their bank. In this sense, the Observatory Romano assumed: "*Western banks could use tools such as the Islamic bonds, known as Sukuks, as collateral*[1]".

The existence of strong and adaptive legal laws coordinated to a developed financial sector is essential. In this sense Imam et al. (2015) discovers that, since the principles of financial institutions are based on an old legal structure, they can have a positive effect on the economy. One of these radical principles is social justice (Al ʿAdâla Al Ijtimâʿiyya). Likewise, the "Hadith" of the Prophet represent another source of legislation. The "Hadith" include the

[1] Collateral: it can be assets, securities or liquidities used as guaranties to reduce credit risk resulting from financial transactions.

words, actions, practices, and approvals of Prophet “Mohammed” (SAW). The "Hadith" are divided into several types according to the mode of transmission, the number of rapporteurs and the authenticity of the "Hadith". These sources highlight the conditions that transactions in Islamic finance must undergo. These transactions must be of the same purpose, and of the same kind with the backing of any transaction to a tangible asset.

In addition, the foundations of Islamic finance such as the prohibition of usury and the sale of debt have proven that the mere existence of these banks has made it possible to relatively protect this finance from the effects of the last financial crisis. However, Islamic finance is not immune to crises. For example, the "Dubai World" crisis is the result of a remarkable crisis in the “Sukuk” market. But in general, we can say, from an Islamic point of view, that the main cause of this crisis is the lack of a social environment capable of dealing with the economic ills that Islam tends to combat. Overall, Islamic finance helps reduce poverty and unemployment rate. Theoretically, the principle on which the Islamic banking system is based is the minimization of the evils which oppose not only economic but also social Islamic norms within a community such as poverty, socioeconomic injustice, distribution fairness of wealth.

As Islamic Finance is generally based on the principle of ethics, we can say that it also supports sustainable economic activity and seeks economic prosperity. Socially Responsible Investing (SRI) which is described as “ethical”, “green” or “sustainable” investing is established on a similar principal which is based on the principle of ESG investments. Sustainable development is defined as the development of human objectives through natural means and is considered as a common factor between SRI and Islamic investment. According to Hirigoyen (1993), Islamic finance is considered as a popular form of SRI and was founded on religious principles that are based on considering ethical and responsible investment decisions.

The Muslim community shares widespread belief on the role of humanity to act responsibly and sustainable and thus express it through their faith-based values in their investments. The Islamic finance industry has been able to expand at a rate of 17 percent since

the last financial crisis. Generally, the Islamic finance sector started as a faith-based initiative which is self-regulated and enforced. However, most recently, governments and monetary authorities have begun to regulate the Islamic finance sector. Even though there is a mutual concern for responsible business.

In general, investors are interested in only profits. However, some investors favor other criteria such as ethical, social, or environmental factors for their investments. Those who choose this route follow the social responsible investment (SRI) path which plays a key role in "the stability of the economy". Those who favor SRI usually oppose the views of Milton Friedman who states that "the social responsibility of companies is to generate profits and that modern companies have no responsibility towards the public and its only responsibility is to provide income to the owner"[2]. He mentions that "the role of the company leader is to earn money and to meet or beat the benchmark."

Thus, Islamic finance, through the sector filtering it imposes, represents an interesting socially responsible investment option. Sustainable investments are considered a derivative of SRI investments and can serve as a platform for Islamic finance to grow on. It is considered that through sustainable development, the objectives of SRI and Islamic finance are converged. However Islamic finance has access to large amounts of SRI funding from global markets. The connectivity between Islamic finance and SRI is being realized in certain markets with momentum. It is thus deemed crucial that "practitioners of Islamic finance" realize the opportunities available in the SRI market. In addition to meeting the requirements of SRI, ethics can serve as a pre-requisite for efficient performance of financial markets. This would result in higher yields in ethical funds. (De Serres, 2007, Burlacu et al, 2004). Thus, for so many policymakers, this diversity in the investors' portfolio can be a chance to invest responsibly or simply seeking financial performance. (Beal et al., 2005).

The common values between SRI and Islamic finance can be grouped together to allow Islamic finance to garner access to the large availability of SRI funds globally. For instance,

[2] The New York Times Magazine, 1970.

Malaysia's SRI Sukuk framework can be commissioned through the stronger interconnection between SRI and Islamic finance. An estimated amount of USD 3.4 trillion is expected to be invested in this ESG index from around the world.

As a part of the alternative financial tools, the digital world and virtual currencies start to conquer the world in the last decade. Created in January 2009, by an enigmatic computer programmer, "Satoshi Nakamoto", many virtual currencies like Bitcoin are strongly interested to be a part of the services portfolio of the Islamic Financial system. Following the 2008-2009 financial crisis, regulatory framework was enhanced by the implementation of stricter capital requirements which led consumers to seek alternatives to conventional banks. Despite the increased popularity of Bitcoin and Islamic finance, the literature about this topic is still very scarce. After the emergence of Bitcoin in the recent years, many questions were revolved by researchers to understand the nature and characteristics of this digital currency. Many economists like Reboredo (2013b) evaluate the importance of digital currency for the minimization of risks in investors' portfolios. Knowing that, the diversification is crucial by allowing traders and investors to benefit from desirable returns by reducing the maximum risks in a portfolio. Many other researchers like Bouoiyour and Selmi (2015), Briere et al. (2015) pose a dilemma if the Bitcoin is a speculative currency, a safe haven or can be considered as a future currency. Bouoiyour and Selmi (2015), by using daily data from 2010 until 2014, do a research on "the complex phenomenon of Bitcoin". By using an "ARDL Bounds Testing method", they reveal that Bitcoin is a very volatile currency with long-term uncertainty. In addition to that, they conclude that Bitcoin cannot be considered as a safe haven. This analysis can be concluded after studying the relationship existing between Bitcoin and Shanghai stock market which is the biggest simulator of the Bitcoin price. The results show that on the short term, there is an existence of a positive and significant relationship between the Shanghai market index and the bitcoin price. However, due to the limitless of the ARDL test, it was not possible by the researchers to detect the relation on the long-term. Bouri et al. (2016) analyze the potential of Bitcoin as a diversifier. The results of this study through the use of "dynamic conditional correlations method" show that Bitcoin may be classified as a diversifier for many stock indices such as bonds, oil and USD.

Bariviera et al. (2017) specify the informational efficiency of the Bitcoin market and to determine the main characteristics of Bitcoin and indicate that the volatility clustering is a key feature of the Bitcoin market. Selmi et al. (2018) performed a nonlinear data analysis technique called the multifractal detrended fluctuation analysis to investigate the time-varying efficiency of this market. They showed that Bitcoin is characterized by a persistent long memory process in its short- term components, which could be attributed by its excessive volatility and speculation. Understanding the Bitcoin from Islamic angle was so interesting not only for Muslim investors but also for policymakers.

The thesis is divided into four chapters. In the first chapter, we illustrate the history and the expansion of Islamic finance worldwide. We show the growth in terms of Islamic finance in Muslim countries and non-Muslim countries as well. We also mention the main transactions applied by Islamic financial institutions and which are based on the Islamic law "Shariah". We mention accordingly in a simplified manner the prohibited items in Islam.

In the second chapter, we study the efficiency of 41 pure Islamic banks operating in in 5 GCC countries for the period 2004 and 2017. We cover the period before and after the international financial crisis. We estimate the cost efficiency of our banks by considering three inputs and three outputs. We rely on two orientations which differentiate in terms of constraints: input orientation and output orientation in order to study the production efficiency which is calculated by the production function based only on the quantities of used input factors and the profits of the outputs provided. This approach is explained by the ability to avoid wasting resources by producing as much outputs as the use of input allows, or vice versa (using as much little inputs as the level of output requires). In order to do this, we rely on the cost stochastic frontier and data envelopment method. Battese and Coelli (1995) proposed a stochastic production frontier which can calculate the efficiency scores of production units by integrating directly in the estimating function and specific macro variables that may influence the efficiency. The second method is the data envelopment method which uses linear programming techniques. Data envelopment analysis was introduced by Charnes, Cooper and Rhodes (1978) in order to generalize the traditional measure of productivity of an input and an

output as a measure of technical efficiency. From our results, we see that the Islamic banks operating in the GCC region do not operate on the efficient cost frontier maybe due to managerial inefficiency and misuse of production factors. The dispersion of cost efficiency although is important. Our results are therefore in the low range of average efficiency scores observed by the empirical studies (e.g. Zuhroh et al., 2015, Tahir and Haron, 2010). Regarding the historical evolution of cost efficiency, we observe an increase over the period 2004-2017: 38.5 percent according to stochastic frontier and 24.7 percent according to DEA method. To test the stability of our results, we propose to modify the distribution of the inefficiency by assuming that the error component representing the inefficiency follows a gamma distribution. Greene (1980, 2005) and Stevenson (1980). While the distribution of efficiency scores varies according to the definition of the adopted measure, the ranking of banks remains relatively stable. The use of the output-oriented DEA model and the Gamma distribution do not change the obtained results significantly. In this context, the results showed that the efficiency scores could not be explained solely by financial ratios, as they are related to external factors corresponding to the X-inefficiency and economic environment.

In the third chapter, we study the characteristics of Bitcoin as a virtual currency versus four Islamic indices. We rely on Garch family models to detect the level and the persistence of volatility during the period 2010 until 2018. We also rely on the Markov switching model to study the duration of persistence of the indices during low risk regime and high risk regime. The rises of virtual currencies have also significantly touched the Islamic world. This study circles around exploring how and to what extent Islamic fund investors can benefit from diversifying their investments in virtual currencies such as Bitcoin. Some studies indicated that regardless of the volatile and speculative behaviors of Bitcoin, the latter possesses hedging and safe haven properties and can be incorporated in a portfolio to curtail the adverse consequences of rising uncertainty surrounding unforeseen shocks/events. From our results, we notice that Islamic indices and Bitcoin are not immune to financial shocks. However, the volatility persistence of Bitcoin is more important than the case of Islamic stock market. We can say that the duration of persistence for Bitcoin is on the short and long terms. In addition, we confirm the role of Bitcoin as a hedge during normal moments and as a safe haven during moment of anxiety. We

also conclude the existence of an asymmetric distribution of returns for all the indices under study. However, it is important to take their respective market characteristics (in particular, their volatile behaviors) into account. It must be stressed the measurement of volatility is widely viewed as a "tool" to determine the level of risk in the financial market.

In the fourth chapter, we study the interaction between three Islamic indices versus their sustainable counterparts. We apply the autoregressive distributed lag model to see the existence of the short-run and long-run relationship between the indices. In the second step, we use the Domain frequency causality which was refined by Geweke (1982) and implemented by Breitung and Candelon (2006) to study the dynamic causality and its directness between each Islamic index and its counterpart. Our study is beneficial mainly for investors who are concerned with many non-financial factors such as religious belief, sustainability, the well-being of society, which consider environmental issues, corporate governance and ethical factors.

Our results show the existence of a long-run equilibrium and the position of the stock markets as complements mainly on the short term and substitutes on the long-term. The "frequency-by-frequency" causality outputs show the existence of a causal relationship on the Short-term between the three sustainable stock market and their Islamic counterparts. These findings show the ability to diversify is an additional opportunity without losing in profits.

First Chapter: Development of Islamic Banks: Evolution and Characteristics

1. The appearance of Islamic Finance and its spread in the world

1.1. Birth and evolution of Islamic banks

The principles of Islamic finance are historically more than 1,400 years old but began to be noticed in the 1940s; thanks to "Sayyid Abu Al Ala Maududi" in Pakistan.

In 1963, Islamic finance began to be exported to the Arab countries with the birth of the first Islamic bank "Mit Ghamr" which was sponsored by Dr. Ahmed Al Najjar in Egypt. It was the first of its kind in the MENA region. In order to revive industrialization in rural areas of Egypt, the social savings bank "Nasser Social Bank" was introduced in 1971. It appeared to respond to the need to reduce the level of poverty and unemployment in the country. To achieve the bank`s goals, the Egyptian government has donated USD 2 million to the bank.

After that, the 1973 oil boom and the decolonization of the Arab countries were important cyclical reasons for the expansion of the Islamic banks. Indeed, in 1975, several Islamic banks emerged such as the "Dubai Islamic Bank", "Kuwait Finance House", "Bahrain Islamic Bank" and the "Faisal Islamic Bank" in Khartoum.

In the 1980`s, the market witnessed strong growth due to continued demand for Islamic financial products. The market for Islamic financial products has attracted the attention of several Western commercial banks, which have begun to offer financial services through its Islamic windows for high net worth clients.

Since the 1990s, efforts have intensified to control and regulate the operation of Islamic banks according to the “Shariah” law. Therefore the following have emerged; the Accounting and Auditing Organization for Islamic Financial Institutions (AAOIF), the General Council for Islamic Banks and Financial Institutions (CIBAFI), the Islamic International Rating Agency (IIRA), the International Islamic Center for Reconciliation and Arbitration (IICRA), the Islamic Financial Standards Board (IFSB); and the Malaysia Accounting Standards Board (MASB).

At the micro level, "Shariah" products must be submitted to the “Shariah” Supervisory Board (SSB). The main missions of the" “Shariah” Board" are:

- Putrefying and analyzing “Shariah” products of financial institutions including legal documentation and characteristics
- Advising Islamic financial institutions while drawing up contracts in order to be submitted to Islamic commercial law
- Detecting the existence of illicit returns on investment (ROI). Islamic banks must structure specific accounts to mask illicit activities. Hence, these returns are considered charitable donations and must be allocated to help people in need
- Auditing of Islamic financial operations
- Issuing an annual report on Islamic banks operations and performance.

At the macroeconomic level, the main regulatory institutions are in Bahrain and Malaysia. Accounting and Auditing Organization for Islamic Financial Institutions (AAOIF) AAOIF is an Islamic international independent "non-for-profit" organization. In 1990, AAOIF was created in Bahrain. This Islamic financial institution has standards which are particularly applied in the Gulf region. The issued standards of AAOIF are as follow:

Figure 1. The main standards of AAOIF

Source: Author’s structure-World Bank Data

In the last two decades, the Islamic finance sector has grown by 7.59 percent in "Shariah" asset growth globally in 2018. Total global assets growth in 2017 was significantly less at around 4.74 percent. This expansion in assets was not only in Islamic countries such as in countries such as countries in the GCC, Iran but also in non-Islamic western countries such as USA, Australia and others in which growth reached 20.2 percent in 2018 and in Asia by 16.3 percent while in Africa it was around 12.6 percent. Even though strong growth was witnessed in 2018. An increase in small financial Islamic financial institutions was also witnessed. According to the Global Finance report in 2017, it can be analyzed from the report that an increase in the rate of Islamic financial assets from 2007 until 2016 occurred especially after the latest recession. It is shown that in 2008, an increase occurred which is equivalent to USD 822 billion and grew to a total of USD 1139 billion in 2010. It continued to increase to USD 1631 billion in 2012, then, it reached USD 1981 billion in 2014. In 2015, it reached USD 2143 billion and in 2016 it rose to USD 2293 billion. By 2023, the Islamic finance market is projected to reach USD 3.8 trillion as reported by the Thomson Reuters Islamic Finance Development Report 2018 through the "Shariah-compliant" organizations which are estimated to be 1400 institutions worldwide. It is projected that this trend will continue to increase to about USD 5 trillion in the coming years.[3] As of March 2020, the issuance of "Sukuks" amounted to approximately USD 180 billion. This amount was mainly contributed to from the GCC and Malaysia. Saudi Arabia was the country that had the largest market share in the Islamic banking market. According to the IFSI stability report in 2018 on the distribution of Islamic financial assets by sector in 2017, it is shown that the highest increase is led by Islamic banking which accounts for 76 percent followed by "Sukuks" at 19.5 percent, Islamic funds at 3.3 percent, and "Takaful" at 1.3 percent. The level of systematic importance of Islamic Banking is led by Iran then Sudan in Africa. Then, they are followed by the GCC which is led by Saudi Arabia followed by Kuwait and Qatar respectively. In Asia, Malaysia is in first place followed by Indonesia. In the MENA region, Jordan and Turkey are ranked at the top. The share percentages for each country is led by Iran at 34.4

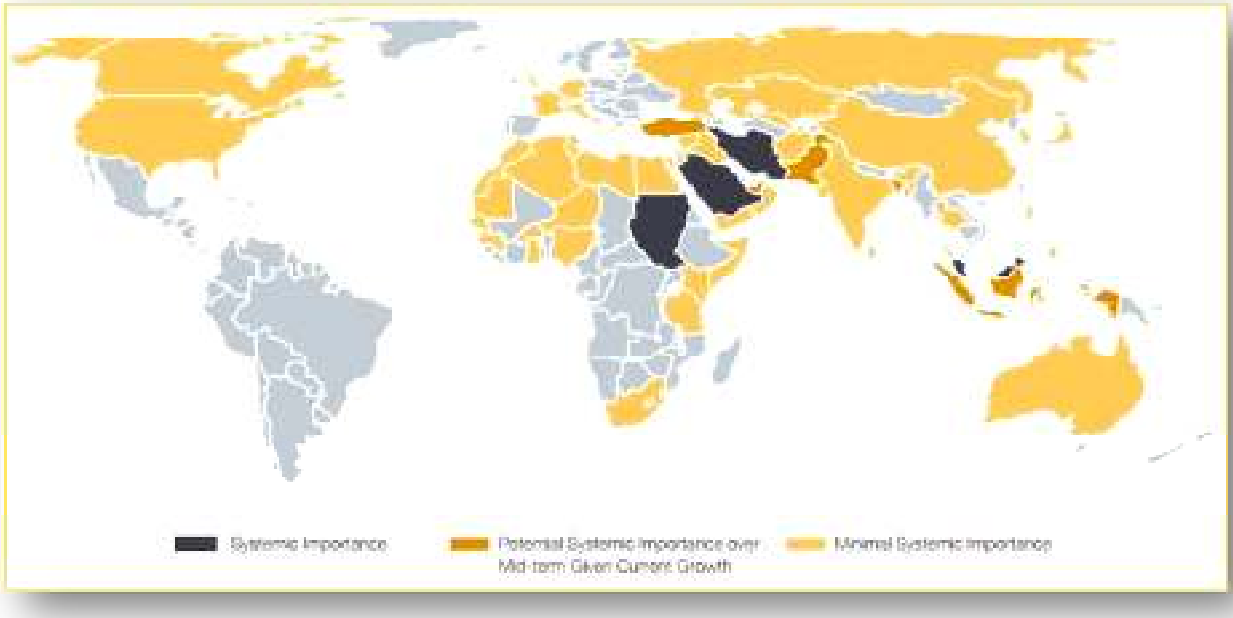
[3] The sources which the data was retrieved from differ and is based on specific standards to measure the rate of growth on assets and to measure the size of Islamic assets worldwide.

percent, followed by Saudi Arabia at 20.4 percent, then the UAE at 9.3 percent, and Malaysia at 9.1 percent.

1.1.1. Islamic Finance in Muslim countries

Most Islamic banking assets have recently been centralized in the Gulf region as well as in Southeast Asia. Iran, Saudi Arabia and Malaysia have the largest number of Islamic financial assets.

Figure 2. Emergence of Islamic Finance in Muslim and non-Muslim countries



Source: IFSB Financial Stability Report 2015, KFHR, IMF

Iran is the country that was leading the sector in terms of shares with a share of 28.6 percent of the global Islamic assets. The total "Shariah" assets reached in 2018 around USD 575 billion. This country has the largest Islamic financial institution. Iran abided to "Shiite" Islamic law in 1983 which had two convergent phases. The first phase in which the Islamic banking system had remarkable success and the second phase in which growth began to slow down. This slowdown is due in principle to the disruption of the political situation in the country and economic sanctions such as the Iran-Iraq war, etc.).

Saudi Arabia comes in second place with 25 percent of the total Islamic assets. It has the most prominent bank being: The National Commercial Bank (NCB), which is considered the largest bank in the Arab world and the second largest in the world. It exercises not only the principles of "Shariah" (two-thirds of the total assets) but also other conventional transactions. This bank issued shares equivalent to euros 4.7 trillion in 2014 and made more than USD 2 trillion in profits in the same year. In this context, the Islamic Development Bank (IDB), founded in 1975 in Saudi Arabia, is also considered an intergovernmental Islamic bank. The main objective of the "IDB" is to increase social welfare and to reduce poverty in a society. Moreover, the intention of the country to open with an amount of USD 590 billion to the global stock market in the coming years which can stimulate investment in the Islamic financial sector.

In third place comes Malaysia with of 23 percent of the share of Islamic financial products. Although Malaysia is a Muslim country, half of the clients in Islamic banks in the country are non-Muslims. Malaysia has experienced significant growth and began to develop gradually since 2000s in terms of expertise and financial innovation at the national and global levels and in particular at the level of the Islamic financial system, In terms of Islamic finance assets, Malaysia is the second market with an amount of USD 491 billion.

Indonesia comes in fourth place. In the Islamic financial sector since it started in 1991 in Jakarta. In the same year, the first Islamic bank was founded and is known today by the name of "Muamalat Indonesia". Later, in the 2000s and in response to the appetite of the Muslim clientele, large Islamic banks such as the "Representative House of Indonesia" were established. Consequently, a massive transfer from conventional banks to Islamic banks followed; as a result the number of rural Islamic banks increased from 105 in 2006 to 146 in July 2010. Recently, there are more than 1,640 Islamic banking branches in the country.

1.1.2. Islamic Banks in the GCC[4] Countries

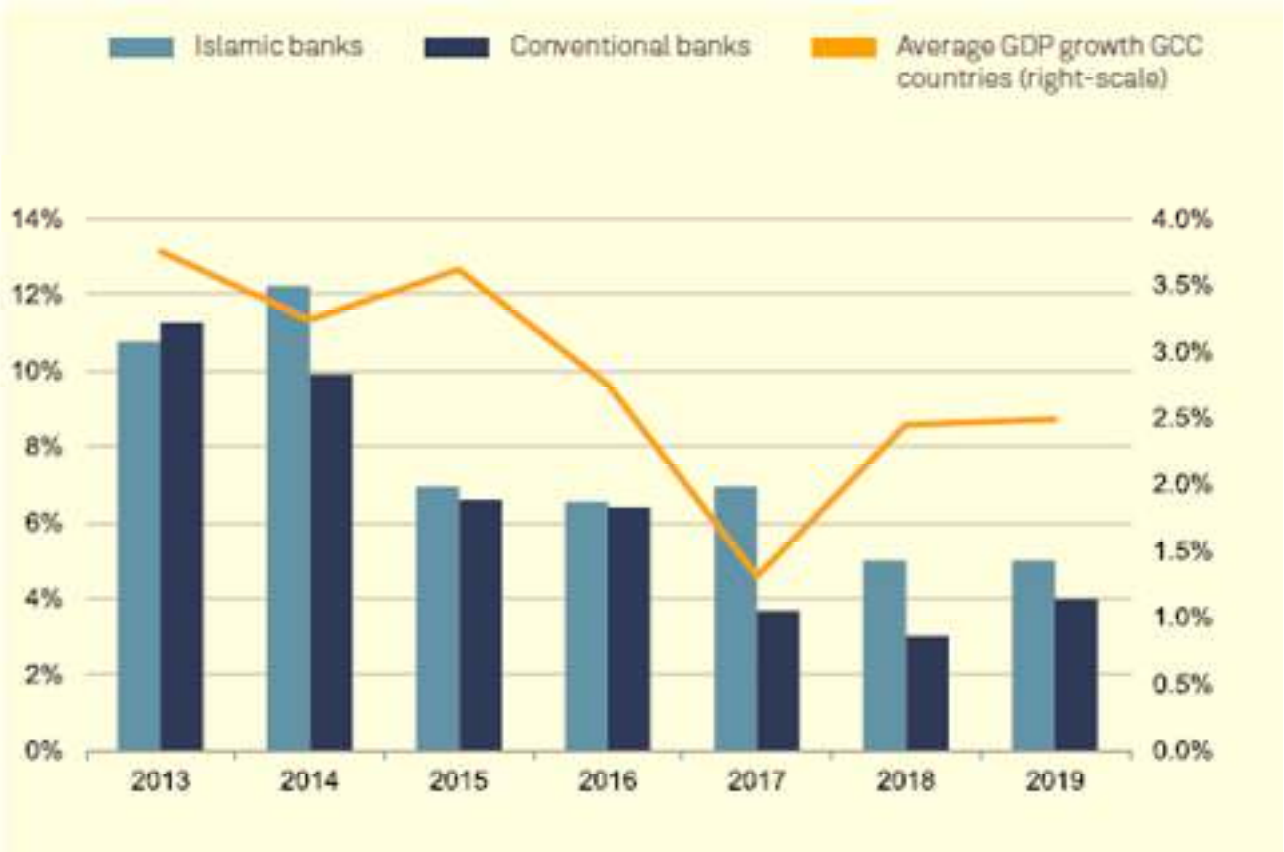
According to the rating agency Standard & Poor's (S&P), projections show that the share of the Islamic banking sector in the Gulf countries and that of the conventional banking sector within five years have a percentage of 30 percent and 25 percent respectively. This means that the share of Islamic banks exceeds that of traditional banks in this region. Note that by the end of 2015, assets in these countries reached round USD 2 trillion compared to USD 1.7 trillion in 2013.

The Islamic transactions expanded by about 5 percent in 2017 compared with about 2 percent the previous year, according to estimations (see Graph 1 below), with strong support from the “Sukuks" market. Between 2018 and 2019, it was expected that growth will converge with that of conventional banks, but that Islamic banks will continue to expand at a marginally faster rate. The volume of "Sukuks" issuance increased in 2017 thanks to jumbo issuances by some GCC countries. It is also important to note that "Sukuks" can play a significant role in economic growth. Echachabi et al. (2016) showed that between 2005 and 2012, "Sukuks" issuance had a positive effect on economic growth in certain Muslim countries and non-Muslim countries as well. That can be explained by the invasion of Islamic finance the main Tiger Cub[5] Economies which do not highly rely on petroleum products. Knowing that, the covered period was characterized by consecutive bubbles and perturbations. After the oil shock in 2014, there was a mild economic recovery in the GCC. The growth in customer deposits recovered slightly in 2017. This was the result of stabilized oil prices and the channeling of higher public-sector deposits to the banking systems. Islamic banks tend to attract retail depositors due to their “Shariah-compliant” nature.

[4] The GCC is composed of Saudi Arabia, Bahrain, Oman, Qatar, the United Arab Emirates and Kuwait. Yemen is considered as an observer rather than a member.

[5] “Tiger Cub Economies collectively refer to the economies of the developing countries of Indonesia, Malaysia, the Philippines, Thailand and Vietnam, the five dominant countries in Southeast Asia”. Wikipedia (2020).

Graph 1. Asset Growth of Islamic versus Conventional Banks.



Source: S&P Global Ratings (2018), banks' financial statements. GCC-Gulf Cooperation Council.

There is an expectation that the Islamic banks' financing growth will reach 4 percent-5 percent, supported by strategic initiatives such as:

- The Dubai Expo 2020
- Saudi Vision 2030
- The World Cup 2020 in Qatar
- Higher government spending in Kuwait led by Kuwait 2035 Vision, the country's national development plan.

A surge in geopolitical risk and ensuing delays of some of these initiatives could negatively affect the base-case scenario. According to an analysis made by the research team of "S&P", the GCC economies are heavily dependent on oil prices. The other challenge is falling oil prices which negatively affect the income and wealth of a population and therefore create a liquidity risk. To remedy this, a balance should be struck between the exposure of conventional and Islamic banks to less politically sensitive infrastructure projects.

Moreover, the three key risks that we foresee for GCC Islamic banks are regional geopolitical tensions, higher cost of risk, and lower profitability. The end of the triple-digit-oil-price era has significantly slowed GCC economies and reduced growth opportunities for their banking systems.

1.1.3. The evolution of Islamic finance in the non-Muslim world

In the early 1980s, Islamic finance began to be exported to non-Muslim countries in Africa such as Senegal and Niger as well as to European countries such as Luxembourg and the United Kingdom. In 1978, the first Islamic bank in Europe appeared in Luxembourg. The Islamic banking system (later replaced by "Islamic Finance House Universal Holdings") was mainly concerned with buying transactions and in particular the exchange of shares with European and global companies. At the beginning of the twenty-first century, several Islamic banks began to spread more and more in the Western world. GIDE which is considered as French association of international lawyers has experimented in 2015 Islamic financing whereby it researched in cooperation the BEMO to issue the first “Ijara Sukuks” (see section 2) which is based on the renting of vehicles owned by Saudi Arabia. Starting from 2003, GIDE also increased its efforts in other sectors such as real estate where a growth of 6 billion euros resulted. These efforts were for the benefit of several banks such as Morgan Stanley, Citi Group, Société General, etc.

1.1.3.1. The United Kingdom

According to the "Lane Clark & Peacock" (LCP) company which is concerned with the immobilization and the granting of the credits the United Kingdom has approximately 10,000 millionaires. The Muslim population, which accounts for 50,000 customers for its “Shariah”

products, is considered as the pioneer not only in European countries but also the Western world. Its Islamic financial sector was worth around £ 2.3 billion in 2014. In 2017, the total assets of UK-based institutions that offer Islamic finance services amounted to USD 6 billion and composed of 6 Islamic banks[6] and 20 commercial banks offering Islamic financial instruments[7] with an amount of USD 700 million accounts for the total net assets of Islamic funds in the UK.

The Islamic financial market of the UK is very advanced and is considered a key market for foreign "Shariah-compliant" institutions. Islamic Financing was first started in the 1980`s whereby the London Metal Exchange offered overnight deposit facilities that were established on the "Murabahah" principle. Shortly afterwards mortgage finance based on the "Ijarah" principle was offered (see section 2). London is considered a major financial center offering Islamic products through large traditional Middle Eastern banks. In the UK, the Financial Services Authority has turned to implementing standards that are in compliance with Islamic financial products. In addition to this, the UK legislation also considered the subject of taxation on Islamic transactions.

The first corporate 'Sukuks" was launched in 2005 through the launching of the Sanctuary Building "Sukuks" which was the first in the UK and in Europe.

The British government introduced measures on the legislative framework for investment bonds or "Sukuks" that are similarly structured to conventional debt instruments. The UK has implemented an extensive range of regulations and policy that support the Islamic finance sector and that are intended to expand the market of Islamic finance services. This led

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[6] The Islamic Bank of Britain (IBB) in 2004
European Islamic Investment Bank (EIIB) 2005
The Bank of London and the Middle East (BLME) in 2007
Qatar Islamic Bank UK (QIBUK) (European Finance Hose) in 2008
Gatehouse Bank in 2008
Abu Dhabi Islamic Bank UK (ADIB-UK) in 2013

[7] In addition to pure Islamic banks in the UK, there are also Islamic windows in a number of commercial banks that aim to meet the requirements of the clients that comply with the principles of Islamic law. This includes Citi Bank, HSBC, UBS, and PNB Paribas.

to the reduction of legal costs and removed obstacles that would affect their issuance. The UK Government also established an Islamic Finance Task Force in 2013 to further regulate the sector. In addition to that it has strong legal expertise for the sector with around 25 law firms specialized in Islamic Finance in matters related to transactions, regulations, compliance, tax, management, and operations. The UK banking sector is regulated by the Bank of England and the Financial Services Authority (FSA). Due to the growing demand for Islamic Finance by ethnic minorities, they have enabled fiscal and regulatory framework to allow Islamic Finance to compete with conventional financial products. The regulatory framework included abolishing the double taxation regime which was associated with a double stamp duty which was applicable when the bank purchased the house and second once the house is bought by the client from the bank. This strengthened demand for Islamic Financing in the UK. They also abolished capital gains tax and stamp duties on land, reformed arrangements for bonds so that returns and income and considered in a matter similar to interest. The FSA also ensures that Islamic Finance is consistent with its objective and principles.

1.1.3.2. France

Through a study that was conducted by the Pure Research Center about the demographic evolution of Muslims in France, in 2020 the number of Muslim inhabitants reached a percentage of 8.3 percent from the total population. It is projected that this number will grow in the next three decades to reach to approximately 7.5 million inhabitants by 2050 which would be equivalent to about 11 percent of the total population. Most of the Muslims which are present in France are from North African origin (Algerian, Tunisian, and Moroccan). They are spread across three generations; the immigrants, the first generation, and the second generation[8]. The Islamic religion is distinguished by its demographic growth which has grown at a more rapid pace than other religions. This is attributed to several reasons which include marriage to relatives, high fertility rates, and continuous immigration. It should also be noted that most Muslims prefer to live within proximity of each other which allows them to migrate

[8] The term second generation refers to the first generation person who was born in France who have evolved after the year 1980. The term second generation is used to prevent the classification of the person as a new immigrant amongst the general society.

easily. France is considered behind in comparison to its neighbors in terms of Islamic finance. Currently, the activity of this market is limited to the real estate sector.

Table 1. France has the highest percentage of Muslim population amongst European countries

Years	Number	Percentage of the population
2010	4,710,000	7.5 percent
2020	5,430,000	8.3 percent
Projection		
2030	6,100,000	9.1 percent
2040	6,750,000	9.9 percent
2050	7,540,000	10.9 percent

Source: Author's structure, Pew Research Center

But following a recent survey by the World Bank, in 2016, 55 percent of the Muslim population was interested in taking loans that respect the ethics of Islam. The good development of this sector pushed the Minister of Economy and Finance "Christine Lagarde" to declare in July 2, 2008 the need to make Paris a major center of Islamic finance. According to her "*Islamic finance can in principle become a factor of financial stability because risk-sharing reduces the debt ratio and trade is backed by tangible assets that are fully guaranteed*." After this declaration, there were several essential tax instructions to facilitate the entry of the capital coming from the Gulf countries to enter later in competition in particular with London. This has been proven by the General Directorate of Public Finance which began in July 2010 to step up efforts to increase the role of Islamic financial transactions within the French economy.

The French authorities have played an important role the development of Islamic Finance who has established an environment to all for growth of the sector. The Paris Euro

place established the Islamic Finance Commission in December 2007 to promote the market and since then the French financial market regulator, the "Autorité des marchés financiers" (AMF), began to allow ‘Sukuks” listings and “Shariah-compliant” investment funds. In addition to that, the Paris Stock Exchange has allowed parity of tax treatment with conventional financial instruments for “Murabaha”, “Sukuks”, “Ijarah”, and” Istisna'a” in July 2008. In this manner, “Sukuks” was officially listed and regulated on the French market and compensation which was paid by “Sukuks” was treated in the same manner as interest on conventional bonds. Non-residents investing in “Sukuks” were also exempt from withholding taxes in France regardless of whether it was governed by French law or another country. In July 2010, amendments were made by the French government for the facilitation of “Sukuks” issuances. The amendments were mainly related to the abolishment of double stamp duties and capital gain taxes on property. In June 2011, the first Islamic deposit scheme was introduced in France through existing conventional banks. Further on, a home financing product and 10-year “Murabahah” contracts were introduced. The demand for “Shariah-compliant” home financing was in high demand for retail clients and it is envisioned that similar tools will be launched for small and medium-sized enterprises. Other financial instruments such as "Mucharakah" and "Mudarabah" are expected to be issued in the near future by the French tax authorities. Presently there are a total of six “Shariah-compliant” funds with a total of USD 147.2 million in total assets under management. These are split between money markets and equity assets at percentages of 47 percent and 53 percent respectively.

Further growth of Islamic finance in the French market is expected to develop further as trade between neighboring Muslim countries such as Morocco, Algeria, and Tunisia. It should be noted that a large proportion of the French population originates from the above-mentioned countries which has led to the strengthening of demand for Islamic Finance in France.

1.1.3.3. United States

As its Muslim population gradually grows to reach around 3.5 million Muslims by the end of 2017, the United States is experiencing significant growth in Islamic finance services. Among the most famous banks in the country, the "Riba Bank of the American Finance House"

which had been authorized to spread in 13 states. This bank has experienced diversity in its financial services and financing in the real estate sector, the medical sector, the automotive sector, as well as in the financing of SMEs. However, the Islamic financial assets in USA are still limited to around USD 4 billion[9] in 2019. The reasons for growth of Islamic finance in non-Muslim countries and particularly in North America and Europe, is to meet the demand of Muslim clients who respect the principles of “Shariah” law. This is accomplished by setting up "Islamic windows" in some banks such as "Citibank, HSBC, UBS, and BNP Paribas". Similarly, many other Western countries are interested in such banks because they have good transparency and financial regulations in comparison to conventional banks. The market size of Islamic finance grew in the US with relation to the growth of Muslim population in the late 1990`s, whereby it rose to 66 percent in the 2000s compared to 50 percent in the 1990s.” The University Bank, Harvard Islamic Finance Program, and the American Islamic Finance House” are considered as the three largest banks in terms of asset size in the US that offer Islamic banking services. In 2013, JP Morgan began offering Islamic banking services as well.

2. Islamic financial instruments

There are various types of Islamic financial instruments. The main forms are represented as follows: Participatory financing tools: “Mucharakah”, Working capital financing and liquidity management: “Murabaha”, “Istisna'a'a” and “Bai' Al Salam”, Asset financing tool:” Ijara”, “Mudaraba”, fixed income investment: "Sukuks" and “Takaful”.

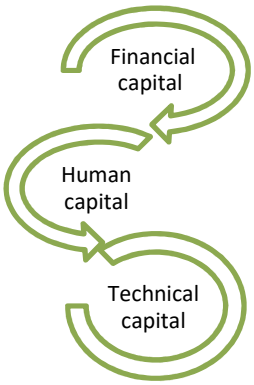
2.1. Participatory financing tools: “Mucharakah”

The contract "Mucharakah" means "participation". It is a transaction whereby the partners distribute the losses and profits according to a predetermined percentage. The bank creates a company and it will be responsible for its management and in which it will involve its depositors in a specific project (joint venture). Indeed, the management of the project is done with the "Mucharikun" according to the law of participation of profit and loss. Since it is a principle of participation and a positive sum without which no one could profit independently

[9] John H Vogel, Lexology, author of Islamic Finance and Markets in USA.

of the others. Similarly, participation here is not limited to physical capital but also to the contribution in the project management. Consequently, any "passive investor" will be stripped of his rights and therefore of remuneration. To guarantee the rights of all partners, the distribution will take place only after the closing of the transaction and the losses will be assumed on the basis of its shareholding. There are three types of invested capital that must be defined when signing the contract. These assets are:

Figure 3. The three types of capital in the "Mucharakah" contract



Source: Ruimy Michel, Islamic Finance, 2008

Therefore, no Islamic bank is limited to a single "Mucharakah" because of the high degree of risk. For this, there will always be a diversified portfolio of "Mucharakah" with a feasibility study of the client proposal. Indeed, thanks to expertise and diversification, this risk can be reduced. There is, however, no way to completely eliminate the risk and therefore whoever wants to make a profit, must accept a minimum risk.

2.2. Working capital financing and liquidity management: "Murabahah", "Istisna'a" and "Bai' Al Salam"

The contract "Murabahah" is better known as "flat profit" or "Ribh" which is a form of loan without risk. According to this contract, when a customer wants to buy a property, the bank does it in its place. The importance of this contract appears in particular in the financing operations for consumption needs. Formally, within the framework of an Islamic financial

institution, a guarantee can be requested but the main guarantee is the trust in the morality of the customers.

The "Murabaha" appears in two ways: the first is a direct transaction by which the bank buys the good and sells it immediately to the customer being the buyer at a higher price. The amount is payable by payments plus a predetermined commission which represents the agreed gain profile (AL Bay'ou Bi Ribhin Ma'loum). According to Iqbal et al. (1998), this transaction is preferable because of its simplicity. In fact, 70 percent of the average funding is used in the form of "Murabaha" in these institutions. The second is an indirect transaction by which an intermediary seller appears to execute the order of the purchase. The "Murabaha" can never take place at the level of a securitization which represents an unreal asset with forward payment, constituting thereafter usury. In this regard, there is a set of conditions that the "Murabaha" must undergo. The buyer should know if the property is in the possession of the seller for this transaction to conform to the “Shariah” norms. In addition, this transaction should have a real, non-monetary value, and should not be subject to a contract future. Similarly, the delivery must not be packaged and the price should be well defined by all parties.

In fact, there is a certain preference for fixed income financing for several reasons:

- The simplicity of this method of financing
- A primary source of liquidity for investors, since companies still need low-risk financing
- These are short-term products
- By their similarities to traditional banking products, these instruments are easily understandable by customers.

Since there are several components that fluctuate in the economy such as inflation rate, prices and so on, Islamic banks do not establish "Murabahah" contracts in the long term in order to reduce the risks of economic conditions and market risk. Another equally important risk is liquidity risk because the receivables from this transaction are debts that will be repaid at maturity. In fact, they cannot be sold on the secondary market at a price different from the

nominal value in the event of the expiry of the maturity date. In addition to this, a credit risk can occur in the event of default.

One of the basic conditions for Islamic financial transactions is to conform to the “Shariah”. It is the need for material possession from the seller. However, there are exceptional cases such as "Salam" and "Istisna'a'a" contracts. What distinguishes these two contracts from derivatives such as options, swaps and others and makes them lawful is the fact that the payment will be made previously. Thus, despite the prohibition of the sale of a non-tangible product according to the general principle of the “Shariah” law, what makes these contracts legitimate is that the goods are considered as a reward paid for the sale of a non-tangible product price paid in advance. Another argument that supports the validity of contracts is that the seller without liquidity will be unable to make a productive investment for the economy. In addition, in order to guarantee the rights of all parties,” Shariah” imposes selective rules.

The contract "Istisna'a'a" differs from the contract "Salam" by the subject of the transaction in question. The "Salam" contract is a source of financing for agricultural goods, but the "Istisna'a'a" contract covers finished and processed goods. Note that the contract "Istisna'a'a" is more risky than the contract "Salam" because the first takes into consideration risks related to the completion of the work. Another difference between the two contracts is that the payment in the "Salam" contract is made in advance while it is not necessarily the case in the "Istisna'a'a" contract. Similarly, the time delay for the delivery of the products is a very essential factor in the "Salam" contract and that is not the case of the "Istisna'a'a" contract. Add to that, in the case of the contract "Istisna'a'a", the manufactured product must meet the specifications already determined.

First, concerning the "Salam" contract; The Arabic term "Salam" means peace. However, in Islamic finance, it refers to "the act of handing something over to someone". Due to its peculiarity, the Prophet evokes the "Salam" contract in his words and affirms that: "*Whoever practices “Bai 'Al Salam” that he specifies his merchandise for a known volume, for a known weight and for a known delay*". In addition, in order to guarantee the rights of all parties,

“Shariah” issues very selective rules. Indeed, in this kind of contract by which the bank acts as purchaser, the goods are delivered in a subsequent manner while payment is made, at a price fixed in advance. In addition, the products should be generally available on the market at the time of delivery. One of the conditions for the "Salam" contract to be valid, it is necessary to specify "the object of the transaction in kind, in cash, quality, quantity and time of delivery." It should be noted that the bank must be very careful when managing the "Salam" contract because of the risks that may occur. The main risks are:

- Counterparty risk when placing the payment in advance
- Credit risk in case of default
- A risk on the quality of the goods following an unanticipated accident which may threaten the harvest and the quality of the products those which render them non-compliant with the specifications already determined
- Price risk as the actual price of the product may be lower than anticipated
- A possible loss that can occur in the case of unsold products. This can increase the additional expense of storage as well as "Takaful".

Second, it is the "Istisna'a'a" contract. It appears that this contract participates directly in the production process. In other words, it is a contract composed of two parts: the "Moustasni'i" (the buyer) who asks the "Sani'i" to manufacture or create a specific work whose price will be fixed before or after and the characteristics of the work is completely and surely regulated. In other words, in this type of contract, the moral obligation of the manufacturer exists, but the right to terminate the contract is always present before the start of work. However, once the manufacturer starts his work, the right does no longer exist.

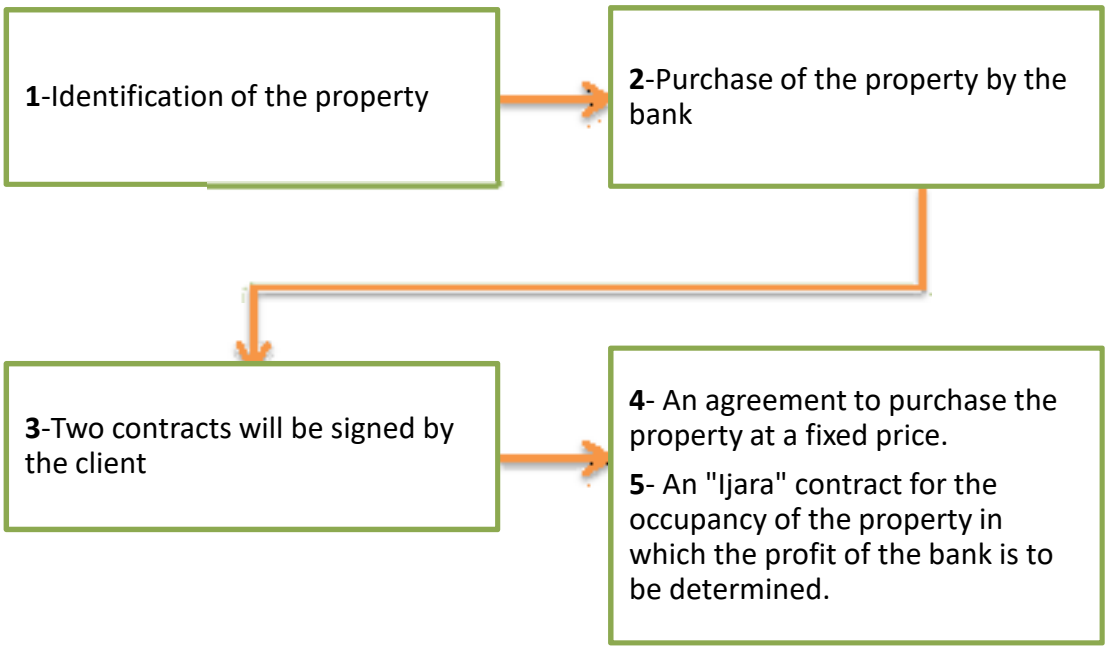
2.3. Asset financing tool: “Ijara”

The term "Ijara" means "rental" which is rather known as "Leasing". It can be combined with the term "Iqtina'a" to become "Ijara w Iqtina'a". This contract is similar to leasing. Through this transaction, there will be financing of movable and immovable investment projects over the medium and long term. In this contract, three actors intervene: "the supplier is the seller,

the lessor represented by the bank and the tenant who rents the property. In this contract, the customer may be entitled to buy what is rented later.

The steps can be summarized as follow:

Figure 4. Description of "Ijara" transaction



Source: Ruimy Michel, Islamic Finance, 2008

Regarding the main risks that may result from this transaction, these are related to the risks of the owner because the bank owns the place during the period of this contract. Moreover, in case of any problem, it is the bank only that should bear the risk. For this, the bank requires the client to sign a contract with specific housing conditions. To reduce the risk, the bank should take out an insurance policy, the fees of which will be added to the amount to be paid for the rent.

2.4. “Mudaraba”

The transaction of "Mudaraba" literally means "competition". It is an intermediation contract allowing a manager-entrepreneur, the "Mudarib", to invest on behalf of a capital owner "Rabb Al Mal". In the case of Islamic financial institutions, it may be that the bank itself becomes an investor, or an applicant who has to invest its own funds. In this case, the bank acts as agent. The importance of this type of transaction is to take advantage of the expertise of "Mudarib" and the physical capital of "Rabb Al Mal" at the same time for a better selection of projects. Indeed, the major responsibility rests here on the entrepreneur who must carry out a good management and a good control of the investment project.

The "Mudaraba" contract must be admitted in accordance with the “Shariah” and according to the principle of profit-loss sharing in order to have a solid relation with the partners, the bank, the depositors and the entrepreneurs by distributing the profits In the same way, it is necessary that the type of the investment project is well presented in a clear and detailed way, since the "Mudarib" does not take a salary but its profits which are determined by a pre-determined percentage, it will be obliged to direct the funds in an optimal way. As for the share of the bank, it also receives a percentage with the return of capital during the contract period. However, in case of losses, the "Rab Al Mal" (the bank as an investor or clients being investors) would bear the physical loss alone while the entrepreneur loses, his reputation, his its time and know-how. In fact, in order to minimize the risk of loss and mismanagement of investor clients, the bank takes on the role of supervisor most of the time. Generally, this contract is risky compared to other types of contracts because the Islamic financial institution relies only on the honesty and sincerity of the partner.

2.5. Fixed income investment: “Sukuks”

These are referred to as "Islamic government bonds". The procedure of this operation begins with the sale of an asset to an entity named "Special Purpose Vehicle" (SPV) which in turn issues these government bonds. In parallel, this legal structure takes the debtor's "bond funds" to offer them to financiers. The latter buy back the same assets of this entity but add the

prices and costs of the transaction. This Islamic bond is a source of financing for several investment projects and contracts such as "Mucharakah" and "Mudaraba". However, it is normally used for infrastructure and real estate sectors.

The first "Sukuks" were issued in Jiddah in 1998. However, this operation was taken seriously in 2001, in Iran and more precisely after the events of September 11th. After these events, Iranian investors were afraid to leave assets in the United States and decided to allocate them. In a religious country where financial techniques are forced to respond to the law of “Shariah”. Following this, the market for "Sukuks" has gradually increased, particularly in the Gulf countries and Malaysia. The total issuance of "Sukuks" in the year 2017 was USD 116.7 Billion which witnessed a significant increase from the year 2016 whereby the total "Sukuks" issuance in 2016 was USD 87.9 billion. From the period 2012-2017, the total accumulated amount was approximately USD 434.8 billion. This increase in "Sukuks" issuance is contributed mainly from the Kingdom of Saudi Arabia and Malaysia.

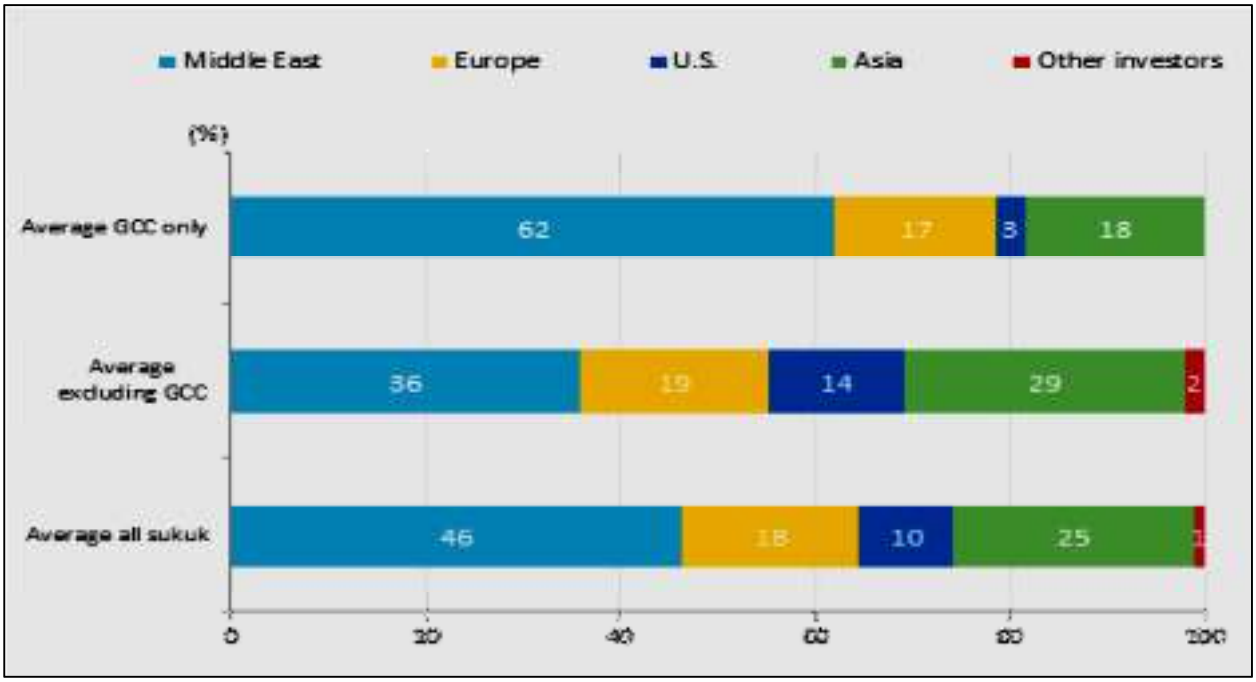
Malaysia ranked in first place internationally followed by a combination of GCC countries for the issuance of "Sukuks" according to the "international credit-rating agencies" especially for short term "Sukuks". In 2002, Malaysia issued USD 600 million. The market for its local "Sukuks” market grew in 2018 to USD 111 billion with most of it consisting of "corporate Sukuks". With regards to the GCC countries, an increase in "Sukuks" issuance rose to USD 46 billion in 2018 according to estimates by Standards and Poor's.

In the past 10 years, the Islamic Bonds market emerged in non-Muslims countries especially in developed ones. Many G20 country leaders discussed the importance of "Sukuks" as a financing tool for infrastructure projects and long-run investments. Hence, many developed countries, such as UK, France, Luxembourg, Germany, Hong Kong and South Africa, started including "sovereign and corporate Sukuks"[10] in its annual agenda. For example, in

[10] The difference between corporate and sovereign “Sukuks” can be summarized by the fact that sovereign Sukuks is a form of loan issued by the government which can be in the local currency or a foreign currency. The US and UK generally issue it in its local currency considering that their local currencies are used and accepted worldwide. Countries with a weaker currency in which the currency is volatile and more prone to risk usually issue loans in a foreign currency such as the US dollar to avoid currency risk. Corporate Sukuks on the other hand are issued by

January 2007, the French bank "Societé Générale" and the Japanese bank "Tokyo-Mitsubishi" (UFJ) relied on the "Sukuks" to raise funds with a USD 500 million issue thereof.

Graph 2. Who Invests in "Sukuks"



Source: S&P Global Ratings

In 2006, the British Treasury became the first non-Muslim country which wanted to issue "Sukuks" of an amount equivalent to those of bonds. In June 2014, the launch project was established. The "Sukuks" have been very successful with British investors and are estimated at £ 2.3 billion which is equivalent to USD 3,749. After the "Sukuks" issuance and maturity of them from the UK in 2014, it was announced that it had intentions to enter the "Sukuks" market for the year 2019.

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companies and range from large companies or institutions to small institutions. The main difference between corporate "Sukuks" and sovereign "Sukuks" is attributed to the risk profile of each. Corporate "Sukuks" are considered as a debt and thus is the main source for capital gains in addition to bank loans. Similar to country, in which its risk profile is evaluated by a credit rating or sovereign rating which reflects its reputation and reliability to investors, corporate enterprises also share the same characteristics and have such ratings.

2.6. The Takaful

The principle of "Takaful" is a form of insurance based on the foundations of “Shariah”. In linguistic terms, this term means "Kafala" which means joint guarantee ". In addition, the foundations of this operation are:

1- Mutual cooperation between participants in case of losses and profits,
2- The responsibility of the participants,
3- Insurance and protection against an unexpected incident.

With regard to the types of the "Takaful" system, there are two: the familial "Takaful" and the general "Takaful". Note that in the transaction "Takaful" two agents usually participate. The first is the investor and the second is the operator of the transaction who acts as a "Mudarib". Also here, the losses and profits will be shared equally between the two parties and the conditions are the same as that of the "Mudaraba" contract. There have been several conflicts over the determination of the legitimacy of "Takaful" operations, but since they do not involve interest rates, the jurists have asserted their validity.

3. The basics of Islamic finance

The Islamic system is known by the ethical system. The payment remained neutral until “Hijra” years 70s meaning that morality was the main determinant of financial transactions. Accordingly, it is clear that Islamic ethical system discourages egotism and helps expanding “Shariah” law, wealth distribution among the population especially lower-middle class, public well-being, socio-economic justice (Al ʿAdâla Al Ijtimâʿiyya), personal responsibilities toward Allah.

In order to make this research clear, it is highly recommended to provide a brief overview on the basics of Islamic finance.

First of all, Islamic financial operations are based on the foundations of Islamic law. The Islamic law is based on the concept of Profit Loss Sharing (PLS) that adopts the principle of the positive sum, "Pareto-optimal" games. According to this game theory, the percentage of profits is equal

to the percentage of losses such as “Mucharakah contract”. Thus; the relationship between Islamic banks and depositors is based on the participation principle rather than interest-based relationship.

Following, in Islamic Commercial Law, the Islamic finance is defined as an ethical system where some requirements are supposed to be met. The well-known definition of Islamic finance is the provision of services provided by Islamic finance industry. The financial services should be compliant with the” Shariah” (the Islamic canonical law). In order to determine what is and is not allowed in Islam, many principles of Islamic jurisprudence “Al-Fiqh”[11] should be analyzed. As a result, several centers of jurisprudence were created .

Those banned elements are represented as follows:

First, the prohibition of “Riba” or excess is compulsory in Quran. In brief, any contract conducting to an unjust return is illegal and is called “Ribawi” and then "Fasid" or invalid. The “Ribawi” contract is a result of: 1) conditional loan 2) unequal and deferred commodity trade. Thus, possessing a tangible asset is one of basic principles in Islamic Finance. In “Quran”, financial capital is a factor of production which is indispensable for public welfare. Moreover, transactions must support production basing on the risk sharing agreement and the right to use underlying assets.

Second, as for “Maysir” and Uncertainty (Gharar), some scholars (Madares) consider ''Gharar" Haram by making a contract conditional on unknown event. “Gharar” implies risk and also means deception and delusion. According to the Islamic law of contracts " Aqd' ", contractual risk is banned in Islamic finance as it may cause injustice against other parties.

Third, according to the “Shariah”, any sale must have an economic purpose without having harmful effects on the society. Thus, illicit and illegal activities (Haram) as alcohol, gambling, tobacco, pornography and armaments are prohibited under Islam. However, the returns on

[11] Islamic jurisprudence the” Fiqh" is a process that determines the orientations, rules and regulations deriving from the "Quran" and the "Sunnah". Indeed, the "Fiqh" aims to make the application of Islamic principles compatible with individuals' everyday lives and activities.

illegal activities are considered as charitable donations for people in need. The importance of charity in Islam is to maintain moral behavior. On the whole, there is strong relationship between economic activities and morality in Islamic business.

Fourth, from an Islamic point of view, hoarding is not allowed. In Islam, hoarding is considered as a non-natural phenomenon and limits economic exchange and alms-giving which is necessary to improve attachment relationships between Muslims. There is a difference between saving and hoarding from an Islamic point of view. For example, if money is saved for the use in the future, it considered as a taboo (Haram) in Islamic law as it suggests that the person does not belief that his future faith lies within the faith of "Allah". This is considered as hoarding. Savings on the other hand is considered as the saving of money for investment in the future or for use to improve living conditions in the future. This is considered as "Halal" in Islam. Overall, in Islam, economic activity must have a role in long-term development and money should be invested. Indeed, resources must participate in social welfare by seeking the best opportunities.

4. Conclusion

The growth of the Islamic finance sector was mainly attributed to the growth of the economies of Muslim countries. Islamic banks are considered to have made smart investments and increased Islamic devotion amongst the Muslim population. Islamic banking has expanded and experienced growth after the year 2013 and mainly in the GCC, and Malaysia. The county with the highest market share is Iran with 28.6 percent of the total Islamic banking assets. Saudi Arabia had a market share 25 percent of the total Islamic banking assets. However, that grew in 2020 as Saudi Arabia had played a big role in the issuance of "Sukuks". It can be summarized that the GCC as a whole has the highest Islamic banking assets followed by the Middle East, Asia Pacific, and Southeast Asia. The Islamic banking sector experienced growth due to rising oil prices along with market stability which was attributed to the implementation of the regulatory requirements by monetary authorities.

According to Edbiz consulting, the UK has ranked 17th overall in a ranking of 48 countries which places it first amongst European countries and first amongst countries with a majority of non-Muslim population. However, few western countries (such as France) face legal challenges in terms of implementing “Shariah” principles.

Since the 2007-2008 financial crisis, the Islamic finance sector has witnessed a global growth of approximately 20 percent in terms of assets size. The performance of Islamic banks is not surpassing that of conventional banks considering that the gains achieved by safety from restrictions applied by “Shariah” principles are diminished as they may be losses due to inefficiency. Any “Shariah-compliant” financial institution which is interested in introducing Islamic financial services must complete the challenging task of meeting creditworthiness requirements. During crises, a material effect can be noticed on performance. The studies that were conducted by the Islamic Financial Services Board and International Monetary Fund discovered that after the 2007-2008, the performance of Islamic bank had improved.

Concerning the Islamic financial transactions, all the rules of “Shariah” institutions are based on the foundations of the "Islamic law". The Profit and Loss sharing principle is a pillar in Islamic finance. All the partners accordingly share the profits and the losses according to their role in the investment project. Thus, the risk sharing principle is applied. The parties are involved in sharing the risks and the dividends. The main reason of this principle is to improve the economic activity. In Islam, there is a prohibition of interest “Riba” due to the idea of getting a return without taking any risk or making any effort. Moreover, we should note that uncertainty in businesses is not allowed due to the fact that non transparency while sharing the information can cause a lack of control over the business itself. Accordingly, all the information should be shared and distributed equally amongst the parties. Furthermore, it is prohibited to invest in illegal activities such as gambling, alcohol, pork, prostitution and drugs. All these activities are considered as unethical vehicle to gain profits.

Second Chapter: Measuring the Productive Efficiency of Islamic Banks operating in the GCC Region

ABSTRACT

The concept of measuring efficiency has been widely studied and tested by a large number of economists all over the world. Many economists have looked at the different measures of bank efficiency where they've used diverse methods to test efficiency for every country. In this study, the GCC Islamic banks are studied with regards to different internal and external factors that may be included within the various concepts of productive efficiency. An economic hypothesis was proposed, which suggested that using parametric and non-parametric methods will reveal different impacts (positive or negative) on the studied samples. The purpose of this study is to examine the relative efficiency of Islamic banks operating in GCC region during the period 2004-2017 and to detect the factors explaining the productive efficiency of these banks by applying parametric (stochastic frontier) and non-parametric approaches. The empirical results confirmed that the relationship between efficiency scores and macroeconomic variables and particular financial ratios is not conclusive. The results also showed that the efficiency scores could not be explained solely by financial ratios as they are related to external factors corresponding to the X-inefficiency and economic environment.

1. Introduction

The concepts of productive efficiency have witnessed major evolution during the past centuries. The microeconomics of production is an analytical model that we can use to test our hypothesis. Through the concepts of transformation and production function, the model is defined by a relationship between quantity of inputs (production factors) and quantities of outputs (products).

Historically, Turgot (1768) introduced the implicit concept of standard production function that traces the origin of this economic thought. He proposed a production function that is outlined by the existence of two types of scale yields: increasing returns to scale and decreasing returns to scale in relation to one of the inputs. Whereas Walras (1899) introduced the production function with fixed coefficients, the neoclassical method was the first method that uses the concept of explicit function in a general form. This was the result of development in the studies on the U.S. economy. Clark John Bates (1898) also elaborated Walras concept considering that all production factors, all being equal, are decreasing returns to scale. The same was the case with Alfred Marshall (1890), who assumed a concept of production based on decreasing returns versus increasing returns. Within this era, the microeconomics of production

has been elaborated even more with the induction of Allen's (1939) concept of elasticity of substitution. Paul Samuelson (1947) was another economist who exposed synthetic microeconomics functions – including the generation concept, the dual cost function and the production function.

After the 1970-1980 period, the microeconomic theory was strictly oriented towards decision making units. During that period, the efficiency of production of micro units was developed by the work of Charnes, Cooper and Rhodes (1978). This concept led to a new method called the non-parametric method which measures the efficiency of a decision making units.

To test the results, we estimate the cost efficiency scores using the parametric and the non-parametric (data envelopment method) approaches. Firstly, we present the methods used for calculating the cost efficiency scores, before developing the used approaches. Then, we will use a stochastic cost frontier to calculate cost efficiency levels of Islamic banks. This methodology was proposed for the first time by Aigner, Lovell and Schmidt (1977), and Meeusen and Van den Broeck (1977). If we use the parametric approach, the functional form specifies the frontier of the whole production in a probabilistic perspective. In this case, the coefficients are estimated by conventional econometric methods. In contrast, the non-parametric approach extends the traditional concept of productivity by introducing an overall efficiency, which applies generally to a multi-factor and multi-product technology. This approach is based on linear programming techniques (primal or dual approach to the production frontier) and does not require defining a functional form of the production, cost or profit frontier. It also aims to get the most effective points that define the area of production possibilities.

We note that our empirical study covers the period 2004-2017. We exploit a non-balanced, homogeneous sample formed only of Islamic banks operating in the GCC region. The paper is organized in a manner whereby the first section resumes a brief literature review. The following section presents the econometric methodologies which are outlined through the use

of parametric and nonparametric approaches. Section 4 reports and discusses the empirical findings while section 5 concludes and provides some implications.

2. A Brief Literature review

The literature on bank efficiency has notably grown over the recent years and there are various approaches used to estimate this efficiency. Two of the primary authors who used the data envelopment method on banks were Sherman and Gold (1985) whom significantly applied this method to a series of bank branches.

Pitt and Lee (1981) were the first to use panel data to estimate the efficiency of enterprises using a stochastic production function. Schmidt and Sickles (1984) showed the importance of having panel data to estimate the production frontier

Dietsch (1997) used the parametric method (the free distribution approach) to estimate the cost efficiency of a sample of 375 French banks over the period 1992-1998. The author tested the hypothesis that the least efficient banks take excessive risks, thus analyzing the relationship between cost efficiency and risk taking. Weill (1999) with the help of Dietsch used the non-parametric method (DEA) to measure the efficiency of a sample of 93 French banks in 1994 and found that between 78 percent and 91 percent of efficiency depends on whether the interest paid is considered as input or not.

Eisenbeis, Ferrier and Kwan (1999) were another group of economists who used the parametric (stochastic frontier) and the non-parametric (DEA frontier) approaches to evaluate the cost efficiency of Bank Holding Company over the period 1986-1991. Their results show that the average efficiency varies depending on the method used. There was emphasis on how the results varied with each approach: the stochastic frontier scored an average of 82 percent to 92 percent, but the DEA frontier obtained scores of an average between 61 percent and 72 percent.

Noulas (2001) focused on the DEA method to assess the efficiency of the Greek banks over the period 1993-1999. His findings show that the efficiency of the public banks increased

from 81 percent to 93 percent, while that of private banks decreased from 92.8 percent to 91.4 percent.

Giradone, Molyneux and Gardener (2004) studied the cost efficiency of Indian banks between 1993 and 1996 using the stochastic frontier, and found that the average efficiency varied from 85 percent to 87 percent depending on the number of years.

Sufian and Noor (2009) performed a study on sixteen MENA and Asian countries with the purpose of providing an analysis on the Islamic banking sector`s performance. The study was based on a parametric approach and a non-parametric approach. Small scale Islamic banks" were also found to be more financially stable. It was also discovered through that pure technical inefficiency surpasses scale inefficiency for banking sectors in the MENA region and Asian countries. The efficiency frontier was noticed to be controlled by banks from the MENA region. Concerning the relationship existing between "loans intensity, size, profitability, capitalization, and bank efficiency", it was positive.

Manlagnit (2011) incorporated the stochastic frontier to assess the link between risk and cost efficiency of banks operating in the Philippines. The results obtained showed a negative relationship between risk and cost efficiency.

Moussawi and Obeid (2011) conducted a research to evaluate the performance of Islamic banks from a productive perspective from the period from 2005-2008. The production performance was evaluated using the DEA method. The approach taken was to dissect the productive efficiency into technical, cost, and allocation efficiency. The results of their study revealed that technical and allocation inefficiency led to an increase on banking costs by 14 percent and 29 percent respectively. It was also deemed that the growth of efficiency scores for Islamic banks in the GCC were impacted by internal and external factors.

Abduh et al. (2012) measure "the performance of Islamic insurance industry in Malaysia": Takaful. They use the data envelopment (DEA) and ratio analysis method in their study. The results show that the efficiency of the traditional insurance industry is higher than

the Islamic one in the cases of data analysis and DEA analysis. Due to the low number of Takaful companies in Malaysia their performance projections are limited to a short period of study (3 years).

Tan and Floros (2013) analyze the relationship between risk, efficiency and equity in the Chinese banking sector. Their results showed two observations: a significant positive relationship between risk and efficiency, and a negative relationship between risk and bank capital.

Irfan et al. (2014) examine the performance and efficiency of Islamic banks in the following countries: Pakistan, Iran, Brunei and Bangladesh from the period of 2004 to 2011. The choice is based on the similarities from legal, social and economic perspective. The results prove an effectiveness of about 98.19 percent for these banks in comparison to the return on equity ratio (ROE), 91.4 percent in relation to return on assets (ROA) and 77.03 percent for the net rate of return. The efficiency is ensured by the presence of a cost-efficient financing method such as “Mucharakah”, “Mudaraba” and “Istisna’a”.

Aliyu (2014) presents a study to evaluate Islamic banks in Nigeria using the analysis of "Thematic Coding Units". The study is based on documents issued by the Research Center of the Central Bank of Nigeria (CBN) and the Deposit Insurance Corporation of Nigeria (NDIC). The results show that Islamic banks in Nigeria are much more efficient compared to conventional financial institutions. The research demonstrates that conventional banks suffer on one hand, from a lack of regulations and transparency and on the other hand, from a higher contagion risk and non-performing loans. However, Islamic banks have proven that they are more resilient to surpass economic crises. Accordingly, Aliyu (2014) encourages the adoption of structure of Islamic banks in order to achieve a higher level of economic growth.

Srairi and Sahut (2015) examine the performance of Islamic banks on the level of profitability, liquidity, risk, solvency and efficiency for the period 2000-2004 in the United Arab Emirates. On one hand, the study proves that Islamic banks are profitable and more efficient

than conventional banks. On the other hand, they are characterized by a lower level of liquidity than conventional banks.

3. The Methods of Measuring Productive Efficiency

In order to study the production efficiency (Schmidt and Lovell 1979), we use the Technical Efficiency (see Appendix 2), which is calculated by the production function based only on the quantities of used input factors and the profits of the outputs provided. This approach is explained by the ability to avoid wasting resources by producing as much outputs as the use of input allows, or vice versa (using as much little inputs as the level of output requires).

The methodologies that study the production sets can be classified according to how the production frontiers are specified and estimated. In the literature, there are two basic methodologies for estimating the frontier of production in the economic theory. We can distinguish the parametric or econometric approach, which assumes that the frontier can be represented by a production, cost or profit function with constant parameters to be estimated (the Cobb-Douglas function, CES, Trans-log function, etc.), and the non-parametric approach that specifies, in turn, no precise functional relationship.

3.1. The parametric frontier

3.1.1. The stochastic cost frontier

We will use a stochastic cost frontier to calculate cost efficiency levels of Islamic banks. This methodology was proposed for the first time by Aigner, Lovell and Schmidt (1977), and Meeusen and Van den Broeck (1977).

Pitt and Lee (1981) were the first to use panel data to estimate the efficiency of enterprises using a stochastic production function. A number of theoretical studies have sought, at first, to estimate the stochastic frontier and predict individual efficiency scores that vary with time, and in a second stage to run a regression between efficiency scores obtained in the first step and a vector of internal variables related to the evaluated companies in order to examine the influence of these variables on efficiency. We use this method to identify the

internal and external factors that influence efficiency scores. For Battese and Coelli (1995), the estimation procedure in two stages does not meet the assumption of independent effects of efficiency in these two steps.

For this, we use errors composed model developed to measure the cost efficiency in which the inefficiency term u_i follows a distribution called asymmetric and v_i measures the random error and is normally distributed. The stochastic frontier can be written as follows (Grenne, 1993):

$$C_{it} = C\left(y_{it}, w_{it}, \beta\right) \cdot \exp\left(v_{it} + u_{it}\right) \quad , \textbf{(1)}$$

Where, C_i, y_i , w_{it}, β represent respectively: the production costs of the production unit, the vector of different amounts of output, the price vector of the various factors of production (inputs), β represents a vector of coefficients to be estimated, v_i reflects the random component of the error term, which follows a normal distribution, u_i represents the inefficiency of the production unit and which is accompanied by increased production costs.

We use the Translog cost function to estimate the cost efficiency of Islamic banks. This function can be written as:

$$\begin{aligned} Ln\left(\frac{CT}{w_3}\right) &= \alpha_0 + \sum_{i=1}^{3} \alpha_i Lny_{it} + \frac{1}{2}\sum_{i=1}^{3}\sum_{k=1}^{3} \alpha_{ik} Lny_{it} Lny_{kt} + \sum_{j=1}^{3} \beta_j Ln\left(\frac{p_j}{p_3}\right) \\ &+ \frac{1}{2}\sum_{j=1}^{3}\sum_{m=1}^{3} \psi_{jm} Ln\left(\frac{p_{jt}}{p_3}\right) Ln\left(\frac{p_{mt}}{p_3}\right) + \sum_{i=1}^{3}\sum_{j=1}^{3} \eta_{ij} Lny_{it} Ln\left(\frac{p_{jt}}{p_3}\right) + v_{it} + u_{it} \end{aligned} \quad , \textbf{(2)}$$

Where, CT is the total cost, y_i, y_k represent the quantities produced for each output, p_i, p_j represent the prices of production factors, v_i a random error term and u_i is the error term that captures the inefficiency. In this model, the representative inefficiency random term reflects the inability of banks to control their costs, so this is by building a positive or zero disturbances which increases the cost function.

Accordingly, Ferrier & Lovelle (1990) made the ad hoc assumption that the error term follows a semi-standard asymmetric distribution. The regular disturbance, which reflects the dispersion of costs attributable to random and transient, increases or decreases the total cost. Therefore, this error term follows a symmetrical Gaussian distribution of zero mean, as in the conventional models of linear multiple regressions.

The function (2) is a cost function; it must be concave and homogeneous of degree 1 and $\psi_{jm} = \psi_{mj}$ .The homogeneity of degree 1 with respect to price -induced conditions

$$\beta_j = 1, \sum_j \psi_{jm} = \sum_i \eta_{ij} = 0 \text{ , } \textbf{(3)}$$

3.1.2. The Model of Battese and Coelli (1992, 1995)

Battese and Coelli (1995) proposed a stochastic production frontier which can calculate the efficiency scores of production units by integrating directly in the estimating function and specific macro variables that may influence the efficiency. We can thus specify this model as:

$$y_{it} = f\left(x_{it}, \beta\right)\exp^{(v_t - u_{it})} \text{ , } \textbf{(4)}$$

Where, y_{it} , x_{it} and β represent respectively the logarithm of the production of the production unit in the period t , a vector ($k \times 1$) quantities of inputs and a vector of unknown parameters is to be estimated, for the firm i over the period t. v_{it} is random variables assumed to follow a normal distribution, $N(0, \sigma_\varepsilon^2)$ and independent distribution component u_{it} .The Terms u_{it} are considered as random terms. To calculate the efficiency scores, considering that the two components v_{it} and u_{it} follow a semi-normal distribution truncated to zero $N(\mu, \sigma_u^2)$ with

$$\begin{cases} \mu = 0 \; when\ the\ distribution\ law\ is\ semi - normal \\ \mu \neq 0 \; when\ the\ distribution\ is\ normal\ but\ non\ truncated \end{cases}$$

The estimation of this model can be performed using the maximum likelihood method. Based on the study of Battese and Corra (1977), σ_v^2 and σ_u^2 can be replaced with

$\sigma^2 = \sigma_v^2 + \sigma_u^2$ and $\gamma = \sigma_u^2 / \sigma_v^2 + \sigma_u^2$, **(5)**

The parameter γ must be between zero and unity. Based on the method proposed by Battese and Coelli (1992), the efficiencies of production units may be derived from equation (6), where it is accepted that this term (u_{it}) may vary with time:

$$Eff = \frac{f\left(x_{it}, \beta\right)\exp^{(v_t - u_{it})}}{f\left(x_{it}, \beta\right)\exp^{e_{it}}} = \exp^{-u_{it}} \qquad \text{, (6)}$$

With $u_{it} = \left\{\exp\left[-\eta(t-T)\right]\right\}$ where η is a parameter to be estimated.

The previous model can be rewritten as follows:

$$y_{it} = x_{it}\beta + \left(v_t - u_{it}\right) \quad avec\ i = 1, \ldots \text{ with } \quad = 1, \ldots T \qquad \text{,(7)}$$

Where y_{it} represents the logarithm of the output, x_{it} is the logarithm of vector $(k \times 1)$ quantities of inputs and β a vector $(1 \times k)$ unknown parameters to be estimated for the unit i, over the period t. The v_{it} is random variables assumed to follow a normal distribution $N(0, \sigma_\varepsilon^2)$, and independent of u_{it} . u_{it} is non-negative random variables, expected to follow a normal distribution truncated at zero with mean $\bar{u}$ and variance σ_u^2 . This disturbance captures the inefficiency. These definitions are formally summarized as follows:

$$e_{it} = v_t - u_{it}$$

$$With \quad e_{it} \to N\left(0, \sigma_e^2\right), \quad u_{it} \to N\left(\bar{u}_{it}, \sigma_u^2\right), \quad u_{it} > 0, \quad \sigma_e^2 = \sigma_v^2 + \sigma_u^2, \quad m_{it} = \delta_0 + Z_{it}\delta \quad \text{, (8)}$$

Where Z is vector $(p \times 1)$ of variables that are assumed to influence the efficiency of production units and δ is a vector $(1 \times p)$ of parameters to be estimated. Using this specification of the stochastic production frontier isolates the random error term of the one that reflects the inefficiency of the evaluated production unit and leads to an accurate measure of its efficiency, while taking specific variables' effects on efficiency.

3.2. The non-parametric frontier: Data Envelopment Method (DEA)

The common objective of all variants of the data envelopment method is to use linear programming techniques. This method was applied to banks by Ferrier and Lovelle (1990), Elyasiani & Mehdian (1990), Ferrier, Grosskopf et al. (1993), and Grabowski, Rangan et al. (1993). The technique of linear programming applied to the data envelopment is to define an objective function that minimizes the vector by each unit that can increase its input vector while not producing less, under the pressure of technological possibilities. The field of technological possibilities is described by the constraint program system in the form of a set of inequalities indicating the required minimum and maximum levels of inputs and outputs observed in the sample (Ferrier and Lovell, 1990). The resolution of a well formulated. The frontier features the best practices observed in the studied sample of production units, and it is not a hypothetical technological relationship implied by the choice of a particular functional form program determines the convex domain of feasible basic solutions describing the cost efficient frontier.

Data envelopment analysis was introduced by Charnes, Cooper and Rhodes (1978) in order to generalize the traditional measure of productivity of an input and an output as a measure of technical efficiency. It reduces all inputs and all outputs to a virtual input and a virtual output. The virtual input is determined as a weighted sum of all inputs. Similarly, the virtual output is obtained as a weighted sum of all outputs. Consequently, we get an overall productivity ratio. The virtual input and the virtual output are obtained by giving a weight to each input and each output, and then summing the weighted inputs on the one hand and the weighted outputs of the other. [12]

The efficiency research of decision making unit (DMU) can be generalized to the case where each unit discloses several outputs and multiple inputs. In this model, the efficient

[12] It is emphasized that these weights are not fixed arbitrarily but represent an optimal solution of linear program that aims to maximize a linear function in a set of constraints. In general, in the DEA, we choose the weight to give the most favorable picture of the unit evaluated under the constraint that the scores for all observed units are less than or equal to 1. The ratio obtained for the assessed unit is its efficiency score. It is 1 if the unit is evaluated efficiently, less than 1 otherwise

frontier is calculated rather than estimated, contrary to the notion of restraint average performance in most econometric studies, while efficiency measures are calculated on the frontier.

The CCR model, which extends the basic model of Farrell (1957) to the multidimensional case, uses fractional dynamic programming that can be obtained by a simple linear program. These considerations led to the writing of the program [1] where n is the number of units of the repository, p and m are respectively the dimensions of the vector of inputs x and the vector of outputs y , u_r and v_i is the weighting system associated with outputs and inputs and couple (y_0, x_0) means the production plan of the unit repository is under evaluation.

$$\begin{cases} \max h = \dfrac{\sum_{r=1}^{p} u_r y_{r0}}{\sum_{i=1}^{m} v_i x_{i0}} \\ s.c \quad \dfrac{\sum_{r=1}^{p} u_r y_{rj}}{\sum_{i=1}^{m} v_i x_{ij}} \leq 1 \qquad \text{With } j = 1,...,n \\ \quad u_r \geq 0 \qquad \text{With r} = 1,..., p \\ \quad v_i \geq 0 \qquad \text{With } i = 1,...,m \end{cases} \qquad \text{(LP1)}$$

This program determines the optimal weighting system (u_r^*, v_i^*) that maximizes the overall productivity of operation of the evaluated unit where no other unit is declared efficient (i.e. located above the production frontier) with the same weighting system. However, the non-linearity of the program (LP1) limits the feasibility of this approach by asking many techniques for estimating optimal solutions.

We need the CCR for solving this problem. By demonstrating that the weighting system is only defined as a multiplicative coefficient, and choose a specific solution:

$\left(\sum_{i=1}^{m} v_i x_{i0} = 1 \right)$, **(9)**

They demonstrate that solving the linear program (PL1) equals (LP2). This linearization is the basis of the tremendous growth of non-parametric methods since late 1970s.

$$\begin{cases} \max h = \sum_{r=1}^{p} u_r y_{r0} \\ s.c \quad \sum_{i=1}^{m} v_i x_{i0} = 1 \\ \quad \sum_{r=1}^{p} u_r y_{rj} - \sum_{i=1}^{m} v_i x_{ij} \quad \forall\ j = 1,\dots,n \\ \quad u_r > 0 \qquad \text{With r} = 1,\dots,p \\ \quad v_i > 0 \qquad \text{With } i = 1,\dots,m \end{cases} \qquad \textbf{[LP2]}$$

The choice of a specific solution $\sum_{i=1}^{m} v_i x_{i0}$ eliminates the denominators of global productivity ratios and thus making the linear objective function. By applying the duality theorem to the linear program primal (LP2), we obtain the following dual program:

$$\begin{cases} \text{Min } h_k \\ \sum_{j=1}^{n} \mu_j y_{rj} \geq y_{r0} \qquad \forall\ r = 1,\dots,p \\ \sum_{j=1}^{n} \mu_j x_{ij} \leq h x_{i0} \quad \forall\ i = 1,\dots,m \\ \mu_j \geq 0 \qquad \forall\ j = 1,\dots,n \end{cases} \qquad \textbf{[LP3]}$$

The program (LP3) enables simple and intuitive economic interpretation of the problematic DEA. In this program, the unit's evaluated production plan (x_0, y_0) will be compared to a linear combination of the production plans of the units belonging to the repository

$\left(\sum_{j=1}^{n} \mu_j x_{ij}, \sum_{j=1}^{n} \mu_j y_{irj} \right)$, **(10)**

The resolution of these programs gives an optimal solution h which is a measure of technical efficiency of a production unit. But as the returns to scale are constant, the application of the CCR model leads to measuring the efficiency which confuses technical efficiency with scale efficiency. Banker, Charnes and Cooper (1984) developed a model with variable returns to scale (VRS). This model is actually an extension of the CCR model that includes cases where the returns to scale are not constant. From an analytical point of view, we simply stress that:

$$\left(\sum_{j=1}^{n} \mu_j = 1\right) \quad \textbf{,(11)}$$

In the linear program (LP2 or LP3) to take into consideration the existence of variable returns to scale. The programs then become:

$$\max h = \sum_{r=1}^{p} u_r y_{r0}$$

$$s.c \quad \sum_{i=1}^{m} v_i x_{i0} = 1$$

$$\sum_{r=1}^{p} u_r y_{rj} - \sum_{i=1}^{m} v_i x_{ij} \quad \forall\ j = 1,\ldots,n \quad \textbf{[LP2]'}$$

$$\sum_{j=1}^{n} \mu_j = 1$$

$$u_r > 0 \qquad \text{With r} = 1,\ldots,p$$

$$v_i > 0 \qquad With\ i = 1,\ldots,m$$

$$\text{Min } h_k$$

$$\sum_{j=1}^{n} \mu_j y_{rj} \geq y_{r0} \qquad \forall\ r = 1,\ldots,p$$

$$\sum_{j=1}^{n} \mu_j x_{ij} \leq h x_{i0} \quad \forall\ i = 1,\ldots,m \qquad \textbf{[LP3]'}$$

$$\sum_{j=1}^{n} \mu_j = 1$$

$$\mu_j \geq 0 \qquad \forall\ j = 1,\ldots,n$$

The use of the BCC model thus allows obtaining a measure of productive efficiency free of the scale effect. Indeed, inefficient production unit can only be compared to the production units operating on a similar scale. According to Coelli et al. (1998), we can obtain a measure of scale efficiency by performing DEA analysis of CRS type and VRS type from the same database. If there is a difference, this means that the production unit does not operate on an optimal scale. Finally, integrating the price is possible due to the linear programming problem solving to determine the minimum of the cost.

4. Empirical results

4.1. *Descriptive Statistics*

The cost frontier is estimated by holding a model with variable returns to scale directed towards minimizing inputs. To measure the inputs and outputs identified in our study, we rely on the modern approach which considers agency theory, macroeconomic activity, risk for bank leaders, etc .

In this context, we only have data provided by banks' financial statements. These are not very detailed data which reproduce only the main items of the balance sheet, the off-balance sheet items, and the income statement of each bank. We selected three inputs and three outputs to describe the activity of Islamic banks operating in GCC.

The considered inputs are:

- The labor factor measured by personnel expenses
- Physical capital proxied by fixed assets
- Financial capital measured by interest paid

The selected outputs are:

- Total earning asset (this variable reflects the preferences of bank executives for risk)
- Customer deposit
- The off-balance sheet activities

We note that our empirical study covers the period 2004-2017. We exploit a non-balanced, homogeneous sample formed only of Islamic banks operating in the GCC region. Table 2 presents some descriptive statistics for the various inputs and outputs used to measure banking efficiency in years 2004 and 2017. The data in Table 2 show that the used sample is homogeneous, since the coefficients of variation range is [1.33; 2.05] for the selected inputs and outputs. It should be noted, however, that the input price dispersion tends to increase slightly, since the coefficient of variation increases over the period 2004-2017.

Table 2. Descriptive statistics of the variables used to estimate the cost efficiency of Islamic banks in 2004 and 2017

Variables		2004	2017
Total Assets	Mean	3029578	13359515
	Standard deviation	4732815	19303682
	Coefficient of variation	1.56	1.44
Total Earning Asset	Mean	2410144	11303765
	Standard deviation	3969573	15952688
	Coefficient of variation	1.65	1.41
Off balance sheet	Mean	441898	1776445
	Standard deviation	905993	2471061
	Coefficient of variation	2.05	1.39
Customer deposits	Mean	1992015	9426365
	Standard deviation	3686598	14616644
	Coefficient of variation	1.85	1.55
Total interest paid	Mean	43001	144442
	Standard deviation	62732	220917
	Coefficient of variation	1.46	1.53
Staff expenses	Mean	23853	116617
	Standard deviation	36926	169817
	Coefficient of variation	1.55	1.46
Other operating expenses	Mean	21737	64886
	Standard deviation	37989	86603
	Coefficient of variation	1.75	1.33
PDEP	Mean	0.30	0.17
	Standard deviation	0.72	0.49
	Coefficient of variation	2.42	2.90
PPERS	Mean	0.01	0.01
	Standard deviation	0.01	0.01
	Coefficient of variation	0.89	0.92
PPHY	Mean	0.02	0.04
	Standard devtion	0.03	0.13
	Coefficient of variation	1.60	3.59
Number of banks	41		
Number of observations	574		

Sources: Bankscope and Orbis Bank. The calculation of the mean, standard deviation and coefficient of variation is done by the author.

4.2. Calculation of efficiency scores

We have estimated the efficiency of Islamic banks using the stochastic frontier and the DEA method. Table 3 contains the level of cost efficiency of the banks in the sample under study.

The results show that the selected banks record – on average – considerable inefficiency scores, equal to 38 percent and 25 percent, as estimated by the stochastic frontier and the DEA method respectively. These results have been found by many previous studies according to these two approaches and show that the Islamic banks operating in the GCC region do not operate on the efficient cost frontier maybe due to managerial inefficiency and misuse of production factors.

Table 3. Average Productive Efficiency of Islamic Banks

	Stochastic frontier	**DEA Method**
Maximum	0.89	1
Minimum	0.10	0.10
Mean	0.62	0.65
Standard deviation	0.14	0.32
Coefficient of variation	0.22	0.50
Variation over the period	+38.5 percent	24.7 percent

Sources: Bankscope and Orbis Bank. The calculation of the mean, standard deviation and coefficient of variation is done by the author.

Table 4 shows the evolution of cost efficiency over the period 2004-2017. We notice that the cost efficiency seems to be developing between 2004 and 2007 and decreasing from 2009 onwards according to DEA approach, and slightly increasing over the entire period according to the stochastic frontier. The annual evolution of cost efficiency of banks remains contained within a narrow range [62percent-73percent].

The dispersion of cost efficiency, although important, decreased between 2004 and 2008, and then increased between 2009 and 2017, as the coefficient of variation drops from 70 percent to 41 percent for the first period and from 62 percent to 48 percent for the second, when the cost efficiency is measured by DEA method. On the other hand, for the stochastic frontier, we observe a decrease of the dispersion of efficiency cost from 31 percent to 21 percent over the studied period. This dispersion shows that a reduction in production costs of 38 percent (according to stochastic approach) and 25 percent (according to DEA approach) would allow banks to reduce their inefficiency over the studied period. In general, we can say that this dispersion in coefficient of variation can cause divergence in the results. The higher the coefficient of variation, the higher the volatility which can lead to a decrease in the level of efficiency of certain Islamic banks under study. We have to note that the dispersion in terms of banks between DEA and stochastic frontier can be due to the fact that the stochastic frontier follows a semi-normal distribution so it depends on the functional form. However, the DEA method is highly sensitive to aberrant values.

Table 4. Evolution of average cost efficiency over the period 2004-2017

		DEA (CE)	SF (CE)
2004	Maximum	1	0.77
	Mean	0.53	0.51
	Standard deviation	0.37	0.16
	Coefficient of variation	0.70	0.31
2005	Maximum	1	0.74
	Mean	0.67	0.53
	Standard deviation	0.33	0.16
	Coefficient of variation	0.49	0.30
2006	Maximum	1	0.76
	Mean	0.65	0.61
	Standard deviation	0.32	0.11
	Coefficient of variation	0.50	0.18
2007	Maximum	1	0.74
	Mean	0.70	0.61
	Standard deviation	0.30	0.10
	Coefficient of variation	0.42	0.16
2008	Maximum	1	0.84
	Mean	0.73	0.61
	Standard deviation	0.30	0.12
	Coefficient of variation	0.41	0.20
2009	Maximum	1	0.77
	Mean	0.52	0.63
	Standard deviation	0.32	0.13
	Coefficient of variation	0.62	0.20
2010	Maximum	1	0.77
	Mean	0.59	0.62
	Standard deviation	0.34	0.14
	Coefficient of variation	0.57	0.24
2011	Maximum	1	0.89
	Mean	0.67	0.64
	Standard deviation	0.31	0.15
	Coefficient of	0.47	0.24

	variation		
2012	Maximum	1	0.89
	Mean	0.69	0.65
	Standard deviation	0.30	0.16
	Coefficient of variation	0.43	0.24
2013	Maximum	1	0.88
	Mean	0.66	0.63
	Standard deviation	0.32	0.16
	Coefficient of variation	0.49	0.25
2014	Maximum	1	0.87
	Mean	0.65	0.64
	Standard deviation	0.32	0.14
	Coefficient of variation	0.50	0.21
2015	Maximum	1	0.84
	Mean	0.64	0.64
	Standard deviation	0.33	0.15
	Coefficient of variation	0.51	0.23
2016	Maximum	1	0.83
	Mean	0.66	0.63
	Standard deviation	0.32	0.14
	Coefficient of variation	0.49	0.22
2017	Maximum	1	0.86
	Mean	0.68	0.64
	Standard deviation	0.33	0.14
	Coefficient of variation	0.48	0.21

Sources: Bankscope and Orbis Bank. The calculation of the mean, standard deviation and coefficient of variation is done by the author.

Thus, the average efficiency scores show a high level of cost inefficiency for the Islamic banks operating in the GCC region. Our results are therefore in the low range of average efficiency scores observed by the empirical studies (e.g. Zuhroh et al., 2015, Tahir and Haron, 2010).

Regarding the historical evolution of cost efficiency, we observe an increase over the period 2004-2017: 38.5 percent according to stochastic frontier and 24.7 percent according to DEA method. This trend however, is not verified in all studied countries since, as shown in Table 5, there is a contrasting trend over the period studied.

Table 5. Annual evolution of cost efficiency of Islamic banks operating in the GCC region

Years	**UAE**		**BH**		**KW**		**QA**		**KSA**	
	DEA	SF	DEA	SF	DEA	SF	DEA	SF	DEA	SF
2004	0.31	0.44	0.39	0.48	0.80	0.59	0.39	0.38	1.00	0.66
2005	0.48	0.51	0.55	0.52	0.91	0.61	0.61	0.42	1.00	0.60
2006	0.48	0.60	0.57	0.60	0.75	0.64	0.79	0.64	0.96	0.62
2007	0.57	0.63	0.56	0.61	0.87	0.62	0.94	0.52	0.98	0.62
2008	0.66	0.64	0.61	0.58	0.90	0.61	0.94	0.59	1.00	0.64
2009	0.41	0.62	0.43	0.62	0.54	0.59	0.62	0.66	0.97	0.69
2010	0.52	0.61	0.44	0.60	0.66	0.60	0.81	0.66	1.00	0.67
2011	0.38	0.60	0.61	0.64	0.91	0.64	0.79	0.70	0.97	0.67
2012	0.43	0.60	0.63	0.66	0.89	0.65	0.84	0.68	0.99	0.68
2013	0.45	0.61	0.51	0.63	0.93	0.64	0.78	0.68	1.00	0.69
2014	0.47	0.63	0.47	0.65	0.98	0.60	0.79	0.67	1.00	0.69
2015	0.44	0.62	0.49	0.62	0.95	0.60	0.77	0.70	0.94	0.70
2016	0.49	0.62	0.51	0.62	0.92	0.62	0.90	0.69	0.94	0.71
2017	0.60	0.66	0.47	0.62	0.87	0.63	0.96	0.69	0.95	0.71
Average	0.48	0.60	0.52	0.60	0.85	0.62	0.78	0.62	0.98	0.67

Sources: Bankscope and Orbis Bank. The calculation of the mean, standard deviation and coefficient of variation is done by the author.

In general, the observed cost inefficiencies show that some banks in the sample do not reach their optimal production potential and fail to reduce their cost level due to several factors:

a) The technology and the quality of production factors.

b) The scale of production or the productive dimension of the bank.

(c) The allocation of resources.

d) The differentiation and heterogeneity of products.

c) The management of the bank (the X-efficiency).

4.3. The effects of explanatory financial performance variables on the efficiency of Islamic banks operating in the GCC region

To provide an explanation for this variability in cost efficiency, we run linear regression of the cost efficiency score on: management ratios, size indicators, and macroeconomic variables (as in Casu and Molyneux, 2003; Dietsch and Lozano-Vivas, 2000; Fries and Taci, 2005; Filippaki et al., 2009; Tan and Floros, 2013). Several variables are used for this regression as follows:

- Return on asset (ROA) defined by the ratio of net profits to total assets.
- The bank total assets (TA). This variable is measured by the logarithm of total assets. It reflects the size of the bank.
- The capital ratio (CAP) measured by the equity to total asset ratio.
- Bank liquidity (LIQ) is measured by the ratio of liquid assets to total assets.
- The banking risk (RISK) proxied by the fragility indicator Z-score[13].

[13] The banking risk (RISK) proxied by the fragility indicator Z-score, which is calculated by the following formula:

$Z = \frac{RO\overline{A}}{\sigma_{ROA}} + \frac{CAP}{\sigma_{ROA}}$, where

$RO\overline{A}$ is the average return on assets; σ_{ROA} represents the standard deviation of return on assets; CAP is the equity to total assets ratio.

Concerning the macroeconomic variables, we are taking the inflation rate which is measured by the consumer index (annual percentage) and the GDP growth rate.

To estimate the relationship between efficiency scores and the specific and environmental variables, we use panel data. In this study, we prefer to use the fixed-effects model in order to take into account the specificity of each bank when verifying the relationship between efficiency and the exploited internal and external variables.

The results of the regressions are presented in Table 6. The estimated model has a high explanatory power since the coefficient of determination is equal to 97 percent for the stochastic frontier model and 78 percent for the DEA model.

The results in Table 6 show that regarding the relationship between profitability and cost efficiency, a statistically significant positive relationship at the 5 percent level. It is important to note more the banks are profitable more the control of costs is important. This result is consistent with those of Berger et al. (1997) and Girardone al. (2004). They imply that a reduction in bank costs through a good management of resources exploited in the production process would result in an increase in bank profitability and thus, decrease in costs and then an improvement in cost efficiency. Moreover, we should note that banks which are more integrated in the market share are characterized by a “high market power”. This market part can improve the profitability of the banks.

There is a significant positive relationship between cost efficiency and bank size. Thus, these results show that large banks are more efficient than small banks. This positive relationship, consistent with the finding of Lahyani and Hauner (2005), is explained by the fact that a large size should result in a reduction in production costs due to economies of scale, and also allows large banks to raise lower-cost capital.

The results in Table 6 also show that the link between capital ratio (CAP) and efficiency is negative and statistically significant. This result can be explained by the fact that capital can be accompanied by a decline in the efficiency of banks, through the increase in agency costs

between managers and shareholders (Qi, 1998; Diamond and Rajan, 2001). On an empirical level, some studies have analyzed this question without reaching a consensus answer. For instance, Berger and Bonaccorsi di Patti (2006) study the relationship between equity and efficiency of US banks and came up with a negative association between them. On the other hand, Fiordelisi, Marques-Ibanez and Molyneux (2011) analyze this relationship for European banks and find a positive association.

We also note that bank liquidity is not found to be an explanatory factor for efficiency. In fact, the link between liquidity and efficiency is negative but is not significant regardless of the estimated method. We have to note that the more the banks have liquid assets[14], the more there is ability to face default by the banks. Assuming that the "expected bankruptcy cost hypothesis is also correct" and then liquidity has positively correlated to the profitability of banks. Knowing that, holding liquidity assets can have a negative effect on profitability as it is considered as an opportunity cost which may have a lower return in comparison to other assets. Liquidity is deemed as a significant player in the sustainability of a bank. Thus, the lack in liquidity may cause bankruptcy and vice-versa.

The risk measured by the Z-score indicator does not appear to be an explanatory variable for bank efficiency. This relationship varies according to the methods between positive and negative. This result is not consistent with those obtained in most of the literature that found a positive relationship between efficiency and banking stability. More the banks are involved in different kind of investments, more the risks are minimized. This relationship can be explained by the fact that the higher the risk, the lower the z-score we have. In this case, banks in general will be more interested to invest in lower risky investments which can have impacts on the provisions costs. In general, banks which benefit from a high profitability rate are more able to "absorb the shocks" than banks with lower profitability rate. The latter banks try to get higher profitability by being involved in more risky investments.

[14] "Liquid assets for a bank are considered as a combination of interbank deposits, government issued and guaranteed securities, and cash".

For the macroeconomic variables, the results show notice a positive and statistically significant relationship between the growth rate of the economy and efficiency, when the DEA is adopted. Thus, an improvement in economic activity, which is often accompanied by a decrease in the probability of default of borrowers, affects positively the banks' profits and results in lower banking costs, lower provisions for doubtful loans and therefore, improves the productive efficiency of banks. We note a non-significant negative relationship between inflation and efficiency. The inflation variable is measured by the consumer index (annual percentage). This variable is usually used because it reflects the macroeconomic stability of a country. According to Lozano-Vivas and Pasiouras (2010), when the coefficient of inflation is negative, the efficiency of the banks are affected negatively due to the pressure to control the price of inputs.

Table 6. Relationship between Efficiency Scores and the Internal and External Variables

	DEA Model		Stochastic frontier method	
Variables	Coefficients	t-value	Coefficients	t-value
Constant	**-1.0639**	**-9.121**	**-18.8937**	**-10.1606**
ROA	**0.1020**	**13.952**	**14.2416**	**13.0131**
TA	**0.6262**	**12.363**	**0.6001**	**8.8724**
CAP	**-0.2170**	**-2.554**	**-2.5017**	**-2.3768**
LIQ	-0.0247	-0.096	-1.7696	-1.2447
Z-score	-0.0004	-1.128	0.0079	0.8320
GDP	**1.0319**	**2.839**	-0.4156	-0.4872
INF	0.7365	1.339	-1.0831	0.9784
R^2	0.78		0.97	

Notes: the numbers in bold are statistically significant at the 5 percent level.

Sources: Bankscope and Orbis Bank. The calculation of the mean, standard deviation and coefficient of variation is done by the author.

4.4. Robustness Test

4.4.1. The output-oriented DEA model

In order to test the stability of the results, we propose to carry out two robustness tests. The first is based on testing an output-oriented linear programming model. The second aims to impose other forms of distribution on inefficiency. We have chosen to use an exponential normal distribution and a gamma distribution proposed by Greene (2000, 2005).

Based on the work of CCR (1978), BCC (1984), O' Donnell et al. (2008), the output-oriented DEA model can be written as follows:

$$
\begin{aligned}
& Max\ \phi_{it} \\
& S.t \quad \phi_{it} y_{it} - Y\lambda_{it} \leq 0 \\
& \qquad X\lambda_{it} - x_{it} \leq 0 \quad , \textbf{(12)} \\
& \qquad \Omega\lambda_{it} = 1 \\
& \qquad \lambda_{it} \geq 0
\end{aligned}
$$

Where:

y_{it} : is the vector of the observed output quantities of firm *i* at time *t*;
x_{it} : is the vector of the observed input quantities of firm *i* at time *t*;
Y : is a matrix of observed output quantities of L_k firms for *T* periods;
X : is a matrix of observed input quantities of L_k firms for *T* periods;
λ_{it} : is weights vector;
Ω : is a unity vector.

4.4.2. Amendment to the distribution of inefficiency

To test the stability of our results, we propose to modify the distribution of the inefficiency by assuming that the error component representing the inefficiency follows a gamma distribution. Greene (2000, 2005), specifies a stochastic frontier similar to those introduced previously, but assumes that the error term follows a gamma probability distribution and the model's parameters are estimated by the maximum likelihood method. Greene (1980, 2005) and Stevenson (1980) has shown – under the assumption that the error

term follows a gamma distribution – that the likelihood function behaves correctly in a way that it is compatible with the asymptotic convergence conditions of the Cramer method, and the estimators asymptotically follows a normal distribution. The gamma density takes the form of

$$f(u) = \frac{\sigma_u^{-P}}{\Gamma(P)} u^{P-1} e^{-u/\sigma_u} \text{ , } \textbf{(13)}$$

Where the gamma function is defined as $\Gamma(P) = \int_0^\infty t^{P-1} e^{-t} dt$ and when P is an integer $\Gamma(P) = (P-1)!$. When $P = 0$, the gamma density is equivalent to the exponential density. As with the truncated normal distribution, there are two parameters which govern the shape of the density and the exponential density can be tested. Stevenson (1980) on considered a special set of gamma distributions, namely those that have the Erlang form (where P is an integer). This will produce a tracable formulation for $f(\varepsilon)$. However, for non-integer values of P more care is required. Bekers and Hammond (1987) formally derived the log-likelihood function for $f(\varepsilon)$ without restricting P to be an integer. Greene (1990) followed this by demonstrating likelihood plus several additional terms.

The results of the estimation of the different models are presented in table 7 below. The results obtained show that the average inefficiency calculated according to the Greene model and the DEA output-oriented model (CEO) are 22 percent and 35 percent respectively. We observe that the cost efficiency estimated by the stochastic frontier is greater than that obtained by the DEA method.

Table 7. Average Productive Efficiency of Islamic Banks

	CE (Output Oriented)	CE (Gamma Distribution)
Maximum	1.00	0.99
Minimum	0.10	0.53
Average	**0.65**	**0.78**
Standard deviation	0.31	0.08
Coefficient of variation	0.47	0.10

In table 8 below, we attempt to study the Spearman correlation in order to take into consideration the classification of the previous methods (stochastic Frontier and DEA input and output orientations). The CE reflects the DEA inputs orientation, the CEA reflect the DEA outputs orientation, SF (Greene) reflects the stochastic frontier method outputs orientation and SF reflects the stochastic frontier method input orientation. We see that we have significant positive correlation between all the methods under study. The correlation between the efficiency score input-orientation and output-orientation by the DEA method is about 0.98. This coefficient is the highest due to the use of the same method but with two different orientations. Thus, in this situation, we have stability in the classification of methods. The correlation of Spearman between the efficiency score with input-orientation DEA method and output-orientation stochastic frontier method is about 0.22. This correlation is significant at 10%. This low value scan be due to the fact that for few banks, the score of efficiency can vary according to the type of methods. So, we can say that the stability in classification of methods can differentiate from a bank to another. The correlation of Spearman between the efficiency score with input-orientation stochastic frontier and DEA is about 0.36. The correlation of Spearman between the efficiency score with output-orientation DEA method and output-orientation stochastic frontier is about 0.23. The correlation of Spearman between the efficiency score with input-orientation stochastic frontier and output-orientation DEA method

is about 0.36. The correlation of Spearman between the efficiency score with input-orientation stochastic frontier and output-orientation stochastic frontier is about 0.39.

While the distribution of efficiency scores varies according to the definition of the adopted measure, the ranking of banks remains relatively stable. Spearman's correlations are positive and statistically significant among the four efficiency measures as shown in table 8 below. The use of the output-oriented DEA model and the Gamma distribution do not change the obtained results significantly. Thus, the ranking of each bank represents an indicator of performance, apparently more robust than the value of the score itself. Numerous studies using both parametric and non-parametric methodologies achieve the same result (Guevara and Maudos, 2002, Fiorentino et al., 2006, Fu and Heffernan, 2007, Pasiouras et al., 2009 and Kuchler, 2013).

Table 8. Spearman Correlation Order

	CE	CEO	SF (GREENE)	SF
CE	1			
T-Statistic	-----			
Probability	-----			
CEO	0.98571	1		
T-Statistic	126.1816	-----		
Probability	0	-----		
SF (GREENE)	0.221902	0.231142	1	
T-Statistic	9.472395	11.67	-----	
Probability	0.06369	0.0502	-----	
SF	0.365806	0.363046	0.392663	1
T-Statistic	8.475629	8.401932	2.306799	-----
Probability	0	0	0.0453	-----

Sources: Bankscope and Orbis Bank. The calculation of the mean, standard deviation and coefficient of variation is done by the author.

For our Islamic banks, the results in table 9 obtained here are very close to those obtained previously. These results show that there is indeed a significant positive relationship between profitability and bank efficiency. The impact of size on efficiency is positive and significant, and this result is observed in the two estimated models, which underlines its robustness with respect to the selection of control variables. With respect to CAP, we observe that equity affects negatively efficiency. We also note that bank stability measured by Z-score

affects positively the cost efficiency of banks regardless of the estimated model. Finally, we note that liquidity, economic growth and inflation are not explanatory factors for efficiency since the estimated coefficients have opposite signs and are not significant. The estimated model has a low explanatory power since the coefficient of determination is equal to 51 percent for the stochastic frontier model and 48 percent for the DEA model. By taking the Gamma distribution (output-orientation) we see that the level of efficiency is less important than in the case of semi-normal distribution (input-orientation). The difference in functional forms and in constraints can affect our results. However, the results remain stable and robust.

Table 9. Relationship between Efficiency Scores and Internal and External Variables

	DEA Model (Output Oriented)		**Stochastic Frontier Model Gamma distribution**	
Variables	**Estimated Coefficients**	**t-value**	**Estimated Coefficients**	**t-value**
Constant	0.9875	**39.2252**	0.9773	**41.2395**
ROA	0.0394	**3.3161**	0.0585	**4.7501**
TA	0.0031	**1.8982**	0.0023	**1.9370**
CAP	-0.0385	**-3.3625**	-0.0302	**-2.8811**
LIQ	0.0053	0.8593	0.0109	1.0242
Z-score	0.0005	**3.9420**	0.0004	**3.6298**
TCR	0.0110	0.6403	-0.0056	-0.3717
INF	-0.0148	-0.5959	0.0031	0.1737
R^2	0.48		0.51	

Notes: numbers in bold are statistically significant at the 5 percent level.

5. Conclusion

In this study, we seek to measure the efficiency of Islamic banks operating in the GCC region during the period 2004-2017. To detect the factors explaining the productive efficiency of these banks, we apply parametric (stochastic frontier) and non-parametric approaches .

In the production function, we have firstly applied the inputs minimization cost and in our robustness test, the output maximization scenarios. In both case, we did a comparative study with the non-parametric approach designed by the DEA model.

In the first part, from the descriptive results, we can notice that the input price dispersion tends to increase slightly during the period under study. The comparative results of the average productive efficiency between the stochastic frontier inputs oriented and DEA show an interesting inefficiency scores. We notice also the average efficiency scores are quite high for the Islamic banks under study. Moreover, the evolution of cost efficiency of Islamic banks in the five countries of GCC region shows a contracting result. This can be due to many factors such as the technology, the scale of production, the allocation of resources, the management of banks, etc. Thus, by explaining the effects of financial performance variables, we see a high explanatory power for both models.

In the second part, the robustness test shows us that the distribution of efficiency scores varies according to the definition of the adopted measure; the ranking of banks remains relatively stable. Thus, the ranking of each bank represents an indicator of performance, apparently more robust than the value of the score itself.

In this context, the results showed that the efficiency scores could not be explained solely by financial ratios, as they are related to external factors corresponding to the X-inefficiency and economic environment. The differences in results show weaknesses in each used method to estimate the productive frontier. These shortcomings need to be addressed by extending this study.

We have focused on different approaches to measure the efficiency of a production unit. The main advantage of the DEA method is that no particular form is imposed on the data. Its main disadvantage is that the assumption of constant scale economies is a little bit restrictive and extension of this model to allow non-constant returns to scale is not very reliable. A second disadvantage is that the frontier is calculated from the sample's data and is very sensitive to measurement errors and outliers. Finally, another disadvantage of this model is that it does not test time series.

By relying on the input-orientation (semi-normal distribution), our results show an average of 62 percent and 65 percent in terms of efficiency. By linking between the efficiency and the internal and external variables, we see that the relationship between profitability and cost efficiency is significant and positive at 5 percent level. This implies that a reduction in bank costs through a good management of resources exploited in the production process would result in an increase in bank profitability and thus, increase in costs and then an improvement in cost efficiency. There is a significant positive relationship between cost efficiency and bank size. A reduction in production costs due to economies of scale which allows large banks to raise lower-cost capital. The results also show that the link between capital ratio (CAP) and efficiency is negative and statistically significant. The high capitals in banks decrease the cost efficiency. We also note that bank liquidity is not found to be an explanatory factor for efficiency. The risk measured by the Z-score indicator does not appear to be an explanatory variable for bank efficiency. For the macroeconomic variables, the results show a positive and statistically significant relationship between the growth rate of the economy and efficiency, when the DEA is adopted. We note a non-significant negative relationship between inflation and efficiency due to the pressure to control the price of inputs. By applying the output orientation (Gamma distribution), the results show a level of efficiency equal to 65 percent and 78 percent by adopting the DEA and the stochastic frontier respectively. In terms of internal and external variables, our results are quite similar and robust. The difference in terms of efficiency differentiates from a method to another and from an orientation to another according to the functional forms and the constraints taking while the estimation and the calculations of the scores.

Third Chapter: Bitcoin and Islamic Global Stock Markets: Complements or Substitutes?

ABSTRACT

This paper seeks to study the characteristics of Bitcoin versus global Islamic stock markets. Specifically, it will rely on the component Garch model and Markov switching model to understand the volatile behavior and role of Bitcoin as a hedge or safe haven for four Islamic stock markets: S&P Asia Shariah, S&P BRICS Shariah, Shariah and S&P Emerging BMI Shariah. Our findings reveal that Bitcoin can be utilized as a strong safe haven or a weak hedge against Islamic stock markets under study. The results appear robust. However, they show that Bitcoin is highly volatile which can an obstacle to Islamic stock portfolio.

1. Introduction

The 2008-2009 global financial crisis has yielded to a trend towards questioning the effectiveness of standard economic and financial structures which govern the conventional monetary and financial system. This has lessened the fiat's ability to continue to hold value. Here, cryptocurrencies are leading the charge by offering a completely decentralized secure alternative to fiat currencies[15] during times of upheaval. Bitcoin has shown great resilience during periods of heightened uncertainty, underscoring its hedging, safe haven and diversification capabilities against rising uncertainty (see, inter alia, Bouoiyour et al., 2018). In March 2013, two weeks after the Cyprus Banking crisis had occurred; the new digital currency was growing at a high rate. Given the anxiety over the banking crisis and the implementation of "deposit taxes" in Europe in countries such as Spain and Greece, the trading value of the online currency increased sharply which opened its door to the world of digital cash. Accordingly, consumers began to trade the currency and its success became growingly evident as consumers began to benefit from the expulsion of their money away from their home countries. Due to the expansion of this phenomenon, many viewed this process as an "alternative liquidity vehicle". In 2017, there was an increase from USD 18 billion in the market capitalization of crypto currencies to around USD 600 billion by the end of 2018. Accordingly, Central Banks have been

[15] Fiat money is not backed by a physical commodity. Thus, it is excluded from any intrinsic value. For instance, U.S dollar is a form of Fiat currency not backed by commodities.

considering whether to regulate crypto currencies from a legal and technical perspective due to its increased market capitalization.

The rises of virtual currencies have also significantly touched the Islamic world. A topic of great debate amongst "Shariah" scholars and within the Islamic finance industry is cryptocurrencies. Arguably, Evans (2017) and Alzubaidi and Abdullah (2017) tested the Bitcoin's compatibility with Islamic finance. They showed that Bitcoin conforms to the prohibition of "Riba" and includes the principles of "Maslaha"(social benefits of positive externalities) and and "Mudharabah" (mutual risk-sharing, as opposed to risk-shifting). They deduced that Bitcoin particularly and cryptocurrencies might be viewed as a better medium of exchange in Islamic finance than "Riba-backed" central bank fiat currency. However, the history of Bitcoin suggests that although it has been thriving, it remains volatile which classifies it as a form of speculation (Gharar[16] in Islam). For this reason, the volatility of Bitcoin discourages its adoption by Islamic banks. Accordingly, killani (2018) argued that if Bitcoin becomes more stable in the future, Islamic finance will consider it to diversify Muslim investors' portfolio services. In our study, we will present in an objective way the different scholars' points of view without entering in this debate.

In the same context, some jurists like Šurda (2014) claimed the compatibility of Bitcoin with other Islamic modes of payment and insisted on its "Shariah" compliance comparing to traditional fiat currencies. They argued that the blockchain[17] system can be based on many Islamic principles such as "Riba-free", Profit and loss sharing and social public interest (Maslaha). Bitcoin is not founded on the concept of debt but on the proof-of-work (POW) system. On the other hand, others such as Bergstra (2014) asserted that the excessive volatility

[16] Gharar means ambiguity which is not allowed in Islamic finance according to the Islamic rules.

[17]Block Chain is a modern and general technology in the field of electronic authentication and information security. The application of Bitcoin is dependent on this technology. A synthesis between Bitcoin and the Block Chain technique exists which leads us to differentiate between each. Block Chain is not to be confused with Bitcoin, however, it can be stated that Bitcoin incorporates Block Chain technology. It is also significant to demonstrate the effects of the technical characteristics of Block Chain technology on the formation of Bitcoin.

of the cryptocurrency market in general and Bitcoin with large extent makes it illegal or "Haram".

There are several studies on the characteristics of Bitcoin and Islamic stocks. There is just a limited literature on the dependence between Bitcoin and Islamic finance. Some studies including Bucholz et al. (2012) and Bouoiyour et al. (2016) argued that Bitcoin is a generally used for speculative purposes. In other words, regardless of the arguments over Bitcoin' relative merits, there are still some issues regarding this cryptocurrency that impedes it from being a currency that is compatible with the basic Islamic requirements for a currency.

Likewise, few studies have been done on the characteristics of Bitcoin. Reboredo (2013) evaluates the importance of this digital currency for the minimization of risks in investors' portfolios. Knowing that, the diversification is crucial by allowing traders and investors to benefit from desirable returns by reducing the maximum risks in their portfolio. Najeeb et al. (2015) assessed the potential for Malaysian Islamic investors to diversify their portfolio. They conclude the possibility for International investors to take into consideration the diversification benefits of Bitcoin. Dyhrberg (2016) tested the potential of Bitcoin as a cryptocurrency to attract international investors. He also takes into account the hedging features of this digital currency and discovers from his empirical study the capability of Bitcoin to be integrated in investors' portfolios due to its hedging characteristics.

Rather than assessing the characteristics of Bitcoin and Islamic stock indices as it is largely documented in the existing literature, and beyond testing how a cryptocurrency conforms with Islam and "Shariah" as it is already done, this study circles around exploring how and to what extent Islamic fund investors can benefit from diversifying their investments in virtual currencies such as Bitcoin. Some studies indicated that regardless of the volatile and speculative behaviors of Bitcoin, the latter possesses hedging and safe haven properties and can be incorporated in a portfolio to curtail the adverse consequences of rising uncertainty surrounding unforeseen shocks/events (see, Dyhberg 2016; Bouri et al. 2017; Selmi et al. 2018). Offering precise information regarding the dynamic relationship of Bitcoin and Islamic stock

markets is particularly relevant for investors since diversified portfolios may be composed of both virtual currencies and Islamic stocks. To our best knowledge, there are only two studies focusing on the ability of Bitcoin to serve as a portfolio diversifier for Islamic fund managers. Siok Jin and Masih (2017) conducted three methodologies, nameley M-GARCH-DCC, Continuous Wavelet Transforms and Maximum Overlap Discrete Wavelet. Four sharia indices, dubbed Malysian Sharia stocks (FBMSHA), Dow Jones Islamic Developed Markets (DJIDEV), Dw Jones Islamic Emerging Markets (DJIEM) and Dow Jones Islamic Europe (DJIU) were accounted for. Daily closing prices from January 2010 until January 2017 were used in order to examinate the relationship between the Sharia indices and Bitcoin. Three quite interesting results were drawn: (1) Bitcoin can play the role of a divesifier in Malysian investors portofio; (2) Bitcoin can be a diversifier for the other three sharia indices but in the short term; and (3) the Bitcoin is influenced by the long-term fundementals more the short-term factors. More recently, Bouoiyour and Selmi (2019) addressed whether diversification drive down risk-adjusted returns by examining possibilities of using Bitcoin as portfolio optimization strategy for Islamic fund managers in emerging and developed countries. They supported the evidence of diversification gains and downside risk reductions that confirm the usefulness of including cryptocurrencies in Islamic shares portfolios. They also indicated that investors who hold a diversified portfolio made of developed Islamic stock index and Bitcoin may face losses over bearish regime. They suggested that in such situation, investors may take a position on emerging Islamic stock market.

The present research goes complements the existing literature by assessing possibilities of employing Bitcoin as a portfolio diversification tool for different Islamic stock markets (in particular, S&P Asia Shariah, S&P BRICS Shariah, Shariah and S&P Emerging BMI Shariah) in periods of low and high volatility. Precisely, we use a dependence- Markov switching model to acknowledge the potential of switching between collapsing and rising risk regimes. It must be pointed out at this stage that the switching regime in tail dependence is important to analyze the risk spillovers and for decision making process.

The remainder of the chapter is arranged as follows. Section 2 gives an overview on the conception of money in Islam. In the same section, a presentation of the position of Bitcoin as an alternative mode of payment according to “Shariah” is provided. Section 3 outlines a detailed account of the methodology and presents the data. Section 4 reports and discusses the empirical findings. Section 5 concludes and provides some risk management implications.

2. Some stylized facts and Literature review

2.1. *Money in Islam*

In the classical financial system, "money is anything of value that is generally accepted as medium of exchange, unit of account and a store of value". According to the capitalistic ideologies, money has intrinsic value basing on the principle of similarity between money and commodities in terms of commercial transactions. Nevertheless, in the Islamic financial system, there is a difference between the concept of money and commodity. According to the Islamic theory, money does not have an intrinsic value because it necessitates a direct exchange for commodity unless the transactions are put on the spot. Accordingly, money is only a medium of exchange and a store of value. (See section 3, first chapter)[18]

In this context, there are two main schools; the first one is the ‘Chartalist’ school and the second one is the 'Metallist' school. As can be seen, Islamic doctrines are established on the Islamic canonical law "Shariah".

First, the ‘Chartalist’ school permits the flow of money within an economy. According to theory of ‘Chartalism’, money is primarily considered as a unit of account and does not have an intrinsic value. However, the value of money is likely determined by the central bank in each county which plays a significant role in creating the national currency “Fiat currency”[19] and in

[18] The principle of participation is not only limited to the contribution of physical capital but also to the contribution of project management. Respectively, any "passive investor" will be deprived of his rights and thus of remunerations.

[19] For instance, virtual currency can be used in Islamic banks to facilitate “Mucharakah” financing transaction. That can not only surpass the inefficiency of the current system but also can provide a strong incentive for clients when exchange fees are almost zero.

managing the economic system of the concerned society. Although it preserves its value and tradability through confidence or trust of the public in it. Forms of it include paper money. What differentiates this type of money is its uniqueness and unlimited liquidity. In the "Fiqh", Fiat is not money because it is not naturally available what makes it correlated to inflation (described as an economic ill).[20]

The second school is the 'Metallist' school. This school determines commodity money according to the degree of its tangibility. Commodity money is basically a form of money with intrinsic value such as gold, silver, or paper money backed by gold.

In this context, Hosein (2007) in his book "Islamic and Future of money" argues that commodity money must

1-Have an intrinsic value	**2**-Be abundant	**3**-Be a medium of exchange	**4-**Be durable	**5-**Exist in creation	**6-**Be precious metal or food

Source: Author's structure

Under Islamic Business law, the value of money is equal to the value of the trading commodity that must have an evidence of existence. As has been noted, commodity money in Islam has value likely by demand and supply.

In this context, Hosein (2007) determines six types of commodity-money used during prophet "Mohammad"' Era (SAW). In short supply, all previous Muslim generations used dates, wheat, barley and salt as exchangeable currencies. A few years later, some Muslim populations used some alternative commodities as medium of exchange like Rice in Indonesia. Nowadays,

[20] Inflation is linked to "Al-Bakhs" which is forbidden in Islam.

these “Shariah compliant” commodities are represented by tangible commodities such as Gold and Silver.[21]

2.2. *Bitcoin from Shariah angle*

There is a dilemma concerning the position of Bitcoin as a government currency. However, there are several merchants around the world have accepted Bitcoin as a form of payment comparable to conventional currencies. It is also accepted in several countries as a payment form to cover taxes government fees.[22]

In this context, there are several points of views from an economic perspective whereby economists consider that the government only is entitled to issue currencies. There are many “Fatwas”[23] in several Islamic countries such as Turkey, Palestine and Egypt that classify Bitcoin as “Haram” for several reasons such as Bitcoin not complying with the country`s treasury and may be used to launder money and to lead to an increase in crimes such as drug and human trafficking, weapons trading, and fraudulent purposes which are forbidden in Islam. Bitcoin is considered as a tool to fund or ease the trade of weapons. Due to this, several “Fatwas” suggest that the exchange of Bitcoin is in not accordance with the principles of “Shariah” Law and thus prevented the use of it. Even though several reports have surfaced that highlighted the evolution of methods that provide the identity of the clients. Secondly, Bitcoin contains elements of “Gharar” which encompasses gambling. Thirdly, Bitcoin is an electronic currency which cannot be exchanged by means other than the internet and this leads to anonymity and that is not in compliance with the principles of “Shariah” Law. This anonymity is not only for the

[21] For instance, "Gold Dinar" is largely used in Far East and MENA region. Nevertheless, it has been proven that if commodity money has the ability to satisfy the first five requirements above; it would be real money. For instance, "Rai stones or the stone money" have been used as an exchangeable currency in Micronesia primarily the Republic of Palau.

[22] At the "Dubai conference", December 2015, the issue of Bitcoin was put on the table. Few Muslim experts claimed that Bitcoin can work according to the Islamic law. They agreed that Bitcoin can expand in Islamic world in order to boost development. Accordingly, many Arab countries like UAE created "BitOasis" to offer wallet/exchange Bitcoin around the golf.

[23] Fatwas can be defined as decrees pronounced by the religious referents recalled by the "religious schools" (the Madarés). There are two main currents that constitute their own schools of interpretation: the Shiites and the Sunnis.

source but also anonymity for the future of the currency. There is an issue with Bitcoin which is related to its classification from a religious point of view from an economic and legal perspective. Thus, it cannot be judged from a "Shariah" perspective prior to its classification and it is therefore ignorance (known as "Jahala" in Islam).[24]

Some Bitcoin advisers see that this new phenomenon can be based on "Shariah" principles. Bergstra (2014) argues that Bitcoin is a "money-like informational commodity (MLIC)". He claimed that Bitcoin, can be accepted in the Islamic financial system. Those optimists base their opinions on several analyses which are represented as follows. First, Bitcoin can be transparent as it is designed to be used online and openly. Everyone can track the DNA or the serial number of this digital coin and know its location (in about 200 countries) at any time. Furthermore, Bitcoin is abundant and Blockchains are publically available. Everyone can take part to become a miner by solving mathematical algorithms[25] (see Appendix Figure 6) problems and exchanging currencies for Bitcoin as a mode of payment. Second, money can have intrinsic value when it becomes valuable by public. As for Bitcoin, it is valued for many reasons such as the absence of central planner which has the authority to manipulate accounts. Others proclaim that Bitcoin has value due to its anonymity. Moreover, Bitcoin can be a "Shariah compliant" through the process of mining where resources should be well invested according to its value. The value of Bitcoin likely depends on market demand and supply what makes it a new form of payment. Correspondingly, Bitcoin can be exchanged and prove its own existence. Mining predetermines the sum of coins in circulation what verifies its intrinsic value. Like Islamic bank network, Bitcoin confirm the ownership of the underlying assets (real

[24] An issue was therefore raised to economists and specialists in Islamic law to determine if it is a currency or commodity money. Due to the ignorance (Jahala) of the source, it is deemed as a void (Fased) contract. A contract has several terms and conditions once it is under preparation. The terms and conditions of this contract will then determine whether it is in compliance with the principles of "Shariah" law.

[25] Aside from the methods utilized by conventional banks that count on collateral to appraise credit, AS lenders adopt "data-driven algorithms" to predict the creditworthiness and the possibility of borrower default. The "Data-Driven approach" is a new one that permits the entrance into the digital environment. The Data-Driven Strategy that focuses on traces of personal information known as "digital footprints" uses information to analyze and to interpret the most repeated topics discussed online, to create in the end, real opportunities in a real world.

ownership of Bitcoins) by registering transactions in the public ledger. Third, the Bitcoin market is still in its infancy. However, no one can ignore that Bitcoin is used as a medium of exchange worldwide. Bitcoin can facilitate trade what make it linked one way or another to the real economy. Equally important that, "Riba" issue can be applicable when market currencies become really recognized and accepted as means of exchange. However, the crypto-currency market is a niche market; therefore, applying "Riba" requirements now has no sense. Fourth, Bitcoin is durable like exchangeable food. Bitcoin is secured by computers. It exists on public ledgers and mathematical data can persist for long periods of time. However, there is a probability of data what can make it unreadable to the owner-user. Fifth, money commodity in Islam such as gold or silver exists in creation. This means that it is evaluated by creator. However, raw materials become precious after placer mining in order to make them useful. That means that humans work is compulsory to set their value. Similarly, Bitcoin necessitates the intervention of minors to solve algorithm problems that already exist in creation. The blockchain system can be based on many Islamic principles such as "Riba-free", Profit and loss sharing and social public interest known as "Maslaha" in Islam. Knowing that Bitcoin is not founded on the concept of debt but on the proof-of-work (POW) system. Sixth, many Muslim experts argue that this crypto currency can be based on the concept of risk sharing. In order to be permissible, Bitcoin users should be awake to risks related to the failure of Internet currencies. In Muslim countries, there are many good examples of "Shariah-compliant" crypto currencies.[26] Seventh, as for the role of Bitcoin in socio-economic justice and the spread of the "Ummah", Bitcoin helps many people to improve their quality of life by enhancing their income. Consequently, it can helps in resource optimization by increasing the level of employment and production. Nevertheless, many users hoard Bitcoin to sell it at a high price what make it in disharmony with "Shariah" compliance. Eighth, it is also important to realize that Islam tends to

[26] Located in Indonesia, Blossom Finance is a "Shariah-compliant" company based on profit-risk-sharing and debt free principles. "Blossom" aims to fund small and medium enterprises to invest in Hallal industries. The Malaysian company "Hello" is another good example that relies on the Islamic rules of the Malaysian Fatwa Council. Bitcoin can be easily transferred through a public ledger (a blockchain). This blockchain is founded on a digital gold trading platform in which the intermediary fees are almost zero. Furthermore, many non-Muslim countries such as UK and Canada started launching Blockchain technology where Bitcoin services are backed by gold. In 2017, "Gold Money" and "Onegram" become two reference models based on this principle.

reduce “Ummah”'s "economic ills" like inflation and to assure economic stability. Knowing that, in order to be permissible and to maintain a climate of confidence, the currency must be deflationary and not vulnerable.[27]

The major concern is that the cryptocurrencies remain miss the capability to offer a clearer intrinsic value or a physical existence which is needed by “Shariah”. Islamic finance is a financial system that operates while respecting the Islamic law or “Shariah” which is consisted of “Quran” and “Sunnah” of the Prophet “Mohammed” (SAW). Therefore, its applications are allowable unless it is proven to contradict “Shariah”.[28] (See chapter one)

3. Methodology, data and descriptive statistics

3.1. Methodology

The methodology is conducted in two main steps. The first step applies a Component GARCH model to determine whether the volatility of Bitcoin and Islamic stocks is due to transitory or permanent effects. Prior to comparing the ability of Bitcoin of playing a role as a safe haven or as a diversifier and a hedge against Islamic stock price fluctuations, it is important to take their respective market characteristics (in particular, their volatile bahaviors)[29] into account. It must be stressed the measurement of volatility is widely viewed as a “tool” to determine the level of risk in the financial market. The second step utilizes, a Markov Switching regime model to explore the dependence structure between Bitcoin and four different Islamic indices under various (i.e., low and high) volatility regimes.

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[27] For that reason, Islamic economy imposes regulations and measures. As for the resistance of Bitcoin in inflationary environment, unlike conventional currencies, Bitcoin is a decentralized currency (Weber, 2014) and does not necessitate the intervention of the Federal Reserve. Accordingly, there is no monetary authority monitoring rates and Bitcoin production. The amount of Bitcoins in circulation is limited to 21 million what makes it different from fiat currency. As a result, Bitcoin can be defined as an inflation-resistant currency.

[28] The Islamic financial system is largely dissimilar from its conventional counterpart since the first forbids any activities that account for main principles which are: the collection of interest (riba) is prohibited; ambiguity (Gharar), gambling (Maysir), and loans must be based on profit/loss sharing.

[29] There are many sources of uncertainty such as “economic, monetary policies, financial and political ones”.

3.1.1. Component GARCH model

We use a component GARCH (CGARCH) model to assess the volatile behaviors of Bitcoin and Islamic indices. This technique allows decomposing the conditional variance into smoothly variations due to transitory events and permanent volatility component.

In an attempt to assess the dynamics of Bitcoin and the four different Islamic indices under study, we carry out a component Garch (CGARCH) model.

Engle and Lee (1993) used the CGARCH model in order to detect the type of variance components. The main objective of this GARCH extension is to differentiate between variation due to transitory effects and structural effects. For instance, the "drone attack" occurred in September 2019 in Saudi Arabia can be considered as a transitory problem not only in Saudi Arabia but also in the whole GCC region. The facilities of Aramco were viewed by reporters where they were able to see the damage and the rebuilding works that were being undertaken. The oil production of Aramco was cut down by 50 percent after the drone attack which accounts for around 5 percent of the total world production. As a result, GCC stocks as a whole fell after the attack on Aramco`s facilities. Meanwhile, the Saudi stock market fell 1.3 percent. The petrochemical sector was especially affected according to Mazen Al Sudairi (2019). Other GCC stock markets also fell after the attack, such as the Kuwait Premier Index. BKP fell by 0.4 percent along with the Dubai stocks (DFHGI) which fell around 0.5 percent. However, they were able to recover from the intraday losses. Concerning the structural effects, we can talk about the challenges facing the "Sukuks" investments in Uk such as regulatory barriers. In the United Kingdom, the issuance of "Sukuks" has been challenging due to regulatory constraints. The legal structure that "Sukuks" follows is basically an undivided fraction of ownership in an asset. The administrator of the "Sukuks" asset divides the returns from the asset amongst the asset owners based on their ownership fraction. This can be compared to a collective investment scheme, whereby, a group of investors combine to purchase an asset. However, in the UK, collective investment schemes require approval of financial regulators. These regulations place difficulties on the issuance of "Sukuks" as they would be more costly than the issuance of conventional interest bearing bonds. However, once this issue was highlighted by Islamic

finance specialists to the UK government, legislation decided to omit the regulation and proposed that if the instrument meets the requirements or definition of an "alternative finance investment bond", then it would not be classified as a collective investment scheme.

The conditional variance of the GARCH (1,1) model can be defined as follows:

$\sigma_t^2 - \sigma^2 = \alpha(\varepsilon_{t-1}^2 - \sigma^2) + \beta(\sigma_{t-1}^2 - \sigma^2)$, **(14)**

Where, σ_t^2 corresponds to the conditional variance which is an indicator that detects the exogenous factors that may occur due to the rise in economic policy uncertainty and/or heightened geopolitical risks, etc.

The component GARCH model can be presented by replacing the constant σ2 with a time varying long-run component q_t. The equation of the component GARCH (1,1) is expressed as follows:

$\sigma_t^2 - q_t = \alpha(\varepsilon_{t-1}^2 - q_{t-1}) + \beta(\sigma_{t-1}^2 - q_{t-1})$, **(15)**

$With$

$q_t = \omega + \rho(q_{t-1} - \omega) + \emptyset(\varepsilon_{t-1}^2 - \sigma_{t-1}^2)$, **(16)**

Here, the equation (15) σ_t^2 is the volatility, and the equation (15) is considered as the "transitory equation", $\sigma_t^2 - q_t$ which is the "transitory component" "converges to zero with powers of α+β", $(\sigma_{t-1} - q_{t-1})$ reflects the short-run or transitory component that can fluctuate quickly around the first component. q_t is the long-run or the permanent component . This component "converges to ω with the power of ρ". ω corresponds to the reaction to the shock. P is the leverage effect/ asymmetrical effect which means that the reaction is not the same depending on the sign of the sock. $\emptyset$ reflects the transitory effect. The sum α+β detects the persistence of the volatility. Thus, when this sum is ≅ 1, we can say that there is a high persistence of volatility.

3.1.2. The Markov Switching regime model

Throughout this sub-section section, we conduct a Markov Switching model which acknowledges a switch of conditional variances of the variables of interest over time.

The Markov switching regime model was proposed by Hamilton (1998) also called dynamic model. This model was expanded upon by Filardo in 1994 whereby Filardo published the Hidden-Markov Model (HMM). Filardo (1994) also developed the auto-regressive models. In these models, the smoothing techniques were utilized in several literature reviews and in particular in financial matters such as those related to currency exchange, stock markets, etc. Hamilton (1998) uses the fixed transition probability (FTP) which considers that the transition probabilities do not vary over time. Souza et al. (2010) forecasted crude oil prices by utilizing the Hidden-Markov model (HMM).

Generally, there are three main types of Markov Switching model applied by researchers who have conducted similar studies. The first model used by Engle and Hamilton (1990) is the basic Markov Switching Model and can be represented as follows:

$Y_t = c_{St} + \sigma_t \varepsilon_t$, **(17)**

The second Markov Switching Model which was used by Hamilton (1989) to estimate the US GDP growth is characterized by the allowance for "state-independent autoregressive dynamics". The second model can be represented as follows:

$Y_t = c_{St} + \sum_{j=1}^{q} \emptyset_j (Y_{t-1} - c_{St-j}) + \sigma_t \varepsilon_{t-1}$, **(18)**

The third Markov Switching model is a model which is distinguished by "a state-dependent autoregressive dynamics". This type of model can be represented as follows:

$Y_t = c_{St} + \sum_{j=1}^{q} \emptyset_{jst-1} (Y_{t-1} - c_{St-j}) + \sigma_t \varepsilon_t$, **(19)**

It is important to note that the Markov Switching model is specified by “a time-varying probabilities”. Thus, in order detect the evolution in S_{t1}, $S_{t2}, S_{K^N} \ldots, etc$, the stochastic transition probability can be represented by

$$P\langle S_{t+j} = j \mid S_t = i, S_{t-1} = k, \dots, \rangle = P\langle S_{t+1} = j \mid S_t = i\rangle = pr_{ij}, \quad \textbf{(20)}$$

Where, pr_{ij} varies between a value superior or equal to zero and a value inferior or equal to 1, knowing that $\sum_{j=1}^{k} pr_{ij} = 1$ for all i.

It is important to note that there is a positive relationship existing between the high value of pr_{ij} and the duration of the process to persist in state i. Consequently, measuring pr_{ij} can tell us about the "persistence" in each regime.

More dynamic patterns are able to be taken by the allowing switching between the structures. An observable state variable controls the switching mechanism of the Markov Switching model by following a first order Markov Chain. This is considered as a novel feature of this model. The current value of the state variable is dependent on the immediate post value and is regulated by the Markovian property. Changes in the model structures that are random and frequent are yielded by the Markovian state variable. The persistence of each regime is determined by the transition probabilities. Similar features characterize the threshold model; however, the implementation of the Markov-Switching model is easier as the selection of the a priori threshold variable is not required. The regime in in the model is classified as probabilistic and is determined by the data.

In this context, the Markov-switching regime model is applied in this analysis in an attempt to well understand the properties of Bitcoin as a safe haven, a hedge and or a diversifier in Islamic investors' portfolios and to well define the relationship between Bitcoin and each of S&P Asia Shariah, S&P BRICS Shariah, and S&P Emerging BMI Shariah under study.

According to Kaul and Sapp (2006), Baur and Lucey (2010), Baur and McDermott (2010) and Reboredo (2013), an asset can be classified as a safe haven, hedge, or diversifier. An asset is considered as a hedge if it possesses a correlation which is negative in normal state, doesn`t mitigate risks or during a crash of markets or market anxiety, and has a positive correlation during those specific periods. It is considered as a safe haven if its specific property does not have a correlation or if the correlation is negative with respect to other assets during market crashes. The specific property of a safe haven on average does not have to be a negative or

positive correlation between two assets but a negative or zero dependence should exist within specific time periods. This suggests that the correlation can be considered as negative or positive during bullish state or a normal state. In the case of a diversifier, a similar correlation with a hedge exists whereby its specific property does not minimize losses in market turmoil considering that the correlation exists only on average. In other words, an asset is regarded as a diversifier when it is on average, positively correlated with another asset. Considering the Markov-witching regime, we have two main regimes, namely Regime 1 corresponding to low risk scenario or normal situation, and Regime 2 corresponding to the while high risk state.

3.2. Data and descriptive statistics

We use daily data covering the period from July 19, 2010 till January 05, 2018 for a total of 2727 and 1923 returns for Bitcoin and Shariah indices respectively. The four main indices of the credit rating agency Standard and Poor's. These indices are, namely S&P Asia Shariah, S&P BRICS Shariah, S&P Developed BMI Shariah, and S&P Emerging BMI Shariah. The selection of the four indices and the period under study is due to the availability of data as it can be easily downloaded online.

The volatility is likely determined by utilizing log-normal returns as proxy. The modeling of the volatility of financial returns is appropriately done using the GARCH model due to its simplicity in comparison to other models. The Log-normal returns equation is as follows:

$R_{it} = ln\, P_{i,t} - ln\, P_{i,t-1}$, **(21)**

Where R_{it} *is defined as return values at time t, and* $P_{i,t}$*is calculated from the daily closing price data.*

Table 10 below shows the descriptive statistics as Bitcoin appears the most volatile asset, followed by the different Shariah indices under study. The mean and the median of the Bitcoin and the four Shariah indices are all positive over the period 2010-2018. We notice that Bitcoin shows the highest value by around 0.0713. However, the two Shariah indices : the S&P DEVP and S&P EMER have attempt the lowest by around 0.0080 and 0.0086 respectively.

In addition, Bitcoin exhibits a positive skewness, unlike the Islamic stock indices. It can be shown that the skewness of Bitcoin is around 2.76 versus -0.28, -0.26, -0.53 and -0.63 for S&P Asia Shariah, S&P BRICS Shariah, S&P Developed BMI Shariah, and S&P Emerging Shariah indices respectively. The fact that Bitcoin seems positively skewed implies that including Bitcoin in a risky portfolio may improve the portfolio's skewness and then reduce risk exposure. Graphically, the Skewness measure of Islamic indices is significantly negative meaning that the distribution is "skewed to the left". Consequently, we conclude on one hand the existence of an asymmetric distribution and on the other hand there is more downward than upward. However, skewness measure of Bitcoin is positive meaning that the distribution is "skewed to the right". Accordingly, the two distributions portray an asymmetric return and are characterized by a long tail to the left side and the right side respectively. These characteristics can be shown in Figures 6 and 7 below.

Furthermore, the Kurtosis measured, shows that the normal distribution is "leptokurtic or heavy-tailed" with kurtosis superior to 3 for all indices.[30] Notice that all the indices under study are not normally distributed as the kurtosis value is above 3 indicating the existence of a fat-tail (heavy tail) distribution on the extremities and that is different from the normal one. The statistics substantiate the characteristics of the financial data. In addition to that, it is noticed that the normal distribution which is applied in our study instead of the Gaussian one is reflected by Jacque-Bera (JB) test. The null hypothesis is rejected as the test statistic value JB is not zero.

We can also see that the standard deviation of Bitcoin and the 4 Shariah indices (S&P Asia Shariah, S&P BRICS Shariah, S&P Developed BMI Shariah, and S&P Emerging BMI Shariah) for the period 2010-2018 reflects the volatility of daily returns. In our sample, we have 2727 daily returns for Bitcoin and 1923 for Shariah indices.

[30] For a normal distribution, the coefficient of Kurtosis (Y_2) should be equal to 3. However, this coefficient can be a coefficient of a leptokurtic distribution if$(Y_2 > 3)$ or of an a platykurtic distribution if $(Y_2 < 3)$.

Table 11 below describes the Ljung-Box (1979) and the ARCH-LM process. Meanwhile, the Lagrange Mutliplier test (LM) is also used to detect the existence of ARCH effects. The Q-statistics[31] of Ljung-Box detects the existence of a serial correlation. We conclude from the table 11, the existence of a significant Arch effect can be likely from the residue. The value of Ljung-Box shows the existence of a significant autocorrelation structure in the returns of Islamic indices as well as in the returns of Bitcoin at 1 percent confidence for the Bitcoin and Islamic indices.[32]

Table 10. Descriptive statistics of the returns of Shariah indices and Bitcoin

	BITCOIN	S&P_ASIA	S&P_BRICS	S&P_DEVP	S&P_EMER
Mean	0.004497	0.000429	0.000341	0.000412	0.000227
Median	0.001484	0.000730	0.000329	0.000613	0.000595
Maximum	1.474395	0.045295	0.050786	0.038511	0.040088
Minimum	-0.848765	-0.056377	-0.073007	-0.052796	-0.065132
Std. Dev.	0.071295	0.009636	0.010976	0.008030	0.008644
Coef of $\boldsymbol{var}^{\circ}$	15.853902	22.461539	2.187683	19.490291	38.079295
Skewness	2.761097	-0.282496	-0.255562	-0.533621	-0.633215
Kurtosis	89.42120	5.413482	6.041530	7.727479	7.462707
Jarque-Bera	852087.3	492.2970	762.1612	1881.981	1724.258
Probability	0.000000	0.000000	0.000000	0.000000	0.000000
Observations	2727	1923	1923	1923	1923

Note: *** denote statistical significance at 1 percent confidence level.

[31] The Ljung-Box (Q) statistic detects the existence of serial correlation. The Q-statistic for K lags is represented as follows: $Q^{*} = T\,(T+2)\sum_{k=1}^{k}\frac{\varphi_k^2}{T-K} \sim \chi 2$,
where , T: $reflects\ the\ time\ series$
k: $is\ the\ number\ of\ lags$
φ: $is\ the\ autocorrelation\ coeffcients$

[32] The number of lags chosen for the test ure review. In order o check the existence of linear dependence for returns, the lags which have been chosen (in table B.2) are: 5, 10, 15, and 36.

Table 11. Ljung-Box and ARCH-LM of Islamic indices and Bitcoin

	BITCOIN	S&P_ASIA	S&P_BRICS	S&P_DEVP	S&P_EMER
Ljung-Box-Q (5)	142.018***	78.612***	26.802***	124.263***	52.556***
Ljung-Box-Q (10)	156.6166***	81.168***	38.179***	132.169***	54.895***
Ljung-Box-Q (36)	186.649***	130.067***	75.327***	164.489***	87.686***
ARCH (1)-LM	0.389***	19.686***	60.294***	25.704***	110.293***

Note: *** denote statistical significance at 1 percent confidence level.

The figures 5, 6, and 7 below represent all sample series of the returns of Bitcoin and four Shariah indices under study. We remark in our sample that the “random walk” depends of what is happening in the past. In other words, when a shock happens in the market, it responds to new information which is distinguished by large fluctuations in price than smaller ones. In addition to that, the high-volatility will remain a while after the initial shock.

In this context, we have chosen a normal distribution instead of a Gaussian one. In addition to Kurtosis and Jaque-Berra measures, the histogram of log returns (Figure 6) and the Q-Q plots (Figure 7) were used in order to detect the adequacy of the sample to a normal distribution or to compare two samples. Graphically, the Figure 6 represents the histogram of the normality test. It shows that the distribution is not normal as a result it is not symmetric. Thus, the volatility of returns of the Bitcoin and the four Shariah indices under study is clearly visible. Thus, this observation confirms the results of table 10. Knowing that, if the points aligned with the first bisector is that the distribution probably follows a normal distribution. To conclude, the features of the series under study representing by leptokuritic distribution compared to the fit Gaussian distribution, asymmetric distribution, volatility clustering and threshold effects is known by “ stylized facts”.

Figure 5. Residuals of Shariah indices and Bitcoin

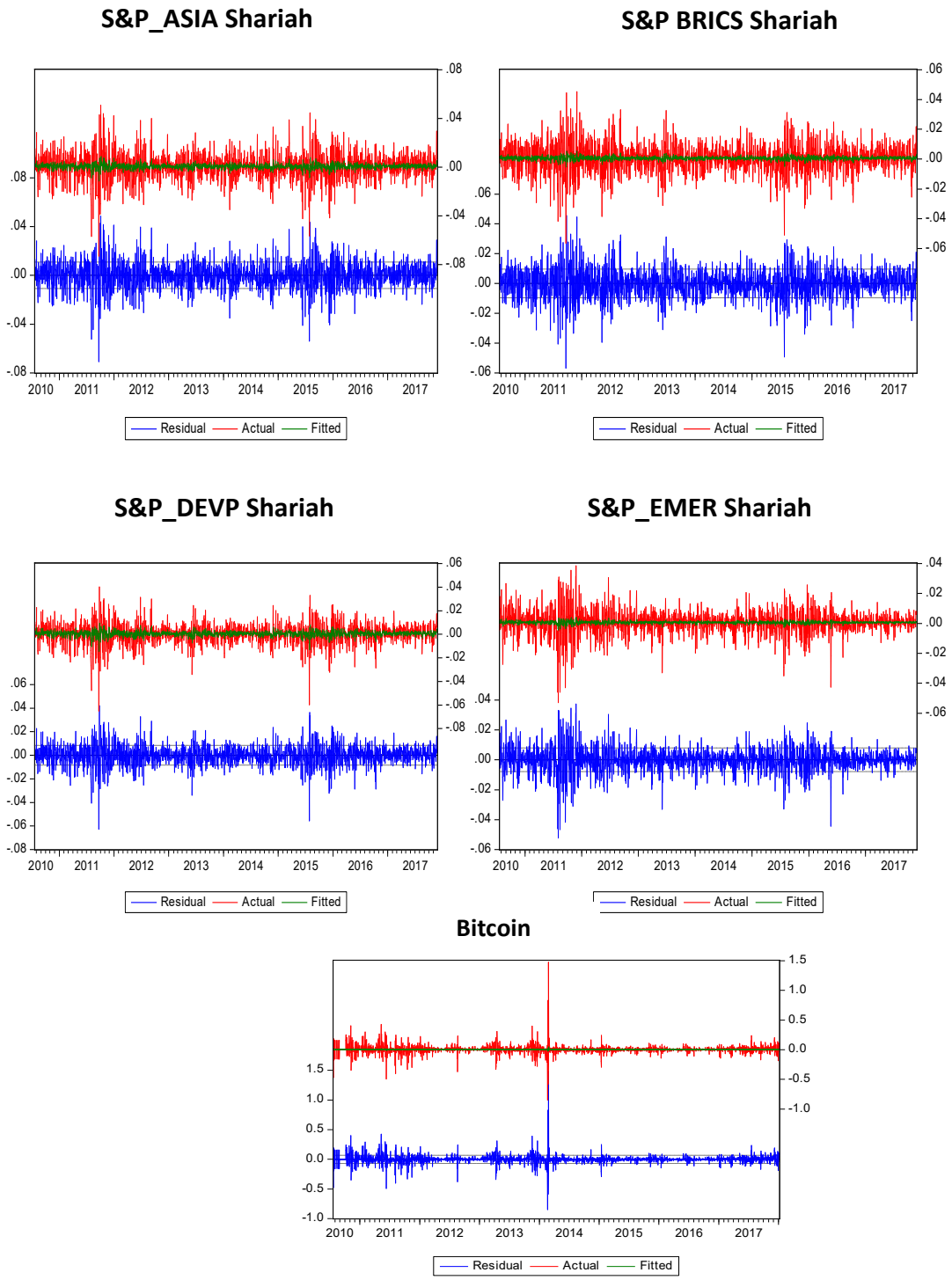
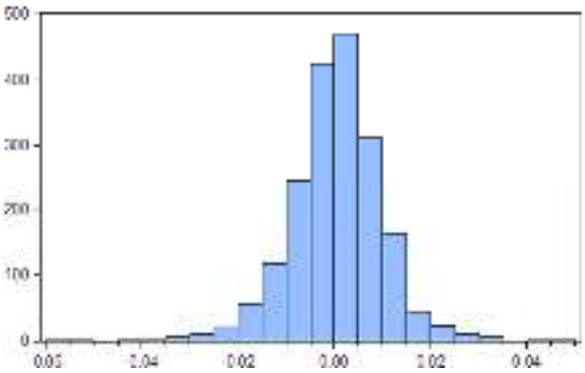
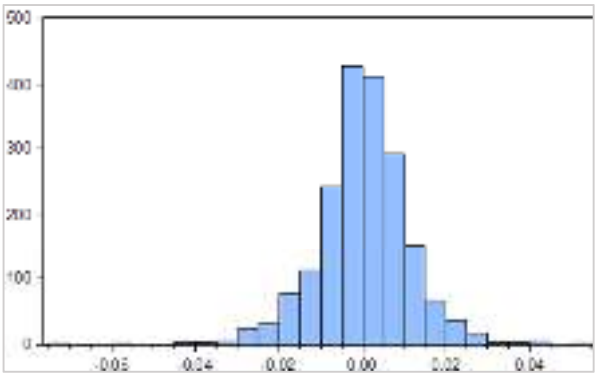


Figure 6. Normality Test of Shariah indices and Bitcoin

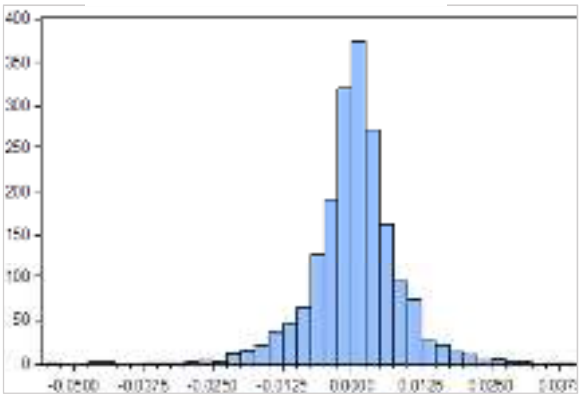
S&P_ASIA Shariah



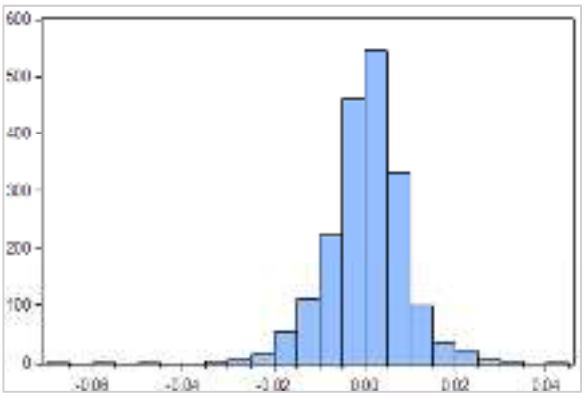
S&P BRICS Shariah



S&P_DEVP Shariah



S&P_EMER Shariah



Bitcoin

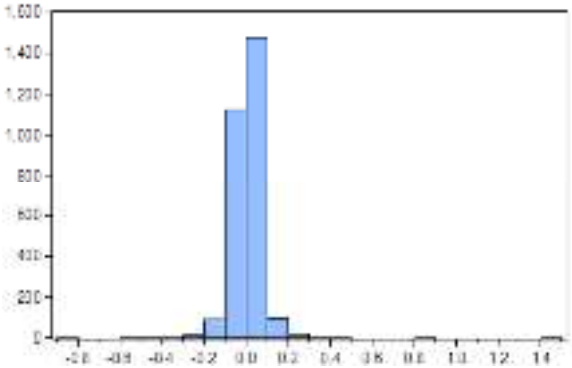
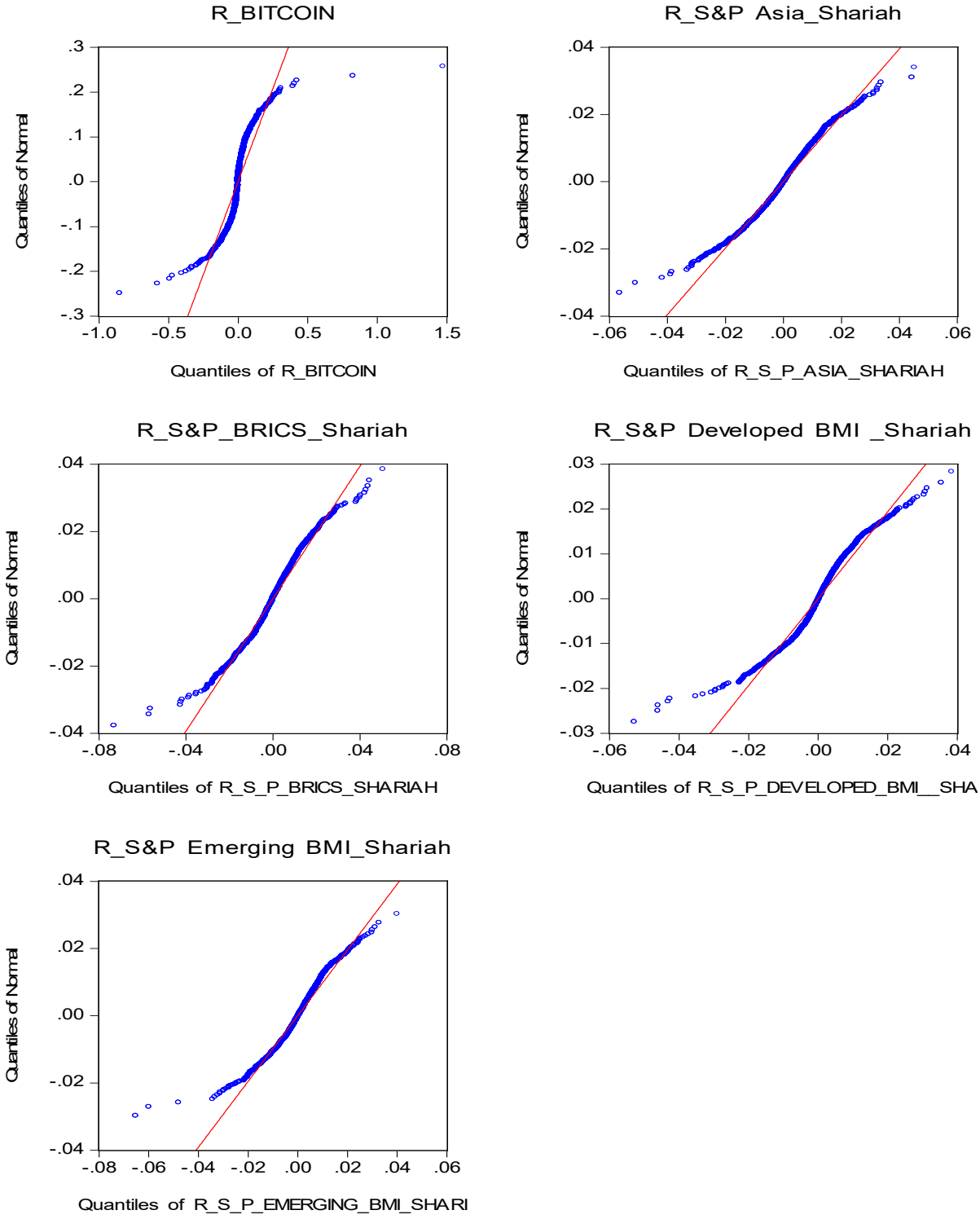


Figure 7. Q-Q plots of Index returns normally distributed for Islamic indices and Bitcoin



In this preliminary analysis we conclude that there is an alternation of periods between periods with high volatility and periods with low volatility. Knowing that when there are periods with great variations, there is a market more volatile. This phenomenon is known by “volatility clustering”. However, the duration of persistence is not the same. In other words, we can conclude the absence of constancy in the volatility of indices under study. Thus, the variance is not stable and varies with time. The preliminary analysis seems insufficient to effectively depict Bitcoin price behavior. Hence, the usefulness of component Garch model is that it differentiates between variation due to transitory effects and volatility owing to structural effects.

4. Empirical results

4.1. *Component GARCH (1,1) model results*

The Component Garch is better than several traditional Garch models as it allows differentiating between short-term and long-term volatility dynamics, i.e., between the temporary and permanent elements of volatility. This permits to see if the volatility of Shariah indices is dominantly due to transitory effects or structural problems.

We conclude from table 12 below that the reaction to shock ω for Islamic indices is lower than the Bitcoin. Thus the reaction velocity due to market perturbations is lower in the case of Islamic indices. The Arch component and the Garch component α and β respectively of the 4 Shariah indices and Bitcoin are positive and significant at 1 percent confidence level. Concerning the asymmetric C-Garch (1, 1) model, α and β are significant for all Islamic indices and Bitcoin under study at 1 percent confidence level. For Islamic indices and Bitcoin as well, we have high Arch effect α. However, the Component Garch effect for Islamic indices is lower than Bitcoin. The fluctuations of Bitcoin not only on the short –run but aloes in the long-run. Concerning the Garch effect, β for Islamic indices is lower than Bitcoin and (0.0491, 0.0501, 0.1294, 0.0629 and 0.18696 respectively). The lower β of Islamic indices includes a lower long-run persistence. This means that Islamic indices have high market reaction as same as Bitcoin but lower persistence than Bitcoin. Thus, if an unexpected shock happens in the stock market,

there is persistence of the fluctuations of Bitcoin not only on the short –run but also in the long-run.

Concerning the parameters of the component Garch (1,1) model, the sum of ARCH and GARCH (α+ β) reflects the volatility process as for all the indices. The sum of ARCH and GARCH (α+ β) reflects the volatility process as for all the indices. In general, α and β reflect the short term persistence and the long term persistence. Also, we show that the sum of ARCH and GARCH (α+ β) is superior to 1 showing that the volatility is highly persistent and that the conditional variance (σ^2) follows a long memory process. The duration of persistence of the four Shariah indices under study are 1.0376, 1.0342, 1.1067 and 1.0503 respectively versus 1.1869 for the Bitcoin index. That shows that the duration of persistence of the Islamic indices is generally high but less important than the case of Bitcoin where thus the shock of volatility is more persistent.

Concerning the transitory component Ø, the coefficients for all Islamic indices under study , S&P Asia Shariah, S&P BRCIS Shariah, are negative by around -0.0372, -0.0293, -0.05375, -0.0211 respectively . Theses coefficients are all significant at 1 percent confidence level for S&P Asia Shariah, S&P Developed Shariah, and S&P Emerging Shariah and Bitcoin except for S&P BRCIS Shariah which is insignificant. For Bitcoin Ø is positive by around 0.1107 and significant at 1 percent confidence level. Concerning the permanent component : q_t , it is negative and non-significant for S&P Asia Shariah and S&P Developed BMI Shariah , and S&P Emerging BMI Shariah by around -0.2361 -0.0478, and -0.1578 respectively. However, for S&P Developed BMI Shariah, it is negative but non-significant for by around -0.5240. For Bitcoin, it is positive and significant at 1 percent confidence level by around 0.8022. We can conclude from our results, that for Islamic indices, the transitory component is relatively negligent compared to Bitcoin. The results of the component models for S&P Developed BMI Shariah show that there exists permanent-transitory component decomposition with all parameters statistically significant. For the Bitcoin, we notice a positive and significant long-run volatility more important than the short-run. This means that the long-run volatility component is mainly affected by “shocks to

economic fundamentals (long-run volatility) rather than fluctuations in market sentiment (short-run volatility).

Table 12. The outputs of Component GARCH Model $(1,1)$

	Component GARCH Model (1,1)					
Islamic Indices	ω	α	β	$\alpha+\beta$	$\emptyset$	q_t
S&P Asia Shariah	$9.32e^{-05}$***	0.988492***	0.049098***	1.03759	-0.037228 **	-0.236070
S&P BRICS Shariah	0.000115***	0.983267***	0.050898 ***	1.034165	-0.029323	-0.047815
S&P Developed BMI Shariah	$7.24e^{-05}$***	0.977273***	0.129438***	1.106711	-0.05375***	-0.523978***
S&P Emerging BMI Shariah	$7.36e^{-05}$***	0.987451***	0.062890***	1.050341	-0.021291	-0.157786
Bitcoin	0.633191***	0.999912***	0.186956***	1.186868	0.110694***	0.802167***

Note: *** and ** denote statistical significance at 1 percent confidence level, 5 percent confidence level respectively..

Figure 8 below graphically depicts the conditional variance for Bitcoin and each of the Islamic Indices (S&P Asia Shariah, S&P BRICS Shariah, S&P DEVP Shariah and S&P EMER Shariah).

In the previous section, we conclude the existence of an asymmetric distribution of returns for all the indices under study. Accordingly, we rely on the regime –switching C-GARCH model wherein there is a variation of the conditional variance in time. This asymmetry leads to two regimes which are significantly different, the first one reflects the stable phase and the second one reflects the instable phase. The Markov Switching regime model is useful to well

describe and understand the characteristics of the change of regimes (as we said in the methodology).

Figure 8 reflects the conditional variance of Component GARCH (1, 1) model of all the indices under study. It can be noticed from Figure 5 that the permanent or structural effect is the most dominant for all Islamic Indices. It can be considered to follow the same trajectory of conditional variance. Islamic indices are deemed to be more affected by structural problems rather than conjectural problems. Meanwhile, Bitcoin is affected by both the permanent and transient effects simultaneously. Due to this, it is classified as speculative and volatile. In addition, we can see the conditional variance is not constant meaning that it is dependent on previous events.

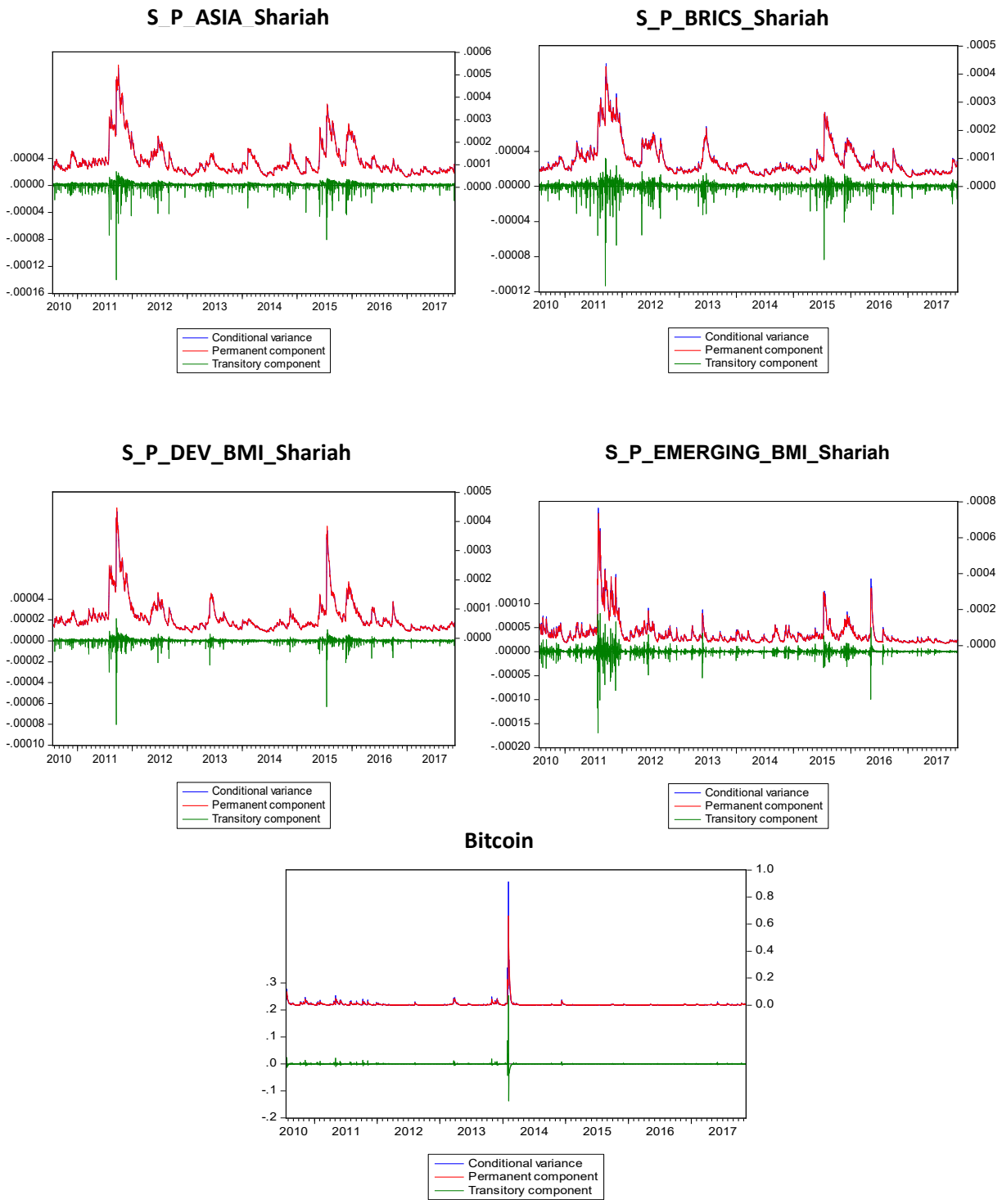
From 2010-2018, there is existence of fluctuations in the four Shariah indices and Bitcoin under study. For the four Shariah indices, it can be concluded that a fluctuation in volatility of the Islamic Indices and it can be said that there are two peaks that are illustrated clearly. The first peak is during the period the end of the year 2010 and July 2011. During the period under study, it can be noticed that the pace is at its highest. From an economic interpretation, it can be stated that the occurrence is attributed due to the effects of the 2009 financial crisis. The peak period is an indirect result due to the European debt crisis. During this period, a peak in the four Islamic indices is shown. It is also noticed that this increase in volatility of returns was temporary. A decrease also occurred at a later point in the case of all four indices. Between the two periods 2011 and 2012, this increase was proportional for the four indices. The S&P Asia Shariah, S&P BRICS Shariah and S&P DEVP Shariah Index witnessed the highest increase in volatility of returns. After 2012, a decrease in the level of volatility of returns starts to appear for the all indices. It can be stated that Standard`s and Poor`s Emerging Shariah is the most stable between the four Shariah indices. Fluctuation continues but at a lower rate until it increases significantly again in the beginning of 2015 in S&P_ASIA Shariah S&P BRICS Shariah indices and S&P_DEVP Shariah indices.

It can also be noticed that further fluctuations occur during the period between 2015 and 2016 but at a slower pace than the 2010-2011 peak. This peak can be due to the 2014 oil market crash. (This will be explained with more details in the following subsection).

Several studies have been conducted to determine whether Bitcoin acts as a diversifier, safe haven, or as a hedge against other commodities like oil price movement (Bououiyour and Selmi, 2017), energy and non-energy commodities (Bouri et al., 2017), stocks, bonds and SHIBOR (Wang et al. 2019). However, the trading of a financial asset varies in developed versus developing countries due to "lack of regulations, political instability, or an under-developed financial system". (Krause 2016, Krause M. 2016). Others like Blundell-Wignall (2014) and Urban (2017) argue that Bitcoin price behavior when economic and financial turmoil prevail.

From the Figure 8, it can be concluded overall that the Shariah indices has witnessed fluctuations but at a slower pace than that of Bitcoin. The fluctuations show that the Islamic market is not immune to external shocks. This rise in the relative volatility also occurred within relative intervals. The S& P Developing Shariah was the most volatile followed by BRICS and finally the Asian Shariah Index. In the case of Bitcoin, the volatility was lower until it eventually reached its highest fluctuation between 2016 and 2017. Shortly after that volatility collapses, this decrease seems relatively moderate.

Figure 8. Conditional variance of Component GARCH (1, 1)



4.2. Markov Switching regime results

In this section, we try to address if Bitcoin can act as a hedge, a safe have, and/ or a diversifier against price fluctuations of four Islamic stock indices (see methodology in the previous section). For an asset to be considered as a safe haven, Bow and Lucey (2010) along with Bow Mcdermott (2010) concluded that it should be uncorrelated or have a negative correlation with respect to another asset during periods of turbulence.

Table 13 below represents the estimated parameters of Markov Switching regime for the four Shariah indices and Bitcoin price index. In our study, we consider two switching states. Quite interesting results were drawn from the application of Markov-switching regime model.[33] The importance of this method is that it allows investors to comprise their portfolio in an efficient manner, whereby, it can allow them to identify the periods they can purchase and sell their financial assets. This is accomplished through the detection of stable and unstable periods of the financial market. If a period of stability occurs, it represents low volatility which leads to the willingness of investors to invest. If the period is unstable or if there is a crisis in the period, there is high volatility which exposes investors to risky assets. This leads to unwillingness to invest.

In our study, we clearly show that the relationship between Bitcoin and each of S&P Asia Shariah, S&P BRICS Shariah, Shariah and S&P Emerging BMI Shariah is non-significant in periods of low volatility (Regime 1). This implies that Bitcoin serves as a hedge for the 3 Shariah stock market under this market scenario. Bitcoin acts also as a safe haven for the 3 Shariah investors in times of ongoing volatility (Regime 2). Concerning the relationship Bitcoin and S&P Developed BMI Shariah, for regime 1, there is a negative but significant relationship between the two assets. That means that the Bitcoin serves also as a hedge for S&P Developed BMI

[33] *Where, Y_t represents the dependent variable, c_{St} is the constant where St varies from 1,2….to K^N. K represents the number of states which is considered to be finite in this case (in particular two states dubbed low and high volatility states). N represents the number of observations. Here, St is defined for each t. Knowing that St_1 and St_2 ret regime 1 and regime 2 respectively, and σ_t corresponds to the standard deviation. For all models, the errors are assumed to be independently distributed with respect to all past and future realizations of the state variable.*

Shariah stock market. However, for regime 2, the relationship is negative and non-significant so Bitcoin serves a safe haven for S&P Developed BMI Shariah investors. We confirm therefore the hedging and safe haven abilities of Bitcoin against during normal time and anxiety market moments in Islamic stock indices. The ability of an asset to be safe haven during bearish market, recompenses the investor for losses that may occur if the price of the other assets decrease.

Table 13. Estimated parameters for each time series Shariah indices and Bitcoin

Variables	Coefficients	Sdt. Error	Z-statistic	Prob.
S&P Asia Shariah				
Regime 1				
R_ Bitcoin	**0.020298**	0.017033	1.191673	0.2334
C	-0.025211	0.002337	-10.78893	0.0000
P11-C	-0.865562	0.448231	-1.931061	0.0535
Regime 2				
R_ Bitcoin	**-0.003937**	0.002695	-1.460967	0.1440
C	0.001041	0.000229	4.539838	0.0000
P21-C	-4.100750	0.316327	-12.96363	0.0000
Log (Sigma)	-4.728253	0.019533	-242.0632	0.0000
S&P BRICS Shariah				
Regime 1				
R_ Bitcoin	**-0.000663**	0.003000	-0.220924	0.8252
C	0.001131	0.000302	3.741248	0.0002
P11-C	3.997071	0.388073	10.29979	0.0000
Regime 2				
R_ Bitcoin	**0.003860**	0.004151	0.929756	0.3525
C	-0.024681	0.003323	-7.426397	0.0000
P21-C	0.286830	0.418357	0.685610	0.4930
Log (Sigma)	-4.597231	0.021685	-212.0026	0.0000
S&P Developed BMI Shariah				
Regime 1				
R_ Bitcoin	**-0.042475**	0.016956	-2.505032	0.0122
C	-0.026383	0.002068	-12.75692	0.0000
P11-C	-0.641859	0.394523	-1.626924	0.1038
Regime 2				
R_ Bitcoin	**0.001601**	0.001781	0.898779	0.3688
C	0.000852	0.000176	4.848666	0.0000
P21-C	-4.463500	0.316362	-14.10884	0.0000
Log (Sigma)	-4.926115	0.018339	-268.6071	0.0000

S&P Emerging BMI Shariah				
Regime1				
R_ Bitcoin	**0.011368**	0.011658	0.975099	0.3295
C	-0.021584	0.002202	-9.801985	0.0000
P21-C	-0.414576	0.328698	-1.261268	0.2072
Regime 2				
R_ Bitcoin	**-0.002281**	0.002402	-0.949600	0.3423
C	0.000905	0.000215	4.204905	0.0000
P11-C	-3.973324	0.323652	-12.27654	0.0000
Log (Sigma)	-4.856377	0.020699	-234.6163	0.0000

Figure 9 reports the switching between high (red color) and low (blue color) probabilities regime. We clearly note that the probability of staying at high and low risk regime varies over time and are heterogeneous depending on the Shariah stock market under study.

For the correlation between Asia S_P_ASIA_Shariah and Bitcoin, it can be noted that the probability (P11) of staying at regime 1 (low risk regime) is more consistent over time while the high probability is pronounced at specific period. The transition probabilities of remaining at regime 1 and Regime 2 (P11 and P21) reached approximately 1 and 0.4--0.5 respectively for various periods. It can be noticed between 2010 and 2011 that the probability of staying at regime 1 persists. However, in 2011 and 2012 respectively, there is a sharp switch among the probabilities of staying at regime 1 and regime 2. In 2013, there is also a switch but less important than it is in 2011. Between 2013 and 2016, the probability of staying at regime 1 persists.

Concerning the correlation between S_P_BRICS_Shariah and Bitcoin , it can be noted that the probability (P21) of staying at regime 2 (high risk regime) is more consistent over time while the probability (P11) of staying at regime 1 (low risk regime) is less important. It can be noticed that in 2011, 2015 and 2016, the probability of staying at regime 2 persists.

For the correlation between S_P_DEV_BMI_Shariah and Bitcoin, it can be seen that the probability (P21) at staying in regime 2 is more consistent especially for the periods 2011, 2015 and 2016.

For the correlation between S_P_EMERGING_BMI_Shariah and Bitcoin, the Probability (P11) of staying at regime 1 is more consistent over time. The transition probabilities of remaining at regime 1 and Regime 2 (P11 and P21) reached approximately 1 and 0.4-0.5 respectively for the periods 2011, 2015 and 2016.

The probabilities in Figure 9 indicate that it is close to zero. The peaks in 2011, 2015 and 2016 are signified by the" vertical solid dashed lines". In this context, we should note that during the period between 2010 and 2018, this result was not surprising due to the considerable geopolitical and economic events that have occurred during that period.

In the last period and in particular after the financial crisis of 2008-2009, fluctuations and volatility in oil prices occurred. This led to investors' interest in alternative finance due to the fact that Islamic financial market was more resilient in 2008 Narayan, Phan and Sharma (2019).

Many studies have been conducted to analyze the relationship between oil prices and stock market in general and Islamic stock market in particular. According to Hussein et al. (2013), Islamic stock prices and oil prices have a bi-directional causality In Malaysia; only the variance in oil prices will affect Islamic stock return in the short run. It should be noted that the effect oil prices are related to the situation in a specific country as an importer or exporter of oil. Through the review of literature, OPEC countries are connected with Islamic indices as in the case of GCC countries. Any shock or crisis in these countries will be contagious to all GCC countries and later to the rest of the world. A few studies (e.g. Badeeb and Lean (2018), Shahzad et al. (2018) have analyzed the relationship between the volatility of oil prices and the Islamic stock market. When discussing the oil stock Nexus, it should be highlighted that the nature of the country as an importer or exporter should consider several macro-economic variables. These include economic inflation, rate of economic growth, interest rates, and trust of investors from oil shocks.

From these macro-economic factors which greatly influence oil prices and thus affect supply and demand and causes fluctuation or economic volatility. This volatility in oil prices can

leads to a decrease in risk premiums which negatively affect stock returns. However, an increase in oil prices leads to an increase in economic inflation which leads to interest rate hikes and thus an increase in return on stocks. In the case of either a negative or positive relationship between Islamic stock markets and oil prices and is dependent on the specific country, affects the financial market. Due to this, a "un-justifigative" behavior occurs. However, investors are affected by negative shocks more than they are affected by positive shocks in oil prices (e.g. Atil, Lahiani and Nguyen (2014).When a decrease in oil prices occurs, lower demand for the Islamic stock market occurs. Therefore, investors seek alternative assets and this leads to greater demand for Bitcoin. For exporting countries, a rise in oil prices leads to a rise in demand for Islamic stock markets and thus lower demand for Bitcoin which labels this as a positive relationship (e.g. Jimenez-Rodriguez and Sanchez (2005). For importing countries a rise in oil prices in an "inconsistent direction with oil shock Nexus" (e.g.Badeeb and Lean (2018). However, others have stated that this relationship can be negative (e.g. Arouri and Nugyan (2011), Le Blanc and Chinn (2004).

Therefore, it can be stated that the effect of oil prices on Islamic stock markets is obvious regardless on the situation or nature of the country for both developed and developing countries. This relationship is positive when markets, the oil market and the Islamic stock market are in the same bearish state or bullish state. However, the relationship is negative in the case where one of them is in a bearish state and the other is in a different state. Therefore, when oil prices decrease, investors shouldn't invest in Islamic indices.

Bitcoin is considered as an alternative tool after 2009. Recent changes have occurred recently such as the European Debt Crisis in 2011 and the Cyprus banking crisis in 2013 and shock oil prices in 2014 and Brexit in 2016, turbulence in the Chinese stock market between 2015 and 2016, demonetization in India in 2016.

We should note that 2013 is the year when Bitcoin was markedly. After two weeks of the Cyprus Banking crisis happened in March 2013, the new digital currency was getting bigger. Due to the fears from the banking crises, the trading value of the online currency was

increasing sharply opening the door to the world of digital cash. Traders and consumers were worried of the “deposit taxes” especially in Spain and Greece. What makes this crptocurrency more attractive is the network which it appears on. This network is similar to the capital markets (as we said in the state of art). What is certain from our analysis is that people were looking for a new form of currency whereby they can benefit from the expulsion of their money away their home countries. Due to the expansion of this phenomenon, many consider this process as an “alternative liquidity vehicle”. Likewise, studies have been conducted to determine whether Bitcoin acts as a diversifier, safe haven, or as a hedge. However, the trading of a financial asset varies in developed versus developing countries due to “lack of regulations, political instability, or an under-developed financial system”. (Krause 2016, Krause M. 2016). Research done on the subject reveals that Bitcoin generally acts as a hedge and diversifier for different financial assets and commodities.

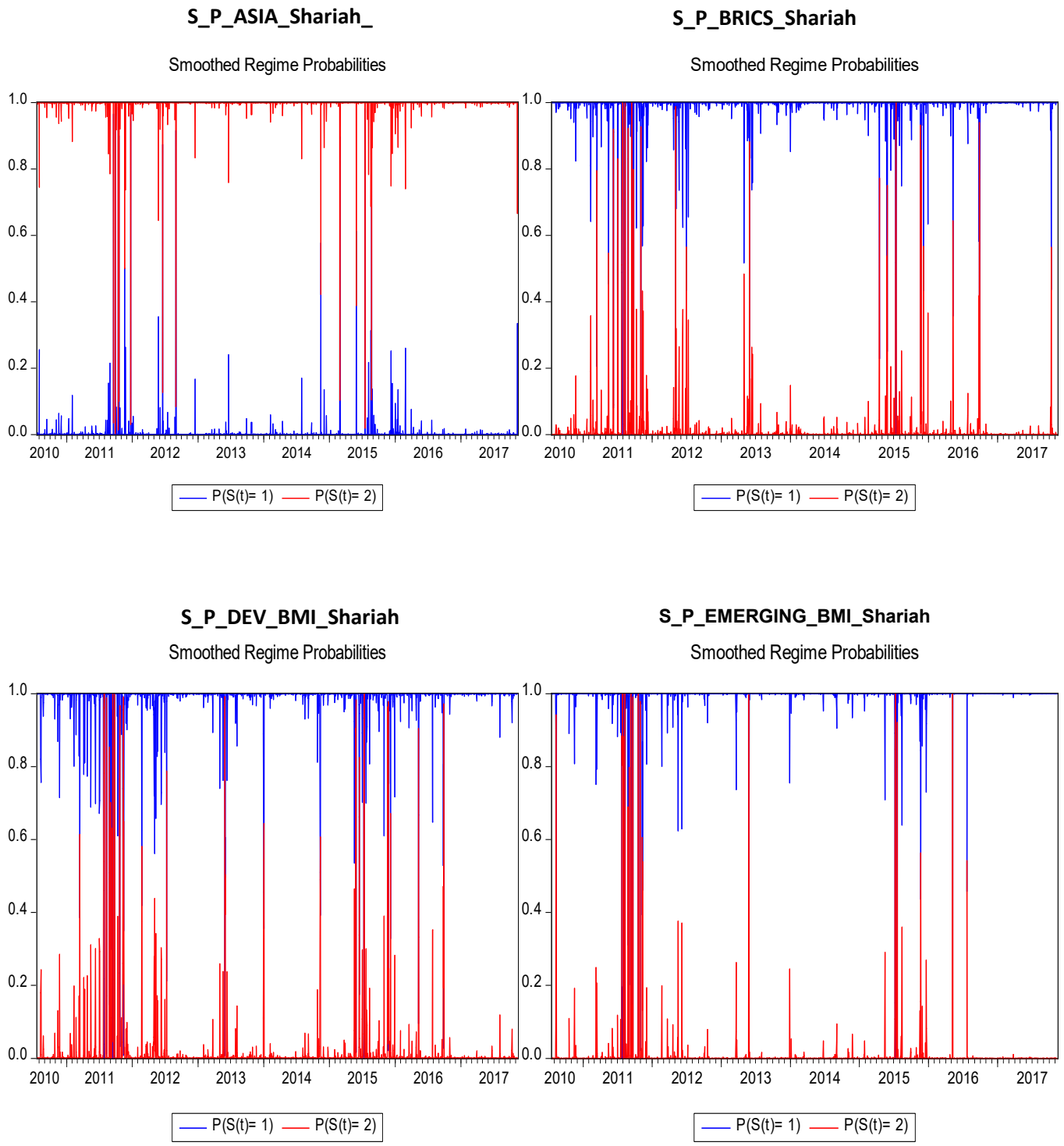
Moreover, after a decision by the European Central Bank to not extend emergency funding to Greece, banks in Greece closed and cash withdrawals were restricted by Greek authorities. This ultimately led to a fall in stocks in Europe and the US. Between June 2015 and early February 2016, a “turbulence” in the Chinese stock market had occurred which led to a one-third drop of A-shares on the Shanghai Stock Market. In the Shanghai stock market a decrease of 13% was witnessed in the stock market value which led to a depreciation of the Yuan against the USD. Therefore, demand on Bitcoin increased. At that time, there were pessimistic predictions in the view of the public. This led to the establishment of Bitcoin as a safe haven and was considered as an investment vehicle during periods of instability.

Demonetization in India in 2016 also occurred with an aim of combatting corruption and crime. Demonetization led to the withdrawal of the rupee from markets from circulation and was instead replaced 500 and 1000 banknotes. During this period, a lack of trust in monetary notes circulation which led to a contraction in money supply. Additionally, it positively influenced inflation due to the restrictions placed on cash in India. Taking into consideration that Bitcoin was not yet legally recognized by the Central Bank of India, it was still considered as

an alternative to the Indian Rupee. This lack of trust in the currency was due to its lack of demand in the local market in comparison to foreign currencies.

4.3. Robustness checks.

Figure 9. Smoothed Regime Probabilities for Bitcoin and Islamic indices



4.3.1. Volatility

In order to test the stability of the results, we propose to carry out two robustness tests. Tables 14 and 15 below represent the extension of Garch family models; Garch (1, 1)[34], the asymmetric Threshold Garch (1, 1)[35] models.

Concerning the symmetric Garch (1,1) model, α and β are the principal components. , α and β are significant for all Islamic indices and Bitcoin at 1 percent confidence level but no significant for all Islamic indices under study. For Islamic indices, we have lower α and higher β than Bitcoin. This means that Islamic indices have lower market reaction and higher persistence respectively than Bitcoin. Thus, if an unexpected shock happens in the stock market, there is persistence of the volatility not only on the short-run but aloes in the long-run. The sum of ARCH and GARCH (α+ β) reflects the volatility process as for all the indices. In general, α and β reflect the short term persistence and the long term persistence. The sum α+ β < 1, α ≥ 0, β ≥ 0, $0 < \omega_0 < \infty$. These are considered as conditions of covariance stationarity in order for the conditional variance to be positive. We conclude from table 14 below that the volatility process of the 4 Shariah indices (S&P Asia Shariah, S&P BRICS Shariah , S&P DEVP Shariah and S&P Emerging BMI Shariah) follows a long memory process (α+ β <1). For Islamic Indices, the sum of (α+ β) is <1 which reflects the stationarity of conditional volatility. They also have a great

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[34] **The Symmetric GARCH Model**
The GARCH model therefore is determined to be a good indicator of the behavior of returns on daily indices due to the fact that it portrays the time dependence of an index return`s volatility.

$$\sigma_t{}^2 = \omega_0 + \sum_{i=1}^{q} \alpha_i \, \varepsilon_{t-1}^2 + \sum_{j=1}^{p} \beta_j \, \sigma_{t-1}{}^2$$

$Where, \sigma^2: the\ conditional\ variance$
$\omega_0 > 0$
$\alpha_i \geq 0$
$\beta_j \geq 0$

[35] The threshold GARCH (TGARCH model) is asymmetric model. This model was introduced by Zakoian in 1994. It can be represented as follows:

$Where, \sigma_t^2 = \omega_0 + \sum_i^q \alpha_i \, \varepsilon_{t-1}^2 + \boldsymbol{\gamma_i \, \varepsilon_{t-1}^2} T_{t-1} + \sum_{t-1}^q \beta_j \sigma_{t-1}^2,$
$\boldsymbol{\gamma_i}$: *leverage parameter*
$T_{t-1} = \begin{cases} 1\ if\ r_{t-1} < 0, bad\ news \\ 0\ if\ r_{t-1} \geq 0, good\ news' \end{cases}$
$r_t = \sigma \varepsilon_t$

duration of persistence of conditional volatility for the 4 Shariah indices of 0.9895, 0.9858, 0.9889 and 0.9808 respectively. Based on the results, the variation of conditional variance is determined to be persistent and reveals the absence of excessive volatility in conditional variance of the 4 Shariah indices. On the other side, for Bitcoin, the sum ($\alpha + \beta > 1$) reflects an explosive behavior. Basing on the result above, ($\alpha + \beta$) is equal to 1.0325. The results show us that the Bitcoin is more volatile that Islamic indices under study.

In the asymmetric TGARCH (1,1) model in table 15 below, α and β are significant for all Islamic indices and Bitcoin. In TGarch (1,1) model, good news are represented by $\varepsilon_t(t-1) < 0$, while bad newsare represented by $\varepsilon_{t-1} > 0$. It is analyzed as to whether there is a leverage effect or not through the hypothesis which states that if $\gamma > 0$ is larger than zero, a leverage effect exists. However, if $\gamma \neq 0$, there are "asymmetric" impacts. Knowing that good news and bad news both have an effect on conditional variance. Bad news generally causes greater volatility than good news. Concerning the four Shariah indices, γ is positive and significant at 1 percent confidence level reflecting good news which leads to the existence of a leverage effect. That means that the volatility is more influenced by good chocs than bad chocs. In the case of Bitcoin, the leverage effect γ is negative and non-significant at 1 percent confidence level which suggests that it has an inverse relationship with the results from the Islamic indices. It said to be affected by bad news without having a leverage effect. In addition to that, the duration of persistence of TGrach models is equal to $\alpha + \beta + 0.5\gamma$. This duration of persistence is higher Bitcoin than Islamic indices under study. That means that the Bitcoin is more volatile than Islamic indices under study.

Table 14. The outputs of Garch (1,1) model

	Garch Model (1,1)			
Islamic Indices	ω_0	α	β	α+ β
S&P Asia Shariah	$9.70735e^{-07}$***	0.04616***	0.94328***	0.98945
S&P BRICS Shariah	$1.65349e^{-06}$***	0.04625***	0.93922***	0.98575
S&P Developed BMI Shariah	$8.09304e^{-07}$***	0.059105***	0.92982***	0.98893
S&P Emerging BMI Shariah	$1.51004e^{-07}$***	0.12933***	0.85144***	0.98078
Bitcoin	$6.90e^{-05}$***	0.26058***	0.77194***	1.032539

Note: *** denote statistical significance at 1 percent confidence level

Table 15. The outputs of TGarch (1,1) model

	Threshold Garch (1, 1)				
Islamic Indices	ω_0	α	β	γ	$\alpha+\beta+0.5\gamma$"
S&P Asia Shariah	$1.34287e^{-06}$	-0.02056***	0.95785***	+0.09121***	0.93705
S&P BRICS Shariah	$1.73124e^{-06}$***	-0.01637***	0.96135***	+0.07617***	0.98307
S&P Developed BMI Shariah	$8.08975e^{-07}$***	-0.01986***	0.95784***	+0.09359***	0.98478
S&P Emerging BMI Shariah	$1.80276e^{-06}$***	0.01690	0.85499***	+0.20269***	0.97037
Bitcoin	$6.87e^{-05}$***	0.2639***	0.7724***	-0.0076	1.03264

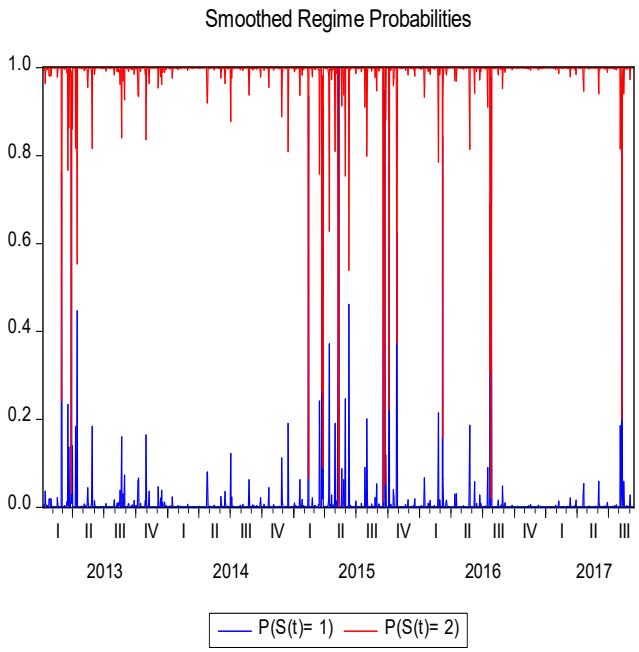
Note: *** denote statistical significance at 1 percent confidence level

4.3.2. Relationship between Bitcoin and Islamic stock market indices for a restricted period

Figure 10 below represents the switching between high (red color) and low (blue color) smoothed regime probabilities for a restricted period ranging from March 2013 until January 2018. For the correlation between Asia S_P_ASIA_Shariah and Bitcoin, it can be noted that the probability (P11) of staying at regime 1 (low risk regime) is more consistent over time while the high probability is pronounced at specific period. The transition probabilities of remaining at regime 1 and Regime 2 (P11 and P21) for various periods. Concerning the correlation between on one hand S_P_BRICS_Shariah and Bitcoin , and S_P_DEV_BMI_Shariah and Bitcoin on the other hand, it can be noted that the probability (P11) of staying at regime 1 (low risk regime) is more consistent over time while the probability (P21) of staying at regime 2 (lhigh risk regime) is less important. It can be noticed that in 2011, 2015 and 2016, the probability of staying at regime 2 persists. The results of Figure 10 slightly change but the fundamental results are still robust. We note that there are some changes in the shift from regime 1 to regime 2 but what still robust is the fact that switching between high and smoothed regime probabilities remains pronounced for the restricted period highlighting the vulnerability of Bitcoin to sudden events. For the correlation between S_P_EMERGING_BMI_Shariah and Bitcoin, the Probability (P11) of staying at regime 1 is more consistent over time

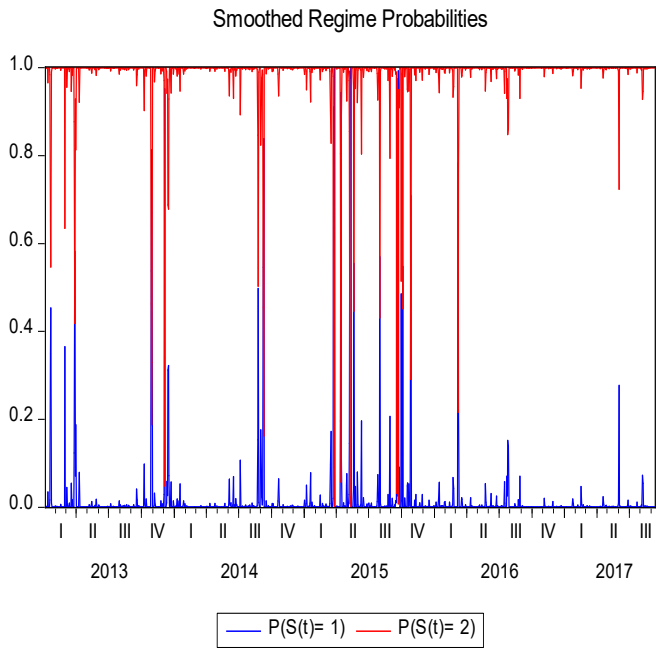
Figure 10. Smoothed Regime Probabilities

S_P_ASIA_Shariah

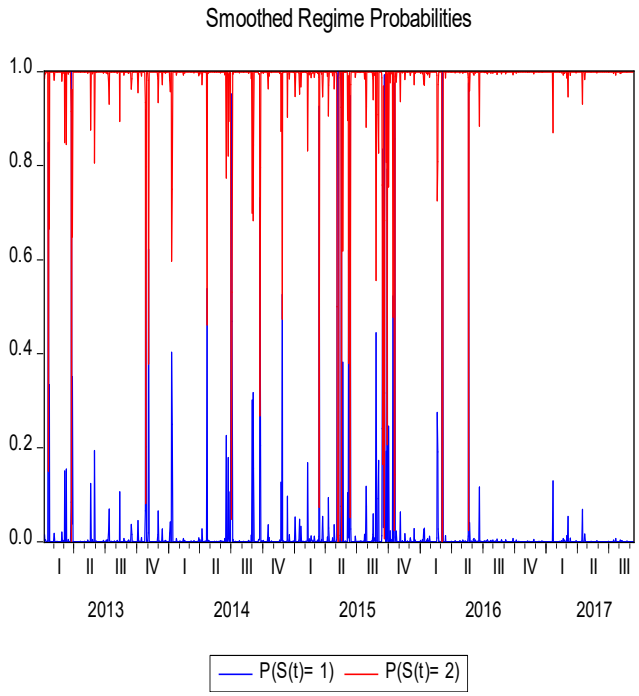


2.

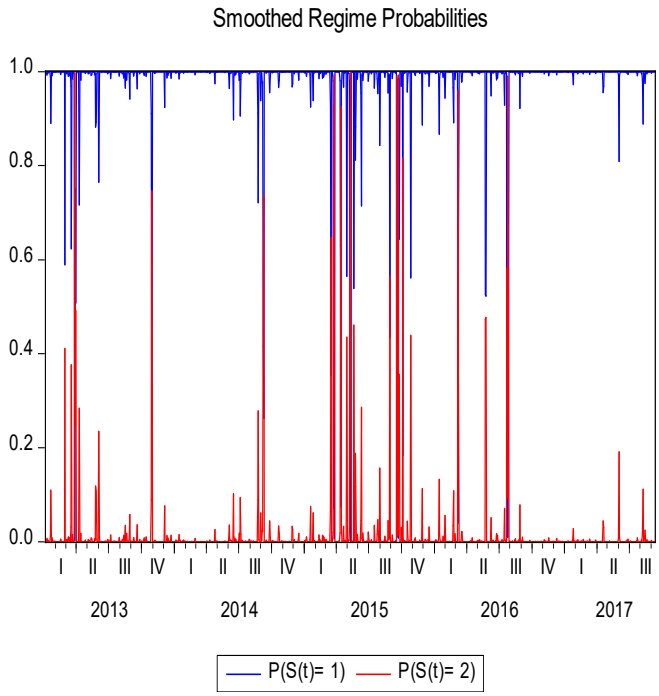
S_P_BRICS_Shariah



S_P_DEV_BMI_Shariah



S_P_EMERGING_BMI_Shariah



5. Conclusion

Various banks and financial institutions in the Islamic world use block-chain technology and cryptocurrency. This study seeks to help investors construct an efficient portfolio which would allow a minimization of risks and a rise in returns.

Throughout this analysis, we use the component GARCH model which considers the long run volatility and the Markov Switching model which deliberates the characteristics of the change of regimes. Empirical results can show that two and the high volatility regime. According to Markov-Switching regime results, we conclude that, Bitcoin serves as a hedge for each S_P_ASIA_Shariah, S&P BRICS Shariah, Shariah, S_P_DEV_BMI_Shariah and S&P Emerging BMI Shariah on Regime but as a safe haven in Regime 2. The probability of staying at Regime 1 is more consistent for S_P_ASIA_Shariah and S&P Emerging BMI Shariah. The probability of staying at regime 2 is more consistent for, S&P BRICS Shariah and S_P_DEV_BMI_Shariah. The probability especially persists during the periods 2011 and between 2015 and 2016. The results reported are in agreement with those of previous studies in which they re-affirm that in the last two decades, the high volatility regimes are due to the two major political and economic events. These results are still fairly robust to different sensitivity tests.

It is shown that Bitcoin can be utilized as a strong safe haven during high risk regime and as a hedge during low low risk regime using empirical findings. This holds valid for all the Islamic stock markets under study. Islamic investors should therefore include Bitcoin as part of their stock portfolio to limit risks and to obtain extreme profits. The development of Fintech[36] for Islamic finance is still in its early stages; however its future is promising.[37]

The "Fin Tech" revolution is therefore necessary to achieve the strategic objectives of Islamic banks which is to improve their competitiveness through commercial banks, to consolidate capital and to develop products and services of Islamic finance. Since “Fin Tech”

[36] When it comes to "Fin Tech" innovation, this expression combines the terms finance and technology and refers to an innovative "start-up" that uses technology to innovate financial and banking services.

[37] There were approximately 120 firms that are involved in the Islamic Fintech sector.

innovation has a positive effect on the costs of financial services, any lack of this technology will weaken the position of Islamic banks vis-à-vis conventional banks.

While this is something all banks must deal with, the issue is critical for Islamic financial institutions. To understand why, you first must learn some of the main principles guiding Islamic banking. Bitcoin conforms to principles of Islamic finance, particularly being free from the effect of riba (i.e., interest), includes the principles of Maslaha (i.e., social benefits of positive externalities), and Mudharabah (i.e., mutual risk-sharing). Moreover, and with respect Bitcoin's legal status as 'money' in Islam, religious scholars did not proclaim it as unallowable, but heavily cautioned against its volatile attitude. This underscores that investors on Islamic indices should be mindful that Bitcoin faces several obstacles. The huge volatility, the speculation and the multiple unknowns involved around the development of this digital currency forestalls it from being regarded as a complete hedge and a well-established safe haven and diversifier asset.

Summing up, the results underline the risk reduction effectiveness of Bitcoin when added to the Islamic stock portfolio either for developed or emerging countries. In other words, our findings suggest that cryptocurrencies and Islamic equities can co-exist as refugee assets, and then it is prominent to look at them as complements that diversify each other's portfolios rather than substitutes. An advantage Bitcoin is that its supply level is fixed and transparent–avoiding the anxiety over the inflationary pressures associated with overproduction that could lessen the value of the asset. Bitcoin can be regarded as a safe haven asset in times of extreme market downturns and also can be chosen as a good diversifier. The extremely volatile and the speculative behavior of Bitcoin may allow investors to earn supernormal returns in a very short time span. But investors should be mindful that scandals are rampant in the Bitcoin ecosystem. Bitcoin is an entirely speculative asset, a characteristic that may be taken against Bitcoin, and as being a medium of exchange and store of value. In short, the excessive volatility, the speculation and the multiple unknowns involved in the development of this cryptocurrency forestalls it from being viewed as a well-established hedge, safe haven and diversifier asset. A further challenge facing the future of Bitcoin as a diversifier rely on regulatory changes. Even

though the legal status of Bitcoin is still changing from one country to another, Bitcoin futures can be traded on regulated exchanges. The introduction of futures would help tilt the scale a bit in the direction of Bitcoin. It would limit the risks associated to Bitcoin's lack of regulation. The Commodity Futures Trading Commission introduced specific rules for all speculators and investors in the futures contracts. This would undoubtedly attract professional traders and then improve the trading volume in the market. An increase of the trading volume is a very good news for Bitcoin traders and investors since it would establish the cryptocurrency futures as a significant financial instrument, and hence Bitcoin itself. The effect of the launch of Bitcoin futures on asset allocation and diversification strategies might prove an important area for future research.

Chapter four: Islamic and Sustainable Finance: Complements or Substitutes?

ABSTRACT

This paper seeks to analyze the notion of “doing well while doing good” through examining the performance of Islamic, sustainability indices by investigating the interaction between the returns in three sustainable stock market versus their Islamic counterparts. We will use the autoregressive distributed lag (ARDL) and daily time series data to investigate the long-run equilibrium. Understanding the type this relationship allows us to detect that the DJS and DJI stock market under study are complements mainly on the short term and substitutes on the long-term. Moreover, the direction of causality will be examined through the application of frequency domain Granger of Breitung and Candelon (2006). The results show the existence of a bidirectional causal relationship between Islamic and Sustainable stock market under study. The results appear robust.

1. Introduction

Nowadays, the concept of sustainability[38] has become very important in the global agenda. Investment decision-making process is becoming more reliant on the magical square that takes into consideration four factors: "liquidity, risk, return, and sustainability". Nowadays, investors tend to invest in sustainable projects by integrating ESG (ethical, social and environmental) in to the investment process criteria while making a decision. Thus, institutional investors base their investment decisions on personal value and as a result are convinced to make reasonable profits by protecting people and the planet as well.[39]

[38] According to Brundtland (1987), sustainability means responding to the needs of present generation without hindering future generations from meeting their own needs as well. Sustainability in business means the ability to persist to an efficient social and environmental system. To put it in another way, a business can be robust due to the existence of a sustainable organism.

[39] Adopting an environmentally-friendly approach can be a good example in primary and secondary sectors such as the meat industry (that causes deforestation) and the fashion industry that work in unsustainable way. This global vision can limit the exploitation of resources and reflect a good image of the enterprise.

In this context, there are typical terms used to describe alternative investment such as ethical investment, socially responsible investment (SRI), or "value-based investment". According to Sparkes (2011), SRI is the most technical expression used to describe standard alternative finance. Accordingly, Sandberg et al. (2009) define SRI as "*the integration of certain non-financial concerns, such as ethical, social and environmental in to the investment process*". Alternative finance based on ethical principles has always existed. By relying on social, religious and ethical principles, SRI tends to integrate enterprises into socioeconomic projects. Moreover, repairing financial ethics, moralizing market behavior and improving social corporate responsibility are the most moral issues to put into consideration. Consideration of environmental, social and governance issues such as climate change and firms' pollution, human rights and conflict risk have been increasing the global concern over Green Finance and pushing up community and social ideologies. According to the US SIF Foundation, the amount of SRI assets invested by being based on environmental, social and governance standards attend about USD 7, 791 billion, USD 7, 778 billion and USD 7, 695 billion respectively in 2016.

In this context, it is also important to note that, the principle on which the Islamic financial system is based on is the minimization of the evils that oppose not only economic but also social Islamic norms within a community such as poverty, socio-economic injustice, distribution equitable wealth, economic instability, etc. Moreover, the adoption of a cooperative program based on the principle of joint effort allows parties to benefit from them by figuring out the action of the company's business. Thus, theoretically, the concept of Islamic finance is based on the concept of equilibrium between profit and assuring the well-being of the community. This concept took its origin from the monotheistic religions. Thus, in addition to the main fundamentals of Islam, adopting a meaningful philosophy organizing “responsible collective action” is the bridge between Islamic finance and socially responsible investment. Under those circumstances, Islamic investment and social responsible investment are similar in the sense that they both are based on ethical value. They consider the standards and values in making decisions. Despite this strong philosophical proximity, studies still limited in order to recognize the “complimentary features” of these two types of ethical finance.

The performance of ethical funds in comparison to conventional funds was the focus of analysis in many studies in the following decades (Luther et.al 1992), (Hamilton et. al 1993), (Gregory et. al 1997), (Bauer et. al 2005). In this context, Hakim and Rashidian (2004a), by comparing an Islamic index with a world index and sustainable index, conclude that Islamic portfolio (Dow Jones Islamic Market index) under study is characterized by a "relative lower Beta". This means that Islamic portfolio is characterized by "lower risk and higher Sharpe ratio than other indices under study. Hakim and Rashidian (2004b) verified later that investing in Islamic stocks does not cause additional financial costs compared to sustainable stocks. Accordingly, they concluded from their studies that the performance of Islamic indices is not necessarily dependent to the investment in illegal activities. Investors who are concerned with "hallal" activities can feel secured as investment in this kind of activities can be highly characterized by a moderate profitability/risk profile.

Forte and Miglietta (2011) have attempted to study the relationship between Islamic indices and sustainable indices. From their study, they have attempted to integrate Islamic indices given that it is categorized under SRI`s. They have tried to understand the characteristics of these indices and to classify them. From this study, they concluded that the SRI and sustainable and Islamic portfolios differ from each other. The first difference is "in terms of countries and sectors". It was also discovered that through a "process of stochastic trend", these two indices cannot be compared given that they are "not co-integrated".

Abbes and Trichilli (2015) study the existence of long and short term "integration dynamic" among twenties of developed and developing Islamic market. They discovered the "existence of long-term relationship" of Indices of regions from the same economic situation. However, they discovered a "short-run relationship" and "partially integrated" of Islamic indices from different economic situations. Moreover, they concluded that Islamic stocks may be more secured during economic crises. Thus, Islamic stocks may provide diversification benefits for investors' portfolios.

Azmi et al. (2019) prove the possibility to invest in ethical equity indices without necessarily occurring additional financial costs or loose in profits. They do a comparative study

by integrating Islamic and sustainable indices from one side and conventional counterpart from another side. They rely on Dow Jones database to roll on the study. The main results show that sustainable indices during turbulence or financial crisis as well as during economic expansion show higher Sharpe ration than its conventional counterpart. Moreover, they discovered that few elements can determine the performance of the sustainable equity index under study such as the market itself, and "size premiums". It was also proven that the ethical indices can be more efficient but showing similar volatility to conventional equity index. Accordingly, investors can diversify their portfolios so they can have "safe haven options" during period of crises or depression.

Very limited empirical work has been done on the relationship between socially responsible investment and Islamic finance in general and sustainable and Islamic indices in specific. Many questions still surround the relationship existing with limited studies to address them. However, many of them focus on studies related to investment in religious patterns such as Islamic Investment. Many of these studies consider the investment in Islamic indices in the narrow sense is simply considered as a "proxy investment" of ethical indices in the general sense.

Our study is beneficial mainly for investors who are concerned with many non-financial factors such as religious belief, sustainability, the well-being of society, which consider environmental issues, corporate governance[40] and ethical factors. In addition to investors who chose to diversify their portfolio to minimize risk. Grossman and Sharpe (1986) analyzed firstly the performance between ethically screen portfolios along with the link and ethical concerns between financial indices.

[40] Corporate governance: The way in which a corporation is directed and controlled is referred to as "corporate governance (cadbury report, 2012)". The Organization for Economic Corporation and Development defines it in the same way. The structure of corporate governance establishes the basis on which rights and responsibilities are distributed amongst board members, shareholders, and managers. It also specifies rules and the manner in which decisions are made on corporate affairs.

We apply in our study daily data covering the period from January 21, 2011 till March 03, 2018 for a total of 1860 returns for sustainable and Islamic indices under study (table 5, Appendix). The three main indices of Dow and Jones are, namely DJS_US40, DJI_US, DJS_EUROPE and DJI_EUROPE, DJS_ASIA_PACIFIC and DJI_ASIA_PACIFIC. The selection of the three indices and the period under study is due to the availability of data. We are working on a family of Dow and Jones indices because the access to the data is readily available in comparison to other indices which had limited data. This analysis was dependent on the longest possible period based on data availability. This data allowed us to get a clear idea on the indices under study along with the statistics. This idea has provided a clear image on the economic cycles which had occurred after the 2008-2009 financial crisis and the oil crisis which occurred in 2014. We have attempted throughout this study to consider the statistics tables and attempted to proceed with an economic interpretation.

The interaction between the returns in stock prices in both the long and short-run are investigated in this paper. In order to estimate the co-integration and short and long run relationship, the autoregressive distributed lag (ARDL) is used in this study. The perception of investors' can directly impact the revision of portfolios or investments which will cause an immediate change in financial market prices. The long-run equilibrium will be investigated through the application of the ARDL model in order to analyze the joint movements and the relationship between the returns. The validation of this relationship is by allowing us to examine the hypothesizes whether the DJS and DJI under study are complementary or substitute that diversify each other's portfolios.

However, the direction of causality cannot be identified using those methods. In a series, if proof of co integration can't be confirmed, the causality can be investigated by using the difference variable under the restricted VAR environment. Moreover, the direction of causality will be investigated through the application of frequency domain Granger causality which was refined by Geweke (1982) and implemented by Breitung and Candelon (2006) in order to study the dynamic relations between Dow Jones sustainable and Islamic stock prices. The importance of the use of Frequency Domain Causality is to well understand and to capture

the “dynamic relation” among sustainable stock market and Islamic stock market in country under study. The use of this technique which is based on the concept of time-varying would allow us to robustly and properly analyze the relationship between Islamic stock market and their sustainable counterparts. Moreover, this study is original as for our knowledge it is the first that studies the unconditional and conditional causality relationship between our ethical indices. Thus, by integrating VIX to the study as a constraint, we will be able to capture how this causality varies over time. The importance of the volatility index is by being considered as a main index to measure uncertainty, fear, and risk aversion in financial markets by market participants and researchers. (e.g., Whaley, 2000). Bekaert et al. (2011) and Silvennoinen and Thorp (2013) studies reaffirmed the VIX as a proxy for investor sentiment and risk aversion or Investor “fear gauge”.

The paper is organized in a manner whereby the first section resumes some insights about the characteristics and the link between Islamic finance and socially responsible investment. The following section presents the econometric methodologies are outlined through the use of an autoregressive distributed lag (ARDL), robust, conditional and unconditional Frequency Domain causality. Section 4 reports and discusses the empirical findings and the robustness checks. Section 5 concludes and provides some implications.

2. Some insights about the SRI

2.1. A brief history of Socially Responsible Investment and its global expansion

In the modern Era, the "Quarker community"[41] suggested the adhesion of religious beliefs and practices to business investment. In the beginning of the 17th century, Quaker investors were working in the primary sector of the economy. After the industrial revolution, Quakers became more interested in "innocent trade" such as wool, iron, medicine and food. New standards were created in business such as Truth and sincerity. In the 18th and 19th century, the public trusted the Quakers which is led to the foundation of "Quaker banks" who

[41] Quarter Community is a Christian religious group. This community is also known as "friends of the church".

managed the relationship between employers and workers in order to create fair and equitable work conditions.

During the 20th century, Quakers emerged to East Africa and started to finance small enterprises what led to the rise of “micro-credit schemes” and “community service projects”. In 1928, Pioneer Fund[42] was created in order to collect and manage funds in profitable projects withdrawal from sin stock.[43]

In 1948, English Christian adherents' investors founded specific portfolios for investment industries. Later, in 1960s, the dissatisfaction against racial discrimination and Vietnam War urged global revolutions to create ethical funds to protect the environment and to assure racial equality between people. Following this active movement, the civil rights act and the voting rights acts were made in 1964 and 1965 respectively. During the same period, investing in Community development financial institutions (CDFIs) helped many low-income people to found small businesses. In addition, loans provided by investors helped poor people in an efficient positive way.

During the 70`s, sustainability and environment issues were integrated into investment decisions. After the Three Mile Island nuclear accident, many activists manifested against the

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[42] The bases of the Fund are:

- Prohibition of exploiting activities especially: tobacco, alcohol and gambling stocks in order to preserve Socially Responsible Investment screens.
- Capital growth with reasonable returns.

[43] Firstly, ESG incorporation is traditionally based on the environmental, social and corporate governance standards. The metrics are taken especially by institutional investors for their portfolio construction in order to classify "stocks and fixed-income investments". The main objective of this strategy is to create sustainable value with reasonable returns by depending on positive ESG policies and practices.
Secondly, shareholder engagement is well-known strategy in USA to raise sustainable and responsible investment. Active shareholders bring seriously social, environmental and corporate governance issues to the table. These global issues have been attracted not only by the company mangers but also by the public. Institutional investors and money managers engage companies into ESG practices such as climate change, sustainability target, and executive payment. In addition to that, companies under this strategy have the ability to work in accordance with "government regulatory agencies" in order to make a charge of ESG issues to the supreme legislative body.

negative environmental impacts of nuclear power plants. In 1970, there were two social-based decrees taken by General Motors to support socially responsible investment.

During the 80`s, enthusiasts of SRI made effort and pressure against the racial policy of apartheid in South Africa. With a view to achieve this objective, "individual and institutional investors" withdraw their capital pushing to American capital outflows from South Africa. This procedure led ultimately to the failure of the racial policy.

During the same period, many socially responsible mutual such as "Calvert Social Investment Fund Balanced Portfolio and the Parnassus Fund" were created. These funds permit investors to build out their portfolio by applying negative or exclusionary screens and positive or "Best-In-Class" screens. Accordingly, investors can decide what they want to include in their portfolio. These screens use environmental, social and governance (ESG) standards while making investment decisions such as alcohol, tobacco, environmental pollution, treatment between genders, etc.

Many environmental and social movements were rising. Renneboog et al. (2008) put in evidence the negative impacts of many environmental and health disasters such as Chernobyl and Exxon Valdez. In 1986, a nuclear catastrophe occurred and killed more than 4000 persons. The radioactive materials had many destructive effects on fauna and flora. Later, there was an increase in the number of people infected by cancer especially thyroid cancer and leukemia. In 1989, Exxon Valdez was the largest oil spill in USA. Around 11 million gallons escaped in the Pacific Ocean and attacked more than 250,000 water animals such as seabirds and seals. Accordingly, many ethical investors become more interested not only in positive return but also in social return. This new business mentality permits to gain profits without being harmful to society and to raise the standards of living. Accordingly, labor practices such as health and safety services have been improved.

During the 90`s, socially responsible mutual funds were greatly increasing and requiring indexes to measure its performance such as the Domini Social Index. The performance index

placed environmental and social norms which permitted to differentiate between the performance of negative screens and positive screens. The index will also alert investors to the fact "sin stocks" have high returns than traditional stocks. Mutual funds in the US in 1995 were estimated to be at 55 funds and with a total asset value of around USD 12 billion. Meanwhile, in 2005, the number of funds was at 200 with a total asset value of USD 179 billion. In the European market, strong growth of SRI funds was noticed as the number of funds flew from 4 in 1984 to reach a total of 159 funds by 1999 and by June 2005, it reached 375 funds with an estimated asset value of around 24 billion Euros. The case in Australia was similar as SRI assets grew from AUD 325 million in 2000 and 11.98 billion by 2006. In Canada, SRI assets grew exponentially by 2006 to reach 503.61 billion from the 65.46 billion it was at in the period from 2003 to 2004.

In general, the ESG has been increasing over the past two decades. Graph 3 (Appendix) shows the US ESG growth over the period from 2004-2016. During the ex-ante financial crisis, the total US assets incorporating ESG criteria rose from USD 1.7 in 2004 to USD 2.1 Trillion in 2006. This growth continued to increase during the 2008-2009 financial crises. That means that the environmental, social and corporate investing was not affected by the negative recession. However, in 2010, U.S ESG assets increased by 2014 percent. 2014 was the year when the ESG investing came into its own. The total amount of US assets was around USD 6.2 Trillion and kept increasing to reach USD 8.1 Trillion in 2016. These assets are under the management of 300 companies and 1,043 social associations. At the start of 2016, the value of the total US assets invested in sustainable and responsible industries was approximately USD 8.72 Trillion. The portion of environmental, social and corporate governance investment is equal to USD 8.10 Trillion from the whole SRI assets. Likewise, the part invested by incorporating Shareholders Resolutions strategy was approximately USD 2.56 Trillion at the start of 2016. (See Appendix, Graphs 2 to 5).

2.2. Social Responsibility and Maqasid Al Shariah

In this section, the Islamic perspective on social responsibility along with the ethics and values associated with it will be discussed. It can be observed that financial moral rules come from practice and activities known as "Shariah" (see Appendix, Figure 1).

Al-Ghazali (1937) mentions that the main objective of “Maqasid Al-Shariah" is that it serves as a benefit. It is not a benefit for an individual but rather for the well-being of society as a whole. The general benefit is in compliance with the "Hadith"[44] and the "Holy Quran" in general.[45] This idea is in accordance with that of Kamali`s (2009) who reaffirmed in his works the importance of benefits for individuals and the general community. The main purpose of it is to improve the standards of life and to prevent any form of damage not only for humans but for all living organisms and natural resources in order to achieve an assurance for all future generations to survive. The theory of "Maqasid Al-Shariah" originated from the fundamentals of Islam whose main purpose is to distribute resources in a manner where equality and justice is served amongst the “Ummah”. The distribution of resources is conducted in an efficient manner. According to the theory of production in Islam, scarcity is considered to be one of the problems that are apparent in Islamic economics. Due to its importance, it has been pointed out in the "Holy Quran" that negligence and indolence are to be avoided in order to maximize production. The Holy Prophet Mohammad (SAW), has stated to request for God`s help and that nothing is impossible.

Imam et al. (2015) discovered that since the principles of Islam and as a result the principles of Islamic institutions are based on an old legal structure, they can thus have socio-economic benefits. One of these radical principles is social justice (Al Adala Al Ijtimaiya) with a

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[44] The "Hadith" of the Prophet represent another source of legislation. The "Hadith" include the words, actions, practices, and approvals of Prophet Mohamad (SAW). The "Hadith" are divided into several types according to the mode of transmission, the number of rapporteurs and the authenticity of the "Hadith". These sources highlight the conditions that transactions in Islamic finance must undergo. These transactions must be of the same purpose, and of the same kind with the backing of any transaction to a tangible asset.

[45] In the Islamic religion, the benefit is split into two types with the first being a necessity (“Dururiyat”) and the second being complimentary (“Tahsinat”).

basic principle which states that the well-being must be offered for the whole community as well as the resources must be distributed equitably among the working population and especially amongst the poorest. In this sense, the Prophet (*SAW*) said: "*He is not a man of faith who falls asleep satiated while his neighbor is hungry* ".

Another important benefit of the "Shariah law" appears by the protection of property rights and contract under a transparent legal system. Nevertheless, playing this role demands respect for the laws and teachings of the Islamic "Shariah" in order to achieve its primary objective; which is the absolute economic well-being and spreading of the "Ummah". In this context, the concept of the Islamic economic system has been emphasized in the theories of Chapra (1985) who studied the duties assigned to man and aim to maximize social welfare. As Islam emphasizes the human role, the progress of human capital is a prerequisite for the development of society. The Profit Loss Sharing (PLS) principle which is considered as a cooperative scheme allows parties to acquire institutional profits in an ethical and equitable manner. At the macro level, the PLS principle has a noticeable effect through its ability to create profitable investments which in return raise the employment and investment levels. For instance, several Islamic financial instruments play a fundamental role in reducing the level of poverty and increasing the level of employment in the economy. Indeed, the "Salam"[46] contract by providing the necessary financing, leads to the reduction of poverty in rural areas and particularly in the agricultural sector. It will also be beneficial to present the role of “Zakat" funds in reducing poverty. For example, Islamic banks offer a special account known as: "social service account". The mechanism of this account is represented by a collection of donations offered by several agents such as shareholders of the Islamic bank, depositors, employees or just anyone who wants to help.[47]

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[46] The "Salam" contract: This is a contract that has been used since the time of the Prophet Muhammad mainly to facilitate the transactions of farmers during the harvest seasons.

[47] Generally, the distribution of donations is done in cooperation with specialized institutions or with the State and this differs from one country to another. Therefore, the main purpose of " Zakat "is to follow the foundations of Islam and especially those related to the equitable distribution of resources, the prevention of monopoly, the better circulation of property and justice in society. Ibn 'Umar said: "He

The monetary values for both are based on the theory of selection whereby its principles prohibits them from generating a profit at the expense of harm to its employees which may cause damage to society or environmental resources or other potential harm. However, this theory was subject to high criticism and is viewed as simple to apply in theory, however, in reality it requires plenty of effort with respect to the principles of "Maqasid Al-Shariah" and their of awareness of their responsibilities under the SRI concept. It is a challenge to adhere to the environmental requirements and human rights while considering a fair economic perspective. All of these issues allow us to understand the connection between SRI and Islamic financing whereby Islamic financing is considered as more accurate and strict. On the other hand, SRI is a broad topic in the investment world.

3. Methodology, data and descriptive statistics

3.1. The autoregressive distributed lag (ARDL) model

The ARDL bounds testing approach is used to investigate the relationship between three sustainable indices versus their Islamic counterparts represented as follow: DJS_US40, DJI_US, DJS_EUROPE and DJI_EUROPE, DJS_ASIA_PACIFIC and DJI_ASIA_PACIFIC. Pesaran et al. (2001) developed the ARDL bounds testing in order to analyze the co-integration amongst estimated variables. The investigation of the long-run relationship among the estimated variables was conducted through the application of various cointegration approaches such as those developed by Engle and Granger (1987), and Juselius (1990). According to the general ARDL-model, it is considered as a part of the dynamic model which can detect the temporal effects and also allows us to clarify the adjustments, prevision, from the explanation of the variable.

The ARDL bounds testg is considered as being more flexible in comparison to the relatively more traditional cointegration models. According Harris and Sollis (2003), Tiwari and Shabaz (2013), the ARDL approach allows unbiased estimation of the short-run dynamic and

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who hoarded goods (and does not give the prescribed zakah) is concerned with the punishment promised by God in the Qur'an to those" who hoard gold and silver ". For instance, the Islamic Bank of Jordan, considered one of the leading Islamic banks in the MENA region, has helped approximately 40,000 individuals by having them benefit from funds amounting to (USD 22 million between 2001 and 2003 to combat poverty.

long-run equilibrium model and is relatively more efficient for a small sample. Moreover, the ARDL model allows differentiating dependent and explanatory variables and doesn't suffer from the issue of endogeneity (Ahmed, Muzib, & Roy, 2013).

Endogenous regressors are taken into account through the use of the ARDL bound testing technique and an unbiased estimate in the long-run and valid t-statistics value is delivered. Haug (2002) and Alimi (2014) argue that improved and unbiased results can be provided through the ARDL bound testing approach, which is considered as a better analysis technique. In order to apply this technique, we will present the first general equation (1) that allows investigating the relationship between indices under study. Thus, the equation of the general autoregressive distributed lag (ARDL) model is expressed as follows:

$Y_t = \alpha_0 + \sum_{i=1}^{P} \alpha_i \, Y_{t-i} + \sum_{j=0}^{q} \beta_j \, X_{t-j} + \varepsilon_t,$ **(22)**

Where $p \geq 0 \; and \; q \geq 0, \alpha_0$ represents the constant, $\alpha_i$and β_j translate the short-term effect and the long-term effect respectively while ε_t translates the error term in the equation.

In this study, we will start by presenting first the sustainable indices under study as dependent variables as follows: D(R_DJS_US40), D(R_DJS_Europe), and D(R_DJS_ASIA_PACIFIC). We will present the Islamic indices under study as the dependent variables as follows: D (R_DJI_US), D (R_DJI_Europe), and D (R_DJI_ASIA_PACIFIC). The considered variables represent the returns for sustainable and Islamic indices in USA, Europe and Asia Pacific regions respectively.

The six following equations (23,24, and 25) will represent the relationship between each sustainable index and its Islamic counterpart in the entrusted three regions under study. In our study, to obtain precise the results" a log-linear specification of the variables under study. These three equations are represented as follow:

$D(R_DJS_US40) = \alpha_0 + \sum_{i=1}^{n} \alpha_{1i} \, D(R_DJS_US40_{t-1}) + \sum_{i=0}^{m} \alpha_{2i} \, D(R_DJI_US_{(t-1)}) + \beta_1 \, R_DJS_US40_{t-1} + \beta_2 \, R_DJS_US40_{t-1} + \varepsilon_t,$ **(23)**

$D(R_DJS_EUROPE) = \alpha'_0 + \sum_{i=1}^{n} \alpha'_{1i} + D\,(R_DJI_EUROPE_{\;t-1}) + \beta'_1 \, R_DJS_EUROPE_{t-1} + \beta'_2 \, DJI_EUROPE_{t-1} + \varepsilon'_t,$ **(24)**

$$D(R_DJS_ASIA_PACIFIC) = \alpha''_0 + \sum_{i=1}^{n} \alpha''_{1i} + D\,(R_DJI_ASIA_PACIFIC_{t-1}) + \beta''_1\, R_DJS_ASIA_PACIFIC_{t-1} + \beta''_2\, R_DJI_ASIA_PACIFIC_{t-1} + \varepsilon''_t, \quad \textbf{(25)}$$

Where, on one hand, D (R_DJS_US40), D (DJI_EUROPE), and D (R_DJI_ASIA_PACIFIC) are used to represent the long-run coefficients. On the other hand, R_DJS_US40, R_DJS_US40, R_DJS_EUROPE, DJI_EUROPE, R_DJS_ASIA_PACIFIC, and R_DJI_ASIA_PACIFIC are used to represent the short-run coefficients.

$$D(R_DJI_US) = \alpha_0 + \sum_{i=1}^{n} \alpha_{1i}\, D(R_DJI_US_{t-1}) + \sum_{i=0}^{m} \alpha_{2i}\, D(R_DJS_US40_{(t-1)}) + \beta_1\, R_DJI_US_{t-1} + \beta_2\, R_DJI_US_{t-1} + \varepsilon_t, \quad \textbf{(26)}$$

$$D(R_DJI_EUROPE) = \alpha'_0 + \sum_{i=1}^{n} \alpha'_{1i} + D\,(R_DJS_EUROPE_{\ t-1}) + \beta'_1\, R_DJI_EUROPE_{t-1} + \beta'_2\, DJS_EUROPE_{t-1} + \varepsilon'_t, \quad \textbf{(27)}$$

$$D(R_DJI_ASIA_PACIFIC) = \alpha''_0 + \sum_{i=1}^{n} \alpha''_{1i} + D\,(R_DJS_ASIA_PACIFIC_{t-1}) + \beta''_1\, R_DJI_ASIA_PACIFIC_{t-1} + \beta''_2\, R_DJS_ASIA_PACIFIC_{t-1} + \varepsilon''_t, \quad \textbf{(28)}$$

Where, on one hand, D (R_DJI_US), D (DJS_EUROPE), and D (R_DJS_ASIA_PACIFIC) are used to represent the long-run coefficients. On the other hand, R_DJI_US, R_DJS_US40, R_DJI_EUROPE, DJS_EUROPE, R_DJI_ASIA_PACIFIC, and R_DJS_ASIA_PACIFIC are used to represent the short-run coefficients.

The letter D in the equations above represents the first difference operator. The variables names represented in the three equations above are preceded by the letter R which translate the return values at time t and calculated from the daily closing price data. The ARDL bounds testing technique used to find the cointegration vector and to test the long-run equilibrium relationship between variables under study. According to Pesaran (1997) and Pesaran et al. (2001), upper critical bound I (1) value and lower critical bound value I (0) can be used to interpret ARDL bounds tests. In order to test the stability of the ARDL approach, we will develop the study by relying on “Breush Godfrey-serial correlation and Ramsey Reset test”.

3.2. *Unconditional Causality Tests*

3.2.1. Unconditional Granger causality

The Granger (1969) approach allows us to analyze the “directionality and directness” between time series. So, we will be able to know how time series under study are related to their history and the history of the other series. In addition to that, Granger causality is based

on the idea that "a cause occurs before its effects" and a well understanding of the cause can help to predict the effects. However, this determination is quite limited to the fact that it can only give a general image about the causality between the time series under study.

In this context, to determine the direction of causality between X and Y; the two variables under study. Thus, Y causes X in the Granger sense if the null hypothesis can be rejected in favor of the alternative hypothesis with ρ lags-VAR (ρ). To note that p here is the model order. If $\beth_k$ is the $n \times n$ matrix of the regression coefficients with k is the optimal lag by selecting Akaike Information Criterion.

In the case of linear Granger causality, we have the followed equation:

$N_t = \begin{pmatrix} Y_t \\ X_t \end{pmatrix}$, **(29)**

So when we decompose the previous equation (29), we get:

$$N_t = \begin{pmatrix} Y_t \\ X_t \end{pmatrix} = \sum_k^p \begin{pmatrix} \beth_{yy,k} & \beth_{yx,k} \\ \beth_{xy,k} & \beth_{xx,k} \end{pmatrix} \begin{pmatrix} Y_{t-k} \\ X_{t-k} \end{pmatrix} + \begin{pmatrix} \varepsilon_{y,t} \\ \varepsilon_{x,t} \end{pmatrix}, \textbf{(30)}$$

While the residuals covariance matrix is represented as follows:

$$cov \begin{pmatrix} \varepsilon_{y,t} \\ \varepsilon_{x,t} \end{pmatrix} = \begin{pmatrix} \sum_{yy} & \sum_{yx} \\ \sum_{xy} & \sum_{xx} \end{pmatrix}, \textbf{(31)}$$

The Y-component of the regression can be written as follows:

$Y_t = \sum_{k=1}^p \beth_{yy,k} . Y_{t-k} + \sum_{k=1}^p \beth_{yx,k} . X_{t-k} + \varepsilon_{y,t}$, **(32)**

Where, $\beth_{yx,k}$ reflects the dependence of the time series Y on the past of the time series X.

The reduced regression model by can be represented as follows:

$Y_t = \sum_{k=1}^p \beth'_{yy,k} + \varepsilon'_{y,t}$, **(33)**

Where, $\beth'_{yy,k}$ and $\varepsilon'_{y,t}$ represent the coefficients and residuals of this model.

Concerning the Granger causality from X to Y conditional on C can be represented as follows:

$M_{x\to y}$=ln$\frac{|\sum' yy|}{|\sum yy|}$, **(34)**

Where, $\sum_{yy}$ and $\sum'_{yy}$ are equal to cov($\varepsilon_{y,t}$) and cov($\varepsilon'_{y,t}$) respectively and are considered as the residuals covariance matrices of the regression model in (32) and reduced regression model in (33) above.

3.2.2. Unconditional Frequency Domain causality

Many questions occurred about its applicability in finance Geweke (1982), expand this approach and put into consideration the capability to differentiate between "direct and indirect influences" which are mediated by a different time series. This "unconditional measure of causality" which was known by time-Domain causality has important features: in the case of non-existence of causality, the frequency domain measures are non-negative and the ability to be decomposed by frequency in order to study the causality. Frequency domain refers to the domain used to analyze mathematical functions with respect to frequency. The frequency domain causality differs from other conventional causality tests that were proposed in literature by being able to explain causality over different frequency domains in a more detailed manner. This is completed through the plotting of causality distribution with a variation of frequency bands from low to high. Hence, the frequency domain approach is able to decompose the predictive powers of variables into both slowly and quickly fluctuating sequences. Low frequency bands are represented by the slowly fluctuating sequence which is considered as described as sequences with a periodicity that is greater than 12 months. Meanwhile, higher frequency bands are represented by the quickly fluctuating sequences which are considered as sequences with a periodicity of less than one year. The main benefit of the frequency domain causality is represented by its ability to decompose the casual influence over different frequency bands which shows the variation of the casual strengths and the predictive power of each variable separately.

The frequency domain causality has been predominantly applied in the empirical economic and finance research fields (Breitung and Candelon, 2006; Croux and Reusens, 2013; Lemmens et.al., 2008). The Granger causality in the frequency domain is proposed in this paper (Breitung and Candelon 2006). The approach used can be summarized as follows:

$A_t = \emptyset(L)Z_t = \varepsilon_t$, **(35)**

Where $\emptyset(L) = 1 - \emptyset_1 L$-….-$\emptyset_P L^P$ and ε_t is a white noise with a zero mean and a constant variance with A_t=$[x_t, y_y]$ is a two-dimensional vector of length T.

$$A_t = \emptyset(L)\varepsilon_t = \begin{bmatrix} \emptyset_{11}(L) & \emptyset_{12}(L) \\ \emptyset_{21}(L) & \emptyset_{22}(L) \end{bmatrix} \begin{bmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \end{bmatrix} = \mu(L)\varepsilon_t = \begin{bmatrix} \mu_{11}(L) & \mu_{12}(L) \\ \mu_{21}(L) & \mu_{22}(L) \end{bmatrix} \begin{bmatrix} n_{1t} \\ n_{2t} \end{bmatrix}, \textbf{(36)}$$

Where $\emptyset(L)$ is a 2*2 lag polynomial, $\emptyset(L)$=$\emptyset(L)^{-1}$ and $\mu(L) = \emptyset(L)G^{-1}$. G is the lower triangular matrix of Cholesky decomposition and $n_t = G\varepsilon_t$. In the matrix above, the system is supposed to be stationary.

The spectral density of x_t can be represented as follows:

$$f_x(\omega) = \frac{1}{2\pi}\left[\left|\mu_{11}(\varepsilon^{-i\omega}\right|^2 + \left|\mu_{12}(\varepsilon^{-i\omega}\right|^2\right], \textbf{(37)}$$

Geweke (1982) and Hosoya (1991) and Breitung and Candelon (2006) reformulated a measure of causality in order to test the non-causality process. According to Yamada and Yanfeng (2014), the importance of this statistical procedure is distinguished by its capability to surpass "the linear constraints on the coefficients of the VAR(ρ) model".

The measure of causality of Geweke (1982) and Hosoya (1991) is represented as follows:

$$M_{y\to x}(\omega) = log\left[\frac{2\pi f_x(\omega)}{\left|\mu_{11}(\varepsilon^{-i\omega}\right|^2}\right] = \log\left[1 + \frac{\left|\mu_{12}(\varepsilon^{-i\omega})^2\right|}{\left|\mu_{11}(\varepsilon^{-i\omega})^2\right|}\right] \textbf{(38)}$$

The equation (38) above is defined as the ratio of the total spectrum divided by the intrinsic component of the spectrum. By following Geweke causality, if $\left|\mu_{12}(\varepsilon^{-i\omega}\right|^2$ is equal zero, then y does not cause x at frequency ω. Accordingly, the null hypothesis is equal to $M_{y\to x}(\omega) = 0$.

Breitung and Candelon (2006) reformulated the relationship between x and y in a VAR(ρ) equation as follows:

$$x_{1t} = \alpha_1 x_{t-1} + \cdots + \alpha_p x_{1t-p} + \beta_1 y_{1t-1} + \cdots + \beta_p y_{1t-p} + \varepsilon_{1t}, \textbf{(39)}$$

In the Breitung and Candelon causality measure, the null hypothesis: $M_{y\to x}(\omega) = 0$ is equivalent to:

$H_0: R(\omega)\beta = 0$, **(40)**

$$H_0: \begin{cases} \sum_{j=1}^{p} \beta_{1j} \cos(j\omega) = 0 \\ \sum_{j=1}^{p} \beta_{1j} \sin(j\omega) = 0 \end{cases}, \textbf{(41)}$$

Where β is the vector of the coefficients of $y\ and\ R(\omega)$.

In equations (40) and (41), the standard F-statistic: *F (2, T-2P)* for $\omega\epsilon(0,\pi)$ is used. The number of restrictions here is 2, the lag length is *p* and the number of observation is *T*. In the mentioned equations, the stationary system is required. Accordingly, under this causality measure, x_t can be replaced by Δx_t. The right-hand side of equation (37) will remain the same. (See Breitung and Candelon, 2006). In this context, the long-run causality is defined as the "causality at frequency ω=0. However, is a stationary system, the causality exists at "a low frequency level". This can be explained by the ability to forecast "the low frequency component".

3.3. *Conditional causality: Breitung and Candelon spectral Granger causality*

The unconditional causality analysis between two series has been criticized in literature review due to the fact that a chosen control variable(s) can have significant effects on the results. Thus, the conditional causality analysis is an extension of the original causality analysis by passing from bivariate time series to multivariate cases. Accordingly, the conditional variables serve the conditional causality to detect the influence from the "origin" time serine to the "target" time series.

By applying the domain frequency causality, we add the C conditional variable to our X and Y variables of interest and we obtain:

$X_t = \sum_{i=0}^{\infty} a_{0i} X_{t-1} + \sum_{i=1}^{\infty} b_{oi}\, C_{t-i} + \varepsilon_{ot}$, **(42)**

$C_t = \sum_{i=1}^{\infty} a_{1i} X_{t-1} + \sum_{i=1}^{\infty} b_{1i}\, C_{t-i} + \mu_{ot}$, **(43)**

ε_{ot} and μ_{ot} are independent and identically distributed with zero mean.

Variance-covariance matrix can be represented as $\begin{bmatrix} \sum \varepsilon_0 \sum \varepsilon, \mu_0 \\ \sum \mu_{\dot{a}}, \varepsilon_0 \sum \mu_0 \end{bmatrix}$, **(44)**

and

$Y_t = \sum_{i=0}^{\infty} c_{0i} Y_{t-1} + \sum_{i=1}^{\infty} b_{oi}\, \mathrm{C}_{t-i} + u_{ot}$, **(45)**

$\mathrm{C}_t = \sum_{i=1}^{\infty} c_{1i} Y_{t-1} + \sum_{i=1}^{\infty} d_{1i}\, \mathrm{C}_{t-i} + \mu_{ot}$, **(46)**,

u_{ot} and μ_{1t} are independent and identically distributed with zero mean.

Variance-covariance matrix can be represented as $\begin{bmatrix} \sum u_0 \sum u_{\dot{a}}, \mu_1 \\ \sum \mu_1, u_0 \sum \mu_1 \end{bmatrix}$, **(47)**

Thus, we got the link between X and Y by adding the conditional variable as follows:

$X_t = \sum_{i=1}^{\infty} A_{1i} X_{t-i} + \sum B_{1i} Y_{t-i} + \sum_{i=1}^{\infty} \delta_{1i}\, \mathrm{C}_{t-i} + \dot{\zeta}_{1t}$, **(48)**

$Y_t = \sum_{i=1}^{\infty} A_{2i} X_{t-i} + \sum_{i=1}^{\infty} B_{1i} Y_{t-i} + \sum_{i=1}^{\infty} \delta_{2i}\, \mathrm{C}_{t-i} \acute{\zeta}'_{1t} +$, **(49)**

$\mathrm{C}_t = \sum_{i=1}^{\infty} A_{3i} X_{t-i} + \sum_{i=1}^{\infty} B_{1i} Y_{t-i} + \sum_{i=1}^{\infty} \delta_{3i}\, \mathrm{C}_{t-i} + \acute{\zeta}''_{1t}$, **(50)**

$\dot{\zeta}_{1t}, \acute{\zeta}_{1t}$, and $'\acute{\zeta}_{1t}''$ are independent and identically distributed with zero mean.

Variance-covariance matrix can be represented as $\begin{bmatrix} \sum \zeta_1 \ \sum \zeta_1, \ \zeta'_1 \sum \zeta_1, \ \zeta''_1 \\ \sum \zeta'_1, \zeta_1 \sum \zeta'_1 \sum \zeta'_1, \zeta''_1 \\ \sum \zeta''_1, \zeta_1 \sum \zeta''_1, \zeta'_1 \sum \zeta''_1 \end{bmatrix}$, **(51)**

In case C has no effect on our results, we can say that $M_{y \to x/\mathrm{C}}$ and $M_{x \to y/\mathrm{C}}(\omega)$ based on Geweke (1984) are insignificant. In this case, $\sum \varepsilon_0 = \sum \zeta_1 = \sum \mu_0 = \sum \zeta'_1$.

The conditional causality is measured by Geweke (1984) as follows:

$M_{x \to y/\mathrm{C}} = \ln\left[\frac{\sum \varepsilon_0}{\sum \zeta_1}\right]$ And $M_{y \to x/\mathrm{C}} = \ln\left[\frac{\sum \mu_0}{\sum \zeta'_1}\right]$, **(52)**

4. Data and descriptive statistics

4.1. Preliminary results

We use daily data covering the period from January 21, 2011 till March 03, 2018 for a total of 1860 returns for sustainable and Islamic indices under study. The three main indices of Dow and Jones. These indices are, namely DJS_US40, DJI_US, DJS_EUROPE and DJI_EUROPE, DJS_ASIA_PACIFIC and DJI_ASIA_PACIFIC. The selection of the four indices and the period under study is due to the availability of data.

The results are determined by utilizing log-normal returns as proxy. The Log-linear specification applied is as follows:

$R_{it} = ln\, P_{i,t} - ln\, P_{i,t-1}$, **(53)**

Where R_{it} *is defined as return values at time t, and* $P_{i,t}$*is calculated from the daily closing price data.*

In order to understand the characteristics of our sustainable and Islamic indices under study, we start by presenting the preliminary analysis represented by Table 16, Figures 11, 12 and 13 below.

Table 16 below shows the descriptive statistics of DJS_US40, DJI_US, DJS_EUROPE, DJI_EUROPE, DJS_ASIA_PACIFIC, and DJI_ASIA_PACIFIC. The mean and the median of all the indices under study are positive over the period 2011-2018. We notice from the table below that indices show quasi similar values except for DJS_ASIA_PACIFIC which show a lower value by $8.89e^{-05}$.

In addition, the six indices under study exhibit a negative skewness. The fact that the indices seem negatively skewed implies that the portfolios investors may be exposed to risks. That can be referred to “black swan events. Graphically, the Skewness measure of Islamic and sustainable indices is significantly negative meaning that the distribution is "skewed to the left" charactering by a long tail to the left. Consequently, we conclude on one hand the existence of

an asymmetric distribution and on the other hand there is more downward than upward. These characteristics can be shown in Figures 11, 12 and 13.

Furthermore, the Kurtosis measured, in table 16 shows that the normal distribution is "leptokurtic or heavy-tailed" with kurtosis superior to 3 for all indices.[48] Notice that all the indices under study are not normally distributed as the kurtosis value is above 3 indicating the existence of a fat-tail (heavy tail) distribution on the extremities and that is different from the normal one. The statistics substantiate the characteristics of the financial data. In addition to that, it is noticed that the normal distribution which is applied in our study instead of the Gaussian one is reflected by Jacque-Bera (JB) test. The null hypothesis is rejected as the test statistic value JB is not zero.

[48] For a normal distribution, the coefficient of Kurtosis (Y_2) should be equal to 3. However, this coefficient can be a coefficient of a leptokurtic distribution if $(Y_2 > 3)$ or of an a platykurtic distribution if $(Y_2 < 3)$.

Table 16. Descriptive statistics of the returns of Sustainable and Shariah indices

	DJS_US40	DJI_US	DJS_EUROPE	DJI_EUROPE	DJS_ASIA_PACIFIC	DJI_ASIA_PACIFIC
Mean	0.000349	0.000399	9.60E-05	0.000166	8.89E-05	0.000199
Median	6.56E-06	0.000293	0.000000	0.000257	0.000000	0.000271
Maximum	0.047227	0.045854	0.062438	0.052631	0.053160	0.042632
Minimum	-0.058738	-0.064118	-0.097283	-0.064818	-0.059072	-0.046754
Std. Dev.	0.008853	0.009097	0.011867	0.010970	0.010216	0.008585
Coef of var°	25.366762	22.79949	123.61458	66.084337	114.91564	43.140703
Skewness	-0.519929	-0.516437	-0.548665	-0.414334	-0.302026	-0.428344
Kurtosis	7.500642	7.891617	8.789041	7.094583	6.265206	6.362984
Jarque-Bera	1656.291	1940.218	2694.917	1354.735	855.9282	934.8826
Probability	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
Observations	1863	1863	1863	1863	1863	1863
ARCH-LM	4.640249***	5.998955***	4.748228***	3.811145***	3.282075***	3.811145***

Note: *** denote statistical significance at 1 percent confidence level at Lags 5

Graphically, the Figure 12 represents the histogram of the normality test. It shows that the distribution is not normal as a result it is not symmetric. Thus, the volatility of returns of the indices under study is clearly visible.

In this context, we have chosen a normal distribution instead of a Gaussian one. In addition to Kurtosis and Jaque-Berra measures, the histogram of log returns (Figure 11 and the Q-Q plots (Figure 13 below) were used in order to detect the adequacy of the sample to a normal distribution or to compare two samples. As a first step, the degree of integration of variables is determined followed by the ARDL estimates. Dicky-Fuller(ADF) along with Philip-Peron are used as tests. The stationarity of variables can be tested by the application of the Augumented Dicky-Fuller unit root test. From the results, it can be noticed that the integration of variables occurs at level. At Trend+Constant, all the variables under study are revealed to be

stationary. (see Table 3, Appendix). The co integration hypothesis amongst the focal variables can be tested through the application of the ARDL bounds testing approach can be tested. Lag length must be selected for prior to conducting the ARDL bound test. Akaike Information criterian (AIC) is used to determine the lag length. Knowing that the choice of the optimal model is due to the selection of the minimum value of AIC.

Figure 11. Evolution of Dow Jones sustainable and Islamic Indices returns from 2011 until 2018

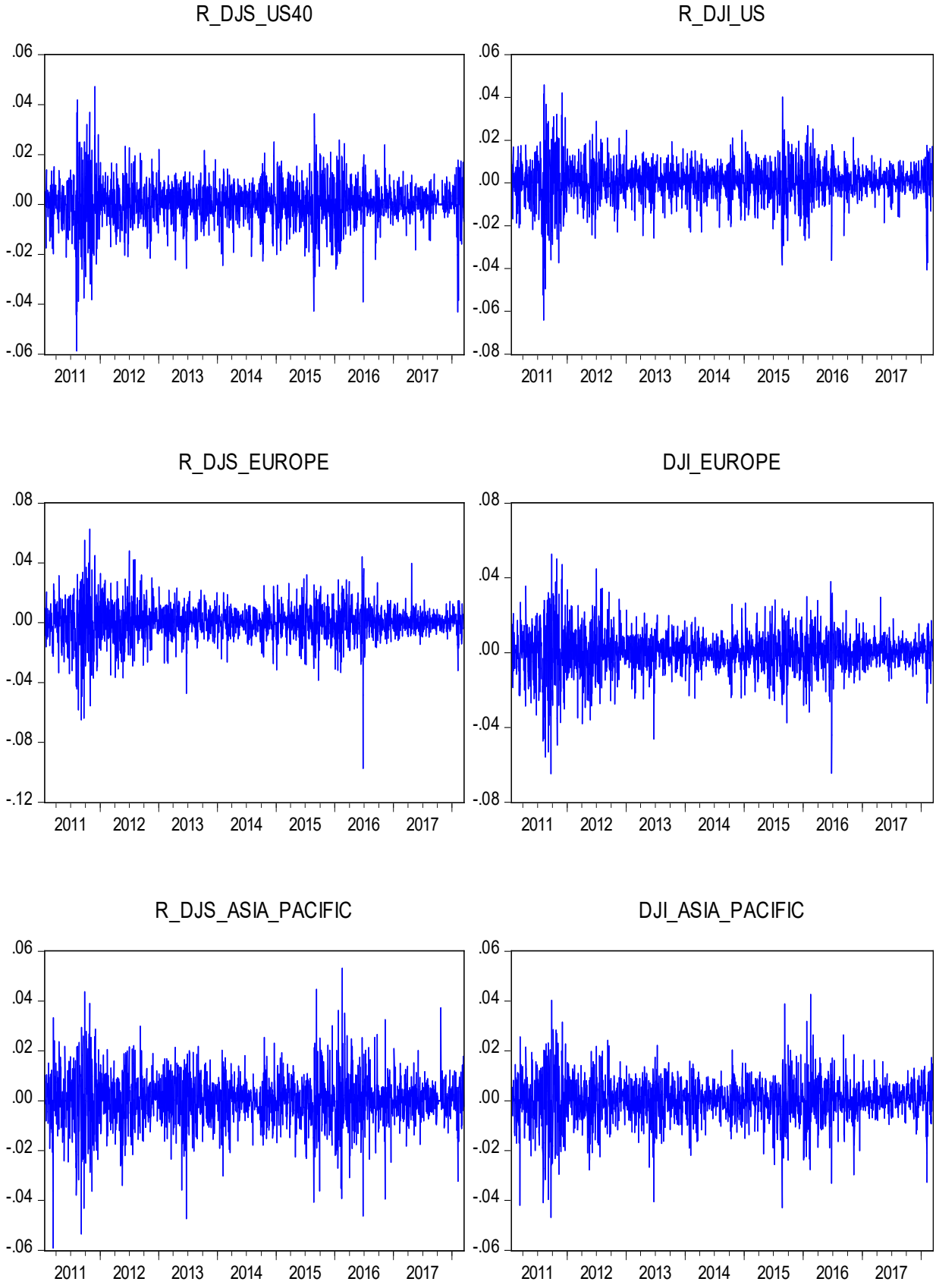
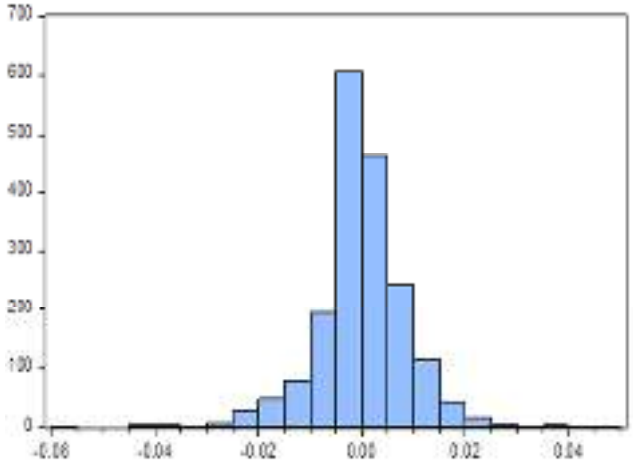
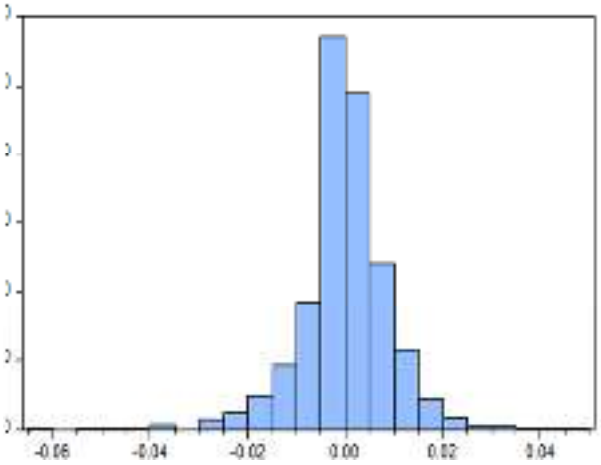


Figure 12. Normality Test of Sustainable and Islamic indices

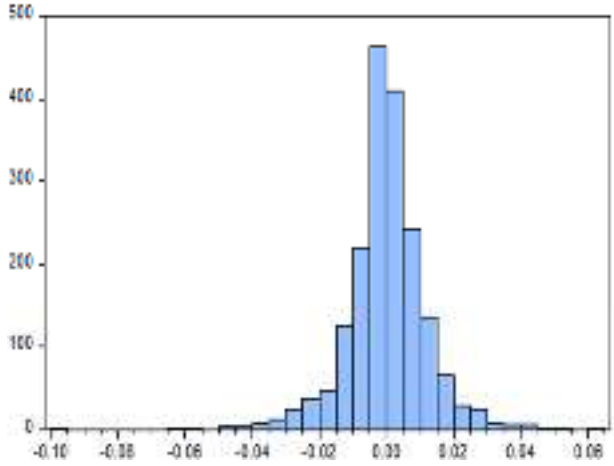
DJS_US40



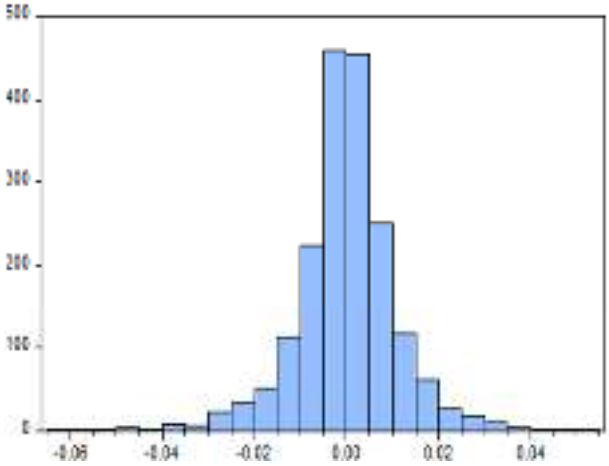
DJI_US



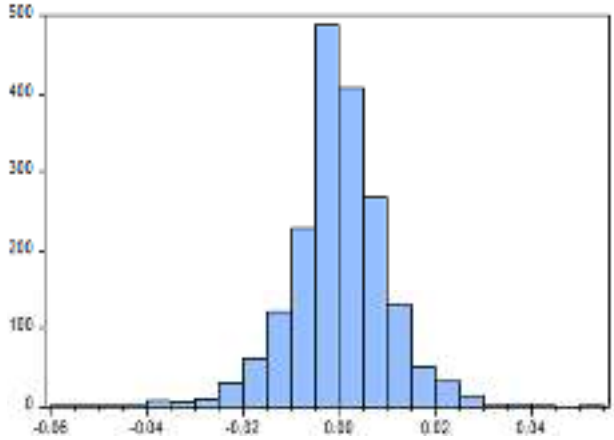
DJS_EUROPE



DJI_EUROPE



DJS_ASIA_PACIFIC



DJI ASIA PACIFIC

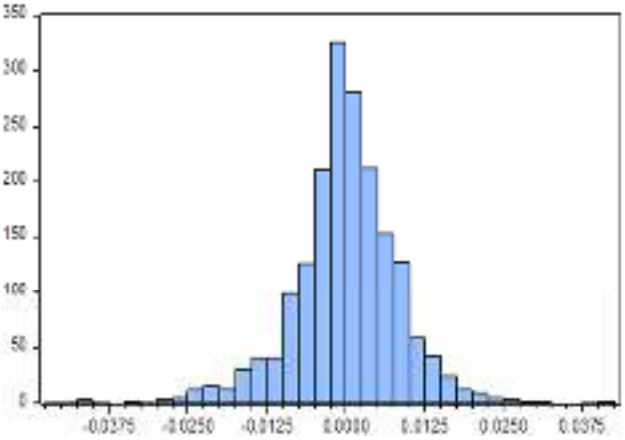
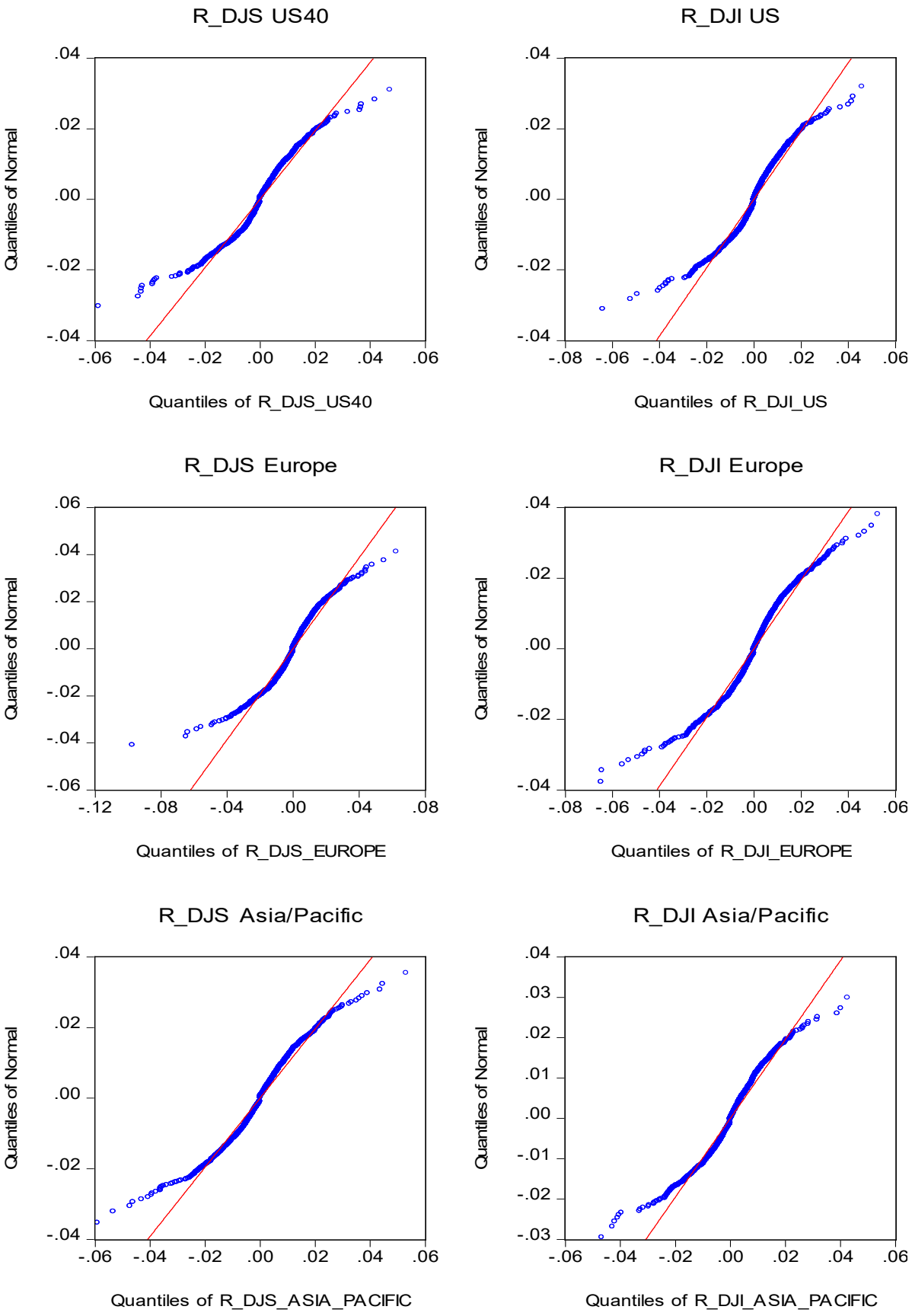


Figure 13. Plots of sustainable and Islamic Indices returns



4.2. ARDL Analysis Results

Interesting results can be noticed by the ARDL Bounds testing approach. In the table 17 below, on one hand, by taking the sustainable indices as dependent variables, the optimal lag length is shown to be one (1) for the R_DJS_US40 and (0) for R_DJS_EUROPE and for R_DJS_ASIA_PACIFIC. On the other hand, by taking the Islamic indices as dependent variables, the optimal lag length is shown to be one (2) for the R_DJI_US and (0) for R_DJI_EUROPE and (1) for R_DJS_ASIA_PACIFIC. The ARDL bound test is further performed after having the optimal lag length to examine the long run relationship between [R_DJS_US40, R_DJI_US], [R_DJS_EUROPE, DJI_EUROPE], and [R_DJS_ASIA_PACIFIC, R_DJI_ASIA_PACIFIC.

Table 17. Lag Length Selection

Dependent Variables/Lags	AIC
R_DJS_US40	
0	-9.165685
1	-9.165702*
R_DJS_EUROPE	
0	-8.974620*
R_DJS_ASIA_PACIFIC	
0	-8.214959*

Dependent Variables/Lags	AIC
R_DJI_US	
0	-9.111025
1	-9.111975
2	-9.113180*
R_DJI_EUROPE	
0	-9.132716*
R_DJI_ASIA_PACIFIC	
0	-8.566610
1	-8.567678*

Notes: * indicates lag order selected by the criterion; AIC: Akaike information criterion

The results of the equations (23) to (28) above are reported in the table 18 below. Table 18 shows the diagnostics results of the ARDL model for long-run elasticities along with supporting statistics. As it can be seen, it is signified that the results have passed successfully for tests of normality, functioning form, serial correlation, and conditional heteroscedasticity.

By taking the sustainable indices as dependent variables, first, for DJS_US40, in the short-run and in the long-run, the results are significant at 1 percent confidence level. Second, for R_DJS_EUROPE, in the short run, the results are not significant but significant in the long-run at 1 percent and 10 percent confidence level respectively. Thus, DJI_EUROPE has no influence on the short term on the DJS_EUROPE. Third, for R_DJS_ASIA_PACIFIC, in the short-term, the results are not significant but highly significant at 1 percent confidence level. The sign of the coefficients allows us to know either the stocks market are complementary (a positive sign is expected) or substitute (a negative sign is expected). In the former case, we expect that DJS_US40 and DJI_US, DJS_ASIA_PACIFIC and DJI_ASIA_PACIFIC are substitute on the short-term, but complementary on the long-term. However, for the European stock market, we notice that DJS_EUROPE and DJI_EUROPE are complementary on the short-term but substitute on the long-term.

By taking the Islamic indices as dependent variables, first, for R_DJI_US, in the short-run, the results are significant at 5 percent and 1 percent respectively except for R_DJI_US (-1) but significant at 1 percent confidence level in the long-run. Second, for DJI_EUROPE, the results are highly significant at 1 percent confidence level in the short-run and the long-run as well. Third, for R_DJI_ASIA_PACIFIC, in the short-run, the results are significant at 10 percent confidence level except for R_DJS_ASIA_PACIFIC (-1). However, the results, in the long-run are significant at 1 percent confidence level. In the former case, we notice that DJS_US40 and DJI_US, DJS_ASIA_PACIFIC, DJI_ASIA_PACIFIC, and DJS_EUROPE and DJI_EUROPE are complementary on the short-run (a positive sign is expected) but substitute on the long-term (a negative sign is expected).

Lastly, we rely on the diagnostic and stability tests represented by Ramsey RESET Test and Breush-Godfrey serial correlation LM Test. For the structural stability, we use the cumulative sum of recursive (CUSUM) for US, European and ASIAPACIFIC indices under study. We find that there are no serious problems.

Table 18. The ARDL Analysis Results

Dependent Variable: D(R_DJS_US40)		
Variables	Coefficients	t-Statistic
C	0.000329	1.605067
D(R_DJS_US40(-1))	0.256058***	3.091529
D(R_DJI_US(-1))	-0.274856***	-3.409717
R_DJS_US40(-1)	-1.468370***	-12.16687
R_DJI_US(-1)	0.455674***	3.888219
R-squared	0.519446h	
S.E. of regression	0.008824	

Diagnostic tests

Ramsey RESET Test	F-statistic	2.742801**
Breush-Godfrey serial correlation	F-statistic Prob. Chi-Square(1)	4.731194** 0.0296

Dependent Variable: D(R_DJS_EUROPE)		
Variables	Coefficients	t-Statistic
C	0.000112	0.407200
D(DJI_EUROPE(-1))	0.018437	0.735355
R_DJS_EUROPE(-1)	-0.816078***	-8.076561
R_DJI_EUROPE(-1)	-0.206254*	-1.839430

Diagnostic tests

Ramsey RESET Test	F-statistic	0.188023
Breusch-Godfrey Serial Correlation	F-statistic Prob. Chi-Square(1)	3.331080* 0.0679

Dependent Variable: D(R_DJS_ASIA_PACIFIC)		
Variables	Coefficients	t-Statistic
C	2.87E-05	0.121651
D(R_DJI_ASIA_PACIFIC(-1))	-0.038546	-1.401373
R_DJS_ASIA_PACIFIC(-1)	-1.275635***	-21.50113
R_DJI_ASIA_PACIFIC(-1)	0.376704***	5.098159
R-squared	0.513260	
S.E. of regression	0.010154	

Diagnostic tests

Ramsey RESET Test	F-statistic	5.830840**
Breush-Godfrey serial correlation	F-statistic Prob. Chi-Square(1)	0.486177 0.990367

Notes: ***, ** and * imply significance at the 1 percent, 5 percent and 10 percent level, respectively

Dependent Variable: D(R_DJI_US)		
Variables	Coefficients	t-Statistic
C	0.000418**	1.980684
D(R_DJI_US(-1))	-0.126184	-1.450211
D(R_DJI_US(-2))	0.074360***	3.211549
D(R_DJS_US40(-1))	0.193452**	2.272488
R_DJI_US(-1)	-0.770287***	-6.201898
R_DJS_US40(-1)	-0.332652***	-2.678248
R-squared	0.518483	
S.E. of regression	0.009063	

Diagnostic tests

Ramsey RESET Test	F-statistic	4.844673***
Breush-Godfrey serial correlation	F(2,1852) Prob. Chi-Square(2)	3.266574** 0.0380

Dependent Variable: D(R_DJI_EUROPE)		
Variables	Coefficients	t-Statistic
C	8.42E-05	0.327433
D(R_DJS_EUROPE(-1))	0.630758***	9.094256
R_DJI_EUROPE(-1)	-0.678362***	-9.274796
R_DJS_EUROPE(-1)	-0.901825***	-29.64535
R-squared	0.498270	
S.E. of regression	0.010972	

Diagnostic tests

Ramsey RESET Test	F-statistic	0.390628
Breusch-Godfrey Serial Correlation	F-statistic Prob. Chi-Square(0)	1.056391 0.3035

Dependent Variable: D(R_DJI_ASIA_PACIFIC)		
Variables	Coefficients	t-Statistic
C	0.000135	0.683312
D(R_DJI_ASIA_PACIFIC(-1))	-0.109483*	-1.838059
D(R_DJS_ASIA_PACIFIC(-1))	0.056159	1.124064
R_DJI_ASIA_PACIFIC(-1)	-0.569545***	-7.011423
R_DJS_ASIA_PACIFIC(-1)	-0.300531***	-4.251218
R-squared	0.479247	
S.E. of regression	0.008512	

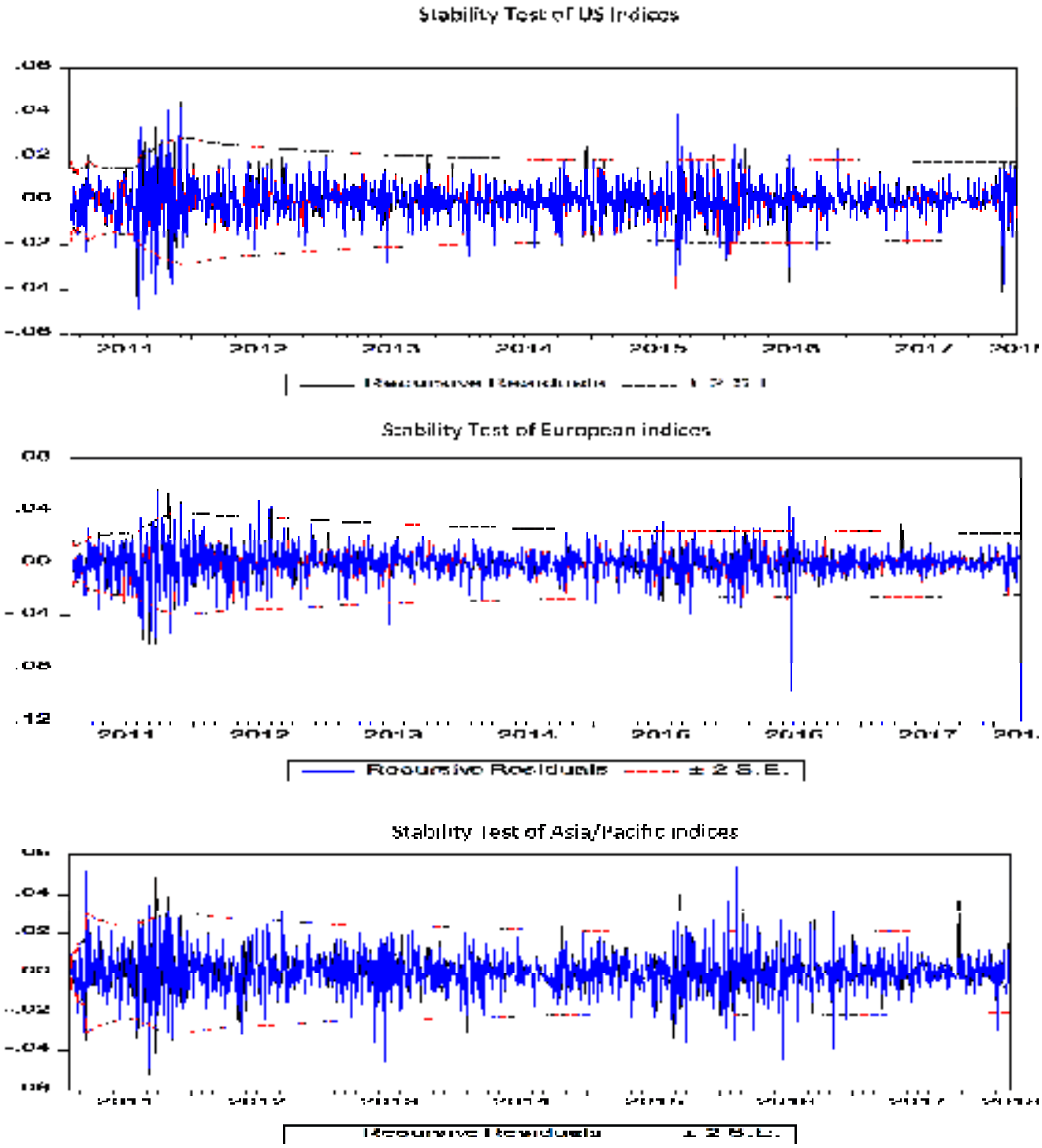
Diagnostic tests

Ramsey RESET Test	F-statistic	2.698606
Breush-Godfrey serial correlation	F-statistic Prob. Chi-Square(1)	0.381730 0.5361

Notes: ***, ** and * imply significance at the 1 percent, 5 percent and 10 percent level, respectively

The analysis of “the cumulative sum of recursive residual” along with the cumulative sum of square of recursive residual was applied for the diagnosis of stability as Brown et al. (1975) had reported. The Figure 14 below illustrates the results “the cumulative sum of recursive residual”. The critical bounds at the 5 percent level of significance are represented by the two straight lines. The short-run and long-run analyses are denoted by the line within the critical bounds. It is implied that the autoregressive and conditional heteroscedasticity and serial correlation are non-existent in the coefficients of error correction model. Thus, the model can be considered as stable.

Figure 14. Plot of cumulative sum of Recursive residuals



Notes: The straight lines represent the critical bounds at 5% significance level

The ARDL bounds testing technique which is based on the Wald test statistic is used to find the cointegration vector and to test the long-run equilibrium relationship between variables under study. The results are summarized in table 19 below. According to Pesaran (1997) and Pesaran et al. (2001), upper critical bound I (1) value and lower critical bound value I (0) can be used to interpret ARDL bounds tests. Thus, the null hypothesis (H0 supposing the nonexistence of long relationship between the two variables under study) is rejected if the estimated value of F-statistic surpasses I (1) value. This implies that a co-integration vector exists and along with a long run relationship among the variables under study. The analysis is however considered as inconclusive if the F-statistic value falls between the upper and lower critical bounds. Accordingly, Table 19 shows the results of the ARDL bounds test for cointegration. The results show the existence of a strong evidence of cointegration. In addition, we conclude that the error term is negative and significant leading to the existence of a long-run relationship (in accordance to Kremers et al. (1992) and Banerjee et al. (1998)) established among sustainable variables (R_DJS_US40, R_DJS_EUROPE and R_DJS_ASIA_PACIFIC) on one hand and Islamic variables (R_DJI_US, R_DJI_EUROPE and R_DJI_ASIA_PACIFIC) on the other hand by showing the F-Statistics value above the upper bounds critical value at 1 percent.

Table 19. Wald Test: Unrestricted intercept and no trend

Dependent Variables	Functions	F-Test Statistics
R_DJS_US40	R_DJI_US R_DJS_US40	501.5525 ***
R_DJS_EUROPE	DJI_EUROPE R_DJS_EUROPE	486.4469***
R_DJS_ASIA_PACIFIC	R_DJI_ASIA_PACIFIC R_DJS_ASIA_PACIFIC	576.4864***
R_DJI_US40	R_DJI_US R_DJS_US40	399.2665***
R_DJI_EUROPE	DJI_EUROPE R_DJS_EUROPE	588.2959***
R_DJI_ASIA_PACIFIC	R_DJI_ASIA_PACIFIC R_DJS_ASIA_PACIFIC	427.0179***

Asymptotic Critical Values, Case III (Pasaran et al. P.300)						
Lags	1 percent		5 percent		10 percent	
K	I(0)	I(1)	I(0)	I(1)	I(0)	I(1)
0	11.79	11.79	8.21	8.21	6.58	6.58
1	6.84	7.84	4.94	5.73	4.04	4.78
2	5.15	6.36	3.79	4.85	3.17	4.14

Note: *** denote statistical significance at the 1 percent level. Asymptotic critical value

4.3. Unconditional Causality Analysis

The performance of these tests is conducted within causality frameworks that are considered to be unconditional and conditional. The estimation of the causalities is estimated by conventional Granger (1969) causality and Domain frequency causality (Breitung and Candelon, 2006).

First, the results of the unconditional frequency domain analysis and conventional Granger can be showed in table 20 and Figure 15, from a to-c below. We rely first on the conventional Granger causality (1969). Thus, an index causes other counterpart index in the Granger sense if the null hypothesis can be rejected in favor of the alternative hypothesis. The

application of the causality test rejects our hypothesis. Accordingly, there is bidirectional causality between R_DJS_Europe and R_DJI_Europe at 5 percent confidence level. There is also a bidirectional directional causality between R_DJS_Asia and R_DJI_Asia at 1 percent confidence level. There is bidirectional causality between R_DJS_US and R_DJI_US at 1 percent and 5 percent confidence level.

Second, the Breitung and Candelon approach was used to analyze the subject in greater detail through the decomposition of the casual relationship into frequency components. The results covering the period 2011-2018 show 3 panels: A- Frequency Causality from DJS-Europe to DJI-Europe, B-Frequency Causality from DJS-Asia to DJI-Asia, C-Frequency Causality from DJS-US to DJI-US. The importance of frequency domain graph and table by understands whether Islamic stock market Granger-cause Sustainable Islamic stock market and the inverse is true.

Table 20 below gives us a global idea about the type of causal relationship between the Islamic and sustainable stocks market under study. These results below show that on the medium-term there is a causal relationship from DJI-Europe to DJS-Europe. Likewise, on the short-term, corresponding to wavelength of $2.0< \omega \leq 3.0$, there is a unidirectional causal relationship from DJI-Europe to DJS-Europe and bidirectional causal relationship at $\omega=3.0$. At $2.5< \omega \leq 2.7$, there is a bidirectional causal relationship between DJI-Asia and DJS-Asia .The MS Granger shows that DJI-Asia stock market lead to DJS-Asia stock market at $2.5< \omega \leq 2.7$ and DJS-Asia stock market causes DJI-Asia stock market at $2.2< \omega \leq 3.0$. Likewise, there is a bidirectional causal relationship at $2.8< \omega \leq 3.0$ between DJS-US and DJI-US.

The graph of a frequency domain in figure 15 below indicates the portion of the signal which exists within each frequency band over a range of frequencies. The Figure 15--a to-c is useful to predict the positive and negative effects of the sustainable stock market on their Islamic counterparts and the inverse is true. The test statistics are showed with 5 percent critical values. These critical values are represented by the dashed line over $[0, \pi]$. The abscissa horizontal (X) axis refers to the Frequency and the ordinate vertical (Y) axis refers to the F-statistics values. In figure 15--a, we provide existence of a medium-run and short-run

predictability. On the medium-run, this match up cycle components with wave lengths less than 3.22 days. Thus, there is a significant effect of DJI_Europe on DJS_Europe at 5 percent significant level implying a wavelength of less than 3.22 days. On the short-run, we provide an evidence of a short-run causal relationship at 5 percent significance level. This corresponds to the existence of a predictive power with a wavelength varying from 3.04 days to 2.07 days. Likewise, we notice a short-run effect of DJS_Europe stock market on its Islamic counterpart with wavelength less than 2.07 days. The Figure 15--b shows the existence of a short-run causal relationship from DJS_Asia to DJI_Asia and from DJI_Asia to DJS_Asia at 5percent significance level. This evidence implies a wavelength of less than 2.52 to 2.32 days and 2.75 to 2.07 days respectively. The Figure 15--c also shows an existence of a short run causal relationship from DJS_US TO DJI_US and from DJI_US to DJS_US at 5 percent significance corresponding to a wavelength of less than 2.23 and 2.07 days.

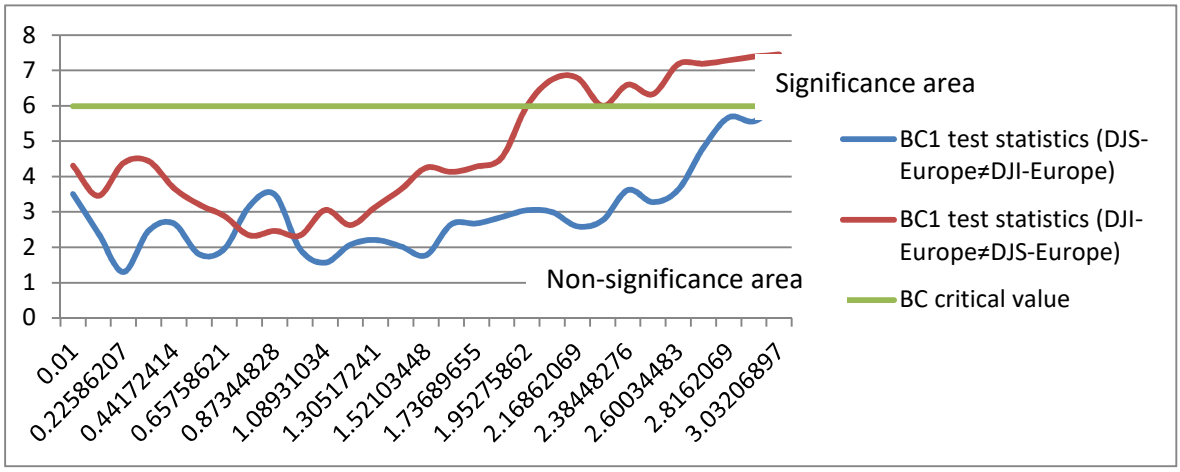
Table 20. Unconditional Causality among Dow Jones variables

		Europe		Asia		USA	
Frequency (ω)	**Days**	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Long-term 0,01< ω ≤ 0,981379	628 6.41	×	×	×	×	×	×
Medium-term ω =1,089310 ω =1,952759	5.81	×	×	×	×	×	×
	3.22	×	√	×	×	×	×
Short-term ω =2,06069	3.04	×	√	×	×	×	×
ω =2,16862	2.91	×	√	×	×	×	×
ω =2,27655	2.77	×	√	×	√	×	×
ω =2,384482	2.63	×	√	×	√	×	×
ω =2,492413	2.52	×	√	√	√	×	×
ω =2,600345	2.41	×	√	√	√	×	×
ω =2,708276	2.32	×	√	√	√	×	×
ω =2,81621	2.23	×	√	×	√	√	√
ω =2,924138	2.15	×	√	×	√	√	√
ω =3,032069	2.07	√	√	×	√	√	√
Conventional Granger	-	3.5922**	3.6718**	12.6737***	12.7825***	4.2589**	7.9178***

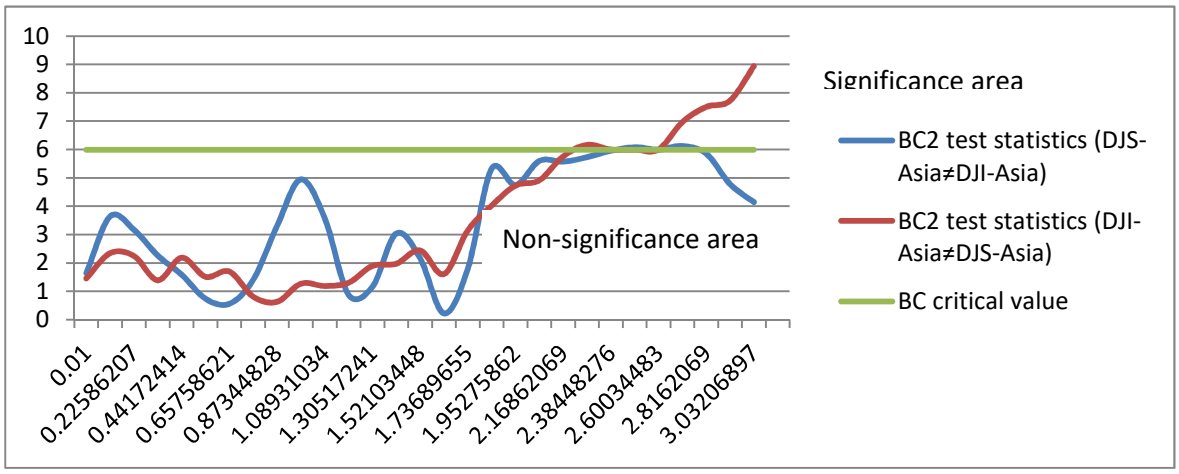
Notes: ***, and * imply significance at the 1 percent, and 5 percent level respectively, (1), (2), (3), (4), (5) and (6) reflect BC1 test statistics(DJS-Europe≠DJI-Europe), BC1 test statistics (DJI-Europe≠DJS-Europe), BC2 test statistics (DJS-Asia≠DJI-Asia), BC2 test statistics (DJI-Asia≠DJS-Asia), BC3 test statistics (DJS-US≠DJI-US) and BC3 test statistics (DJI-US≠DJS-US) respectively. Frequency (ω) = 2π/cycle length (T).

Figure 15. Breitung and Candelon (2006): Unconditional Frequency domain Causality between Islamic and Sustainable stock market

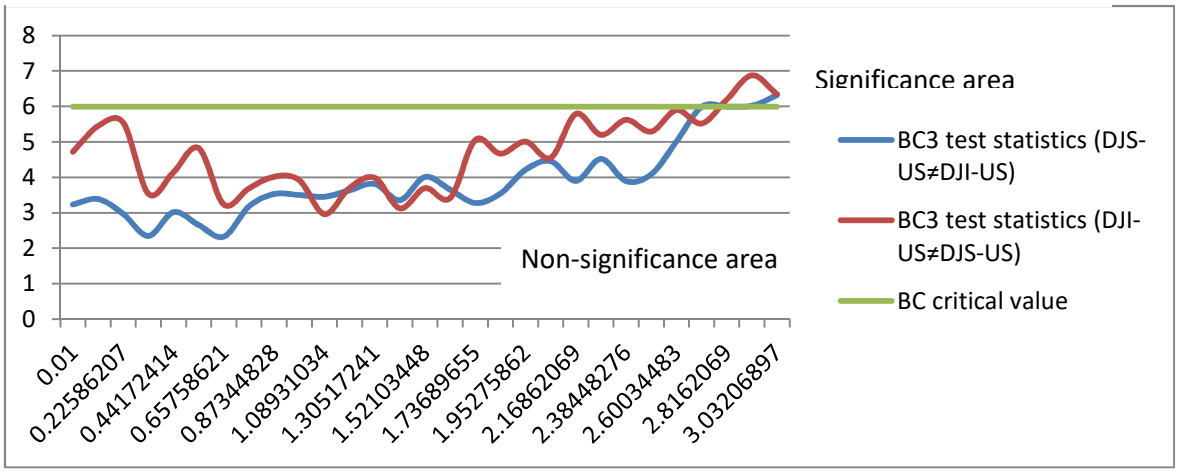
A. Frequency Causality from DJS-Europe to DJI-Europe and vice versa



B. Frequency Causality from DJS-Asia to DJI-Asia and vice versa



C. Frequency Causality from DJS-US40 to DJI-US and vice versa



4.4. Robustness checks: Conditional Causality Analysis

We rely on the conditional analysis to explain the role of the volatility index (VIX) in explaining the causal interaction between our Islamic indices under study and their sustainable counterparts. Moreover, this analysis will allow us to detect the robustness of the unconditional causality analysis. According to Barnett and Seth (2014), when the conditional constraint is included, the causality from two variable can be considered as "the degree to which the past of the first variable of interest helps predict the second variable of interest beyond the degree to which the latter is already predicted by its own past and the past of the conditional variable". The two interest variables in our study are the Islamic and sustainable indices.

The conditional causal relationship between stocks has been studied in literature with results that show the relationship varies across frequencies and time. The understanding of this relationship is very helpful in managing risk and allocating assets during period of uncertainty especially for portfolio managers, hedge or mutual, and financial institutions. Recently, the literature pays more attention to the investors' sentiments, uncertainty index and volatility and its effects on the stock markets. However, there is no study to our best knowledge has been done on the effects of VIX on ethical stocks.

Risk is divided into several categories such as investment risk which refers to risk that is related to returns on future investments. The growth in hedging theories has led to the awareness of participants on the implications of the information on markets. The Volatility Index (VIX) is considered one of two standards to measure risk or to manage risk. The Volatility Index (VIX) obtains the "weighted averaged of the implied volatility series" through placement of the S&P500 index premium prices of the most recent two months along with the utilization of the closest "at-the-money calls.

The reported results are considered to be unexpected. A substantial change in this link is noticed when VIX is taken into consideration. VIX shows its indirect effect on the directionality of our indices. Knowing that the period under study has noticed a rise in volatility since 2011. In

Europe, we see bidirectional causality between R_DJS_Europe and R_DJI_Europe. On the long-run and medium-run, there is effect of R_DJS_Europe on R_DJI_Europe at 10 percent significant level. This corresponds to the existence of a predictive power with a wavelength varying from 17.44 days to 3.14 days. Likewise, we notice a long-run and medium-run effect of DJI_Europe stock market on its sustainable counterpart with wavelength between 7.57 days and 2 days. In Asia, we see unidirectional causality on the long-run and medium-run going from R_DJS_Asia to R_DJI_Asia at 5 percent significant level. This corresponds to the existence of a predictive power with a wavelength varying from 628 days to 2.8 days. In USA, we notice bidirectional causality between R_DJS_US and R_DJI_US at 5 percent significance level on the long-run, medium-run and short-run business cycles. This effect appears with wavelength between 628 days and 2 days. Accordingly, we can conclude that the results change conditionally to the situation of investors fear. Thus, the investors fear gauge represented by VIX has an important influence on the causal interaction between the indices in different regions under study. Thus, VIX implies its effects on the stock markets of other countries and not solely to the US stock market (e.g. Chang et al.2016). It was discovered by Sarwar (2012) that the BRICS market index was also influenced by VIX in addition to the US stock market returns. The MENA region financial markets were analyzed by Trichilli et al. (2009) show that the future Islamic Index return are conditional to investors' fear.

The relationship between stock market indices varies based on the criteria and constraints that are taken into account. In addition, the causal relationship between stocks market can vary according to the market uncertainty as a result of political or economic, disasters, institutional issues, pandemics, environmental issues, investor attention, etc. (e.g. Zhu et al. 2019; Bash and Alsaifi, 2019). Thus, changes in the US market conditions and macroeconomic variables affect the global financial market in a similar manner as with emerging markets due to their sensitivity (e.g. Mensi, 2014). Uncertainty in the US is negatively correlated with returns on US equities which raises the possibility that in emerging markets returns can be impacted negatively as well (e.g. Jubinski and Lipton, 2012). In emerging markets and BRICS, US uncertainty is considered as a good proxy per a study conducted by Sawar and Khan (2016). This was noticed during the period of our study which varies between

2011 and 2018. During this period, many events happened and affected the stock-market behavior. Examples of these events are consequences of last 2008-2009 economic crisis, the oil shock of 2014, the drop in the Chinese stock market, the demonetization in India in 2016 and the US presidential election in 2016. The current economic situation along with investors' wealth can be gauged through the indices. During period of high uncertainty, investors buy or sell in the stock market due to fear or greed. For instance, the 2008-2009 international financial crisis has created panic for investors. This phenomenon caused them to dump stocks. According to Gopal et al. (2019), the change in volatility after the crisis led investors to focus on the diversification of their investment portfolios. A negative correlation exists between a stock market and a low VIX whereby there is a minimal change in the market. However, and a high VIX value would signal a significant change in the market index. Moreover, Pastor and Veronesi (2012, 2013) have attempted to analyze the relationship between the behavior of the stock market and political uncertainty. The research conducted by Pastor and Veronesi suggests that "three types of shocks affect asset price and they are; impact shocks, capital shocks, and political shocks". For instance, one week prior to the 2016 American presidential election, investors' overreaction was very high. A reported increase of 0.44 basis VIX level was applicable to almost all equity markets along with significant t-statistics. An increase of 0.79 basis points was reported on the Japanese VXJ over other markets.

In this context, we should note that in addition to the macroeconomic environment, market capitalization of financial indices is considered as a performance index and can affect the relationship between financial indices (e.g. Babu (2007)). The high the performance index, the higher the causality is between the indices in each region. The performance index varies according to the regions. For instance, according to Dow Jones database, the median of total market capitalization in Asia pacific of Islamic index is around USD 6.6 billion versus 9.7 billion in Europe. However, for USA, the median total market capitalization reaches the highest value by around 16 billion in the beginning of the first month of this year. For sustainable indices, North Americas including US is in the top following Asia Pacific and Europe. For instance, in our study, the median market capitalization in USA in the highest in terms of Islamic and sustainability indices which can reflect the high bidirectional causality between them.

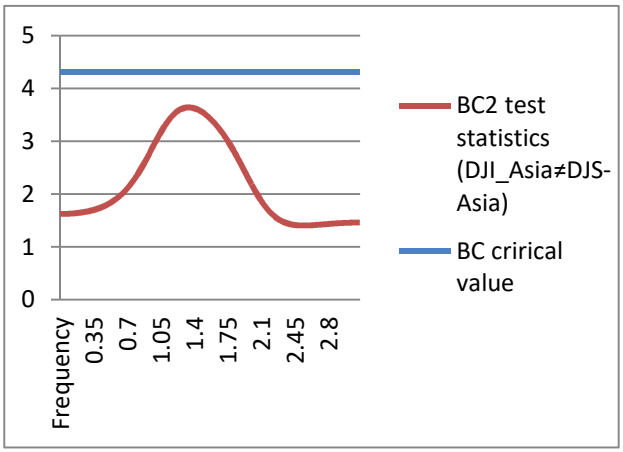
Table 21. Conditional causality among Dow Jones variables

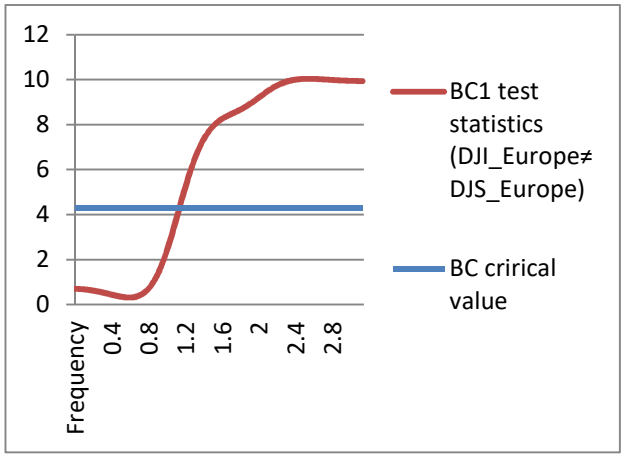
		Europe		Asia		USA	
ω	Days	(1)	(2)	(3)	(4)	(5)	(6)
Long-term 0.01< ω ≤ 0,36	628	×	×	√	×	√	√
	17.44	√	√	√	×	√	√
Medium-term ω =1.089310 ω =1.952759	5.81	√	√	√	×	√	√
	3.14	√	√	√	×	√	√
Short-term ω =2.06069	3.04	×	×	√	×	√	√
ω =2,16862	2.91	×	×	√	×	√	√
ω =2,27655	2.8	×	×	√	×	√	√
ω =2,384482	2.63	×	×	√	×	√	√
ω =2,492413	2.52	×	×	√	×	√	√
ω =2,600345	2.41	×	×	√	×	√	√
ω =2,708276	2.32	×	×	√	×	√	×
ω =2,81621	2.23	×	×	√	×	√	√
ω =2,924138	2.15	×	×	×	×	√	√
ω =3,032069	2.07	×	×	×	×	√	√
ω =3,14	2	×	×	×	×	√	√

Notes: (1), (2), (3), (4), (5) and (6) reflect BC1 test statistics(DJS-Europe≠DJI-Europe), BC1 test statistics (DJI-Europe≠DJS-Europe), BC2 test statistics (DJS-Asia≠DJI-Asia), BC2 test statistics (DJI-Asia≠DJS-Asia), BC3 test statistics (DJS-US≠DJI-US) and BC3 test statistics (DJI-US≠DJS-US) respectively.

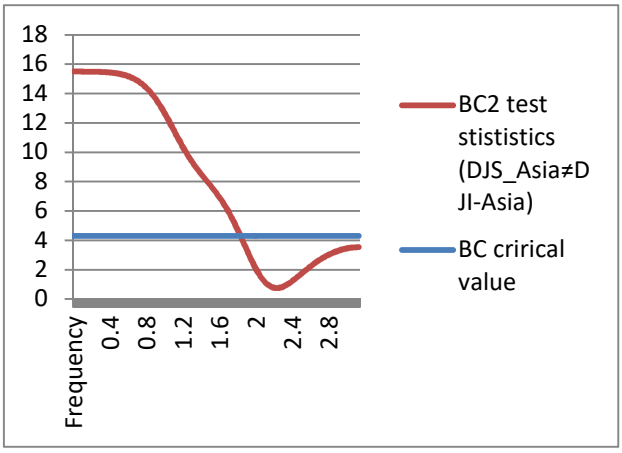
Figure 16. Frequency domain among VIX and Dow Jones variables (Breitung and Candelon, 2006)

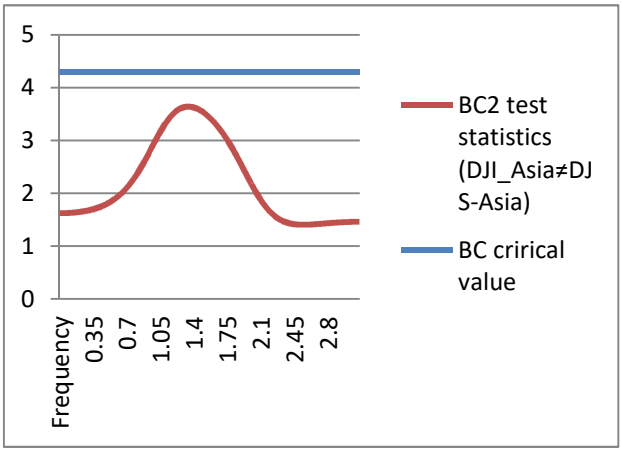
A. Conditional Frequency Causality from DJS-Europe to DJI-Europe and vice versa



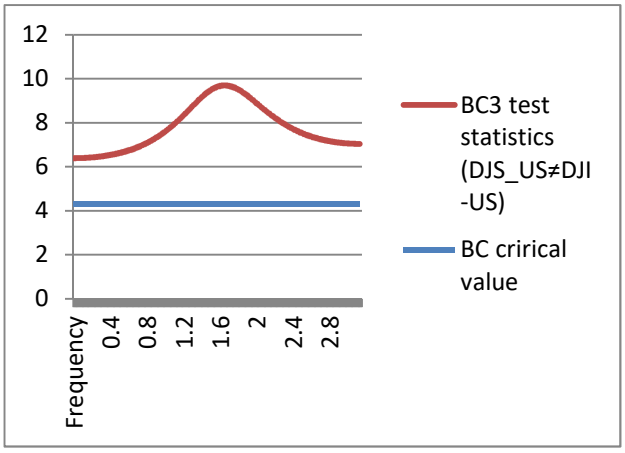


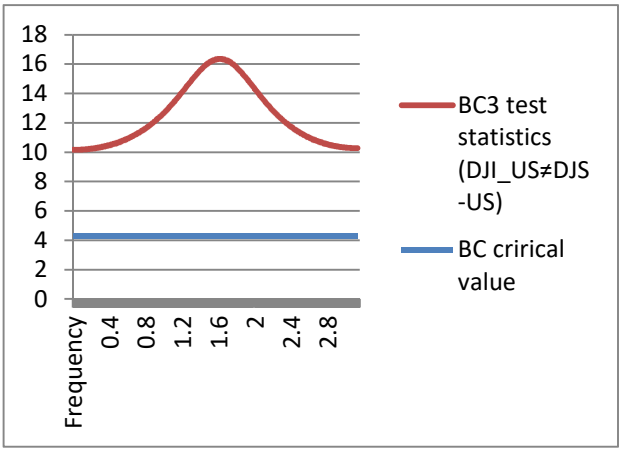
B. Condidtional Frequency Causality from DJS-Asia to DJI-Asia and vice versa





C. ConditionalFrequency Causality from DJS-US40 to DJI-US and vice versa





5. Conclusion

In this study, first we seek to estimate the interaction between Sustainable stock market and Islamic stock market in USA, Europe and Asia-Pacific. In addition, we seek to detect the "investor optimism-pessimism expectation" using daily data from 2011 until 2018. Throughout this analysis, we use the ARDL bounds testing approach which shows that by taking the sustainable indices as dependent variables, for DJI_US and DJI_Asia_PACIFIC have influence on the DJS_US40 and DJS-ASIA_PACIFIC respectively on the short and long-term. However, DJI_EUROPE has no influence on the short term on the DJS_EUROPE. By taking the Islamic indices as dependent variables, there is influence of the three sustainable indices under study on the Islamic counterparts on the short and the long run as well. Thus, we confirm the existence of a long-run equilibrium and the position of the stock markets as complements mainly on the short term and substitutes on the long-term. Moreover, for the structural stability, there are no serious problems. Given that the results are robust, it is deemed that they can be trusted.

It is quite important to consider that the insignificance effect in the Eurozone can be related to the fluctuations in the market during the period under study (from 2011 to 2018). The Eurozone was exposed to many shocks and anxiety moments. There was a sharp fall in the European stocks market especially between June 2015 and early February 2016. In addition to that, we should consider that the Islamic investing in Europe is still in its beginning as there is little competition due to the limited number of Islamic banks or investment funds. It is also important to note the Islamic finance in Europe faces many challenges in terms of legal structure that are difficult somehow to solve (except for UK) .The UK distinguishes itself from the rest of the authorities with its regulations which are implemented by the Financial Services Authority (FSA) whereby Islamic finance is regulated with the same conditions as traditional finance. Its motto is "without obstacles and without treatments of favor". The case of USA is quite similar to UK. The United States which is also more pragmatic in terms of developing "legal frameworks for insolvency and bankruptcy". Concerning the region of Asia pacific, most Islamic banking assets have recently been centralized in the Gulf region as well as in Southeast

Asia. Thus, taking the characteristics of each market is absolutely essential in our study. The results are correlated to the findings of Forte and Miglietta (2011) who find that SRI and Islamic finance are different especially in terms of countries and sectors.

Having confirmed the existence of a long-run relationship between Sustainable stock market and Islamic stock market in countries under study, we apply a "frequency-by-frequency" causality to identify the direction of causality. This later technique straightens out the low frequencies and high frequencies components of a serial time. The study findings show that when applying a non-conditional causality, there is existence of a bidirectional causal relationship on the short-term between the three sustainable stock market and their Islamic counterparts. However, the results are influenced by the volatility index (VIX). As the financial stock market is suffering from imperfections especially during the last decade, we cannot ignore the influence of the volatility index on the linkage between financial stocks market. The implied volatility index shows that there is change in the observed causal relationship whilst shifting from unconditional to conditional causality analysis. Accordingly, within the conditional causality we see effect not only on the short-run but also on the medium and long-run.

We should note that this study can be extended by taking into consideration the influence of macroeconomic variables into consideration. Stock markets are influenced by macroeconomics variables is a claim that is valid in financial economic literature (e.g. Mukherjee and Naka (1995)). Macroeconomic factors such as interest rates and exchange rates affect the stock market as Ross's per the Arbitrage Pricing Theory (APT) in 1976 (e.g. Kurihara (2006), Doong et al. (2005), and Aydemir and Demirhan (2009)). Real effective exchange rate has an effect on the Islamic stock market. It was also found that Islamic stock prices rose when international and domestic interest rates rose due to the fact that investors buy more Shariah compliant stocks (e.g. Habib (2016), Hakim & Rashidian, 2002, Islam & Habib, 2014b)). Accordingly, we can take the exchange rate as an explanatory variable to understand the relationship between our ethical indices under study. This variable can be a good constraint to also detect the causality between them. Thus, including different macroeconomic variables in a following study can be interesting for investors and policymakers. We can also study the

relationship between market capitalization and our ethical indices. This will help portfolio managers and other market players to maximize their profits by optimizing their portfolios and allowing them to make good decisions.

The results are quite important for the investors to better detect the performance of their portfolio. Thus, these findings are essential for investors in order to make the right decisions in the right time. Knowing that taking into consideration other economic factors is also important to be rationally exposed to the stock market. The results are coherent and logical as the foundation of Sustainable and Islamic finance is quite similar. Islamic investing is considered as a subdivision of socially responsible investing with stricter screening criterias. Many investors who believe in the concept of “doing well while doing good” will be willing to diversify their portfolios in order to minimize the risks especially in bullish and bearish periods. Based on the same global concept, we can clearly see the connection between SRI and Islamic financing whereby ISRI is a broad topic in the investment world. These findings show the ability to diversify is an additional opportunity without losing in profits. However, a lot of other considerations should be taken into account. Islamic finance in general should be involved in “mainstream sustainability investing”. Likewise, there is a possibility to integrate so many “Hallal” investments with sustainable investments so finance can be understood in a "secular" way.

General Conclusions

After the consequences of 2008-2009 international financial crisis, the concept of alternative finance starts to expand worldwide. Many questions have been investigating the Islamic financial system, the Bitcoin and the socially responsible investment.

The topics of resilience, intergenerational ethics, and sustainability are becoming important topics of discussion in religious conversations amongst the Muslim communities. Emerging and developing countries consider Islamic finance as a potential tool to solve issues related to poverty reduction, developmental challenges, and to achieve prosperity. It is believed that these can be achieved through Islamic finances inclusive consequences of its requirement for risk sharing and the link it has with real economy assets.

Critics, proponents, and stakeholders are willing to implement the ethical teachings of Islam and thus are ready to take on the current concerns associated with Islamic finance. Islam is characterized with thoughts for valuing fairness, balance, moderation, and compassion. Thus, social responsibility and impact should be methods and consequences of any commerce conducted in light of Islamic teachings. The Equator Principled share similarities with Islamic views on responsibility and sustainability whereby they obligate financiers to abide to environmental responsibility for the projects they support. Sustainability and contemporary responsibility initiatives may be adopted by Islamic institutions in an effort to support ethical values of Islam. For instance, the Clean Energy Business Council, Gulf Bond, Sukuk Association, and the Climate Bonds initiative have collaborated to establish the Green "Sukuks" and Working Party (GSWP) as well as to develop and promote financial products which are "Shariah compliant". These products are intended for investment in solutions for climate change. The "Sukuks" market is considered as a suitable option to assist in the growth and funding of "Shariah compliant" environmental and renewable energy projects.

The rise of virtual currencies has also significantly touched the Islamic financial world. The largest percentage of "Shariah" scholars is present in Malaysia whereby they support the

idea of “Hallal” cryptocurrencies. However, some scholars state that a better understanding of the technology associated with cryptocurrencies would to achieve in order to properly assess it. Blossom Finance which is a microfinance fund introduced Smart “Sukuks” in October 2018. It is considered as the first “Sukuks” based on blockchain technology. The issuance process is considered to be more efficient, cheaper, and allows easy access to customers by using the blockchain technology.

In the first chapter, we notice the expansion of Islamic finance not only in Muslim countries but also in non-Muslim countries which growth reached 20.2 percent in 2018 and in Asia by 16.3 percent while in Africa it was around 12.6 percent. This emergence was reflected by a growth of 6 percent of Islamic assets compared to conventional ones. It should be noted that in the last two decades, the Islamic finance sector has grown by 7.59 percent in “Shariah” asset growth globally in 2018. Iran is the country that was leading the sector in terms of shares with a share of 28.6 percent of the global Islamic assets. Saudi Arabia comes in second place with 25 percent of the total Islamic assets. A surge in geopolitical risk and ensuing delays of some of these initiatives could negatively affect the base-case scenario as the GCC economies are heavily dependent on oil prices. The other challenge is falling oil prices which negatively affect the income and wealth of a population and therefore create a liquidity risk. Moreover, the three key risks that we foresee for GCC Islamic banks are regional geopolitical tensions, higher cost of risk, and lower profitability. The end of the triple-digit-oil-price era has significantly slowed GCC economies and reduced growth opportunities for their banking systems. In the western countries, the United Kingdom is top one. The Islamic financial market of the UK is very advanced and is considered a key market for foreign “Shariah-compliant” institutions. In 2017, the total assets of UK-based institutions that offer Islamic finance services amounted to USD 6 billion and composed of 6 Islamic banks. The UK has implemented an extensive range of regulations and policy that support the Islamic finance sector and that are intended to expand the market of Islamic finance services

In the second chapter, we seek to study the efficiency of Islamic banks in the GCC region by relying on a stochastic cost frontier (parametric approach) and data envelopment method

(non-parametric approach). We rely on the production function and the input orientation and then the output orientation. We got in general similar results. We remark in the five countries under study, considerable level of inefficiency equal to 38 percent and 25 percent as estimated by the stochastic frontier and DEA input orientation respectively. In addition, we remark dispersion in inefficiency between countries according to the two methods used between 2004 and 2007 and decreasing from 2009 onwards according to DEA approach, and slightly increasing over the entire period according to the stochastic frontier. The annual evolution of cost efficiency of banks remains contained within a narrow range [62 percent-73 percent]. By applying the output orientation, we got levels of inefficiency equal to 22 percent and 35 percent as estimated by the stochastic cost frontier and the DEA method. Concerning the spearman correlation, there is in general stability in the results. The cost inefficiency in the Islamic banks under study can be due to many factors such as quality of production factors, the productive dimension of the banks, the management of the banks,...etc. To understand the inefficiency scores, we study the effects of several internal and external variables of the efficiency of the Islamic banks under study. Concerning the macroeconomic variables, we notice that the inflation doesn't have any influence on the efficiency scores. However, we see a significant positive relationship between the growth rate of the economy and the efficiency. Concerning the internal variables, we notice a positive significant relationship between cost efficiency and the bank profitability on one hand and the cost efficiency and bank size on the other hand. However, we notice a negative significant relationship between the capital ratio and the cost efficiency. We don't see an explanatory relationship between the bank liquidity and the cost efficiency on one hand and banking risks and cost efficiency on the other hand.

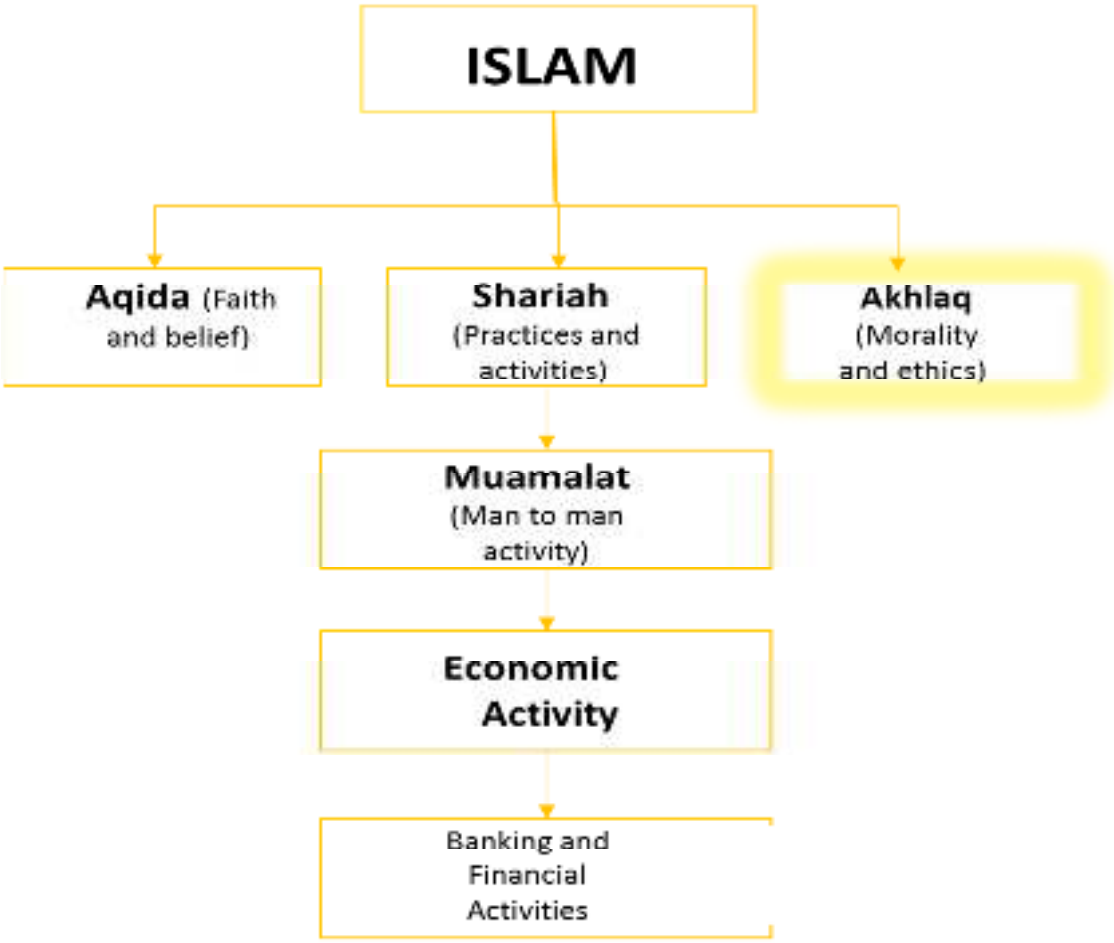
In the third chapter, we are seeking to study the characteristics of Bitcoin versus four Islamic indices in developed and developing countries as well. By relying firstly on family Garch models and more precisely on the component Garch model (1, 1), we compare the volatility of the indices and we discover that Bitcoin in general is more volatile and following an explosive behavior than Islamic indices. Moreover, by applying the Markov Switching model, we determine the characteristics of the changes of indices in two regimes. The first one represents the low risk regime and the second one represents the high risk regime. We conclude that

Bitcoin can be served as a safe haven or weak hedge and also can be chosen as a good diversifier rather than a substitute. Accordingly, Islamic investors should include Bitcoin in their portfolio in order to minimize their risks especially during extreme market downturns. However, Bitcoin has also been criticized for having numerous technical issues, however, a comprehensive understanding of potential issues that may arise will allow stakeholders to implement robust system and continuously update the systems to avoid such issues. Legally, Bitcoin has also faced criticism as potentially being a currency that is utilized to conduct illegal transactions. Its high volatility has also been labeled as a weakness given that the number of Bitcoin in circulation is small and a limited number of merchants have implemented it as an acceptable form of payment. Bitcoin has recently gained popularity; however, many governments have banned the use of the cryptocurrency and opposed it due it not being overseen by a monetary authority or centralized body which leads to limited security over it. Users of Bitcoin receive limited or no legal protection which has led to a struggle for governments in regulating its activities. Criminals can easily utilize it for money laundering, fraud, and theft.

In the fourth chapter, we seek to detect the interaction between sustainable indices and Islamic indices in three regions: USA, Europe and Asia-pacific. We rely on ARDL model; we see a reciprocal influence by Islamic indices and their sustainable counterparts on the short-term and long-term as well. Furthermore, we discover a long-run equilibrium between the indices under study by applying the Walt test. However, the non-influence in the European market can be due to many reasons such as the sharp fluctuations in the European stock market after the international financial crisis and Cyprus Banking crisis in 2013. In addition to that, we should note that the European market is still in its beginning in terms of Islamic finance. After the application of the frequency domain causality which is distinguished by its capability to straighten out the low frequencies and high frequency components, we notice the existence of a bidirectional short-run causality between sustainable indices and Islamic indices under study. Thus, investors can diversify without losing in profits. This combination of these two types of indices allows us to take investment from a secular way.

APPENDIX

Figure 1. Shariah in Islam



Source: Author's structure, Chammas Ghassan (2010), Université Saint Joseph

Figure 2. The benefits of the PLS Principle on the economy

Source: Doctrine Malikite-2016, Author's r's structure

Graph 1. Islamic Finance Assets growth

Source: Islamic Finance Development Report 2015, ICD-Thomson Reuters

Table 1. Balance sheet Growth in selected GCC Islamic Bank Markets

(Mil $)	2013	2014	2015	2016	2017
Qatar					
Balance sheet growth	58,098	69,419	81,381	87,866	95,756
Annual growth rate (%)	12.1	19.5	17.2	8.0	9.0
Relative weight is sample (%)	16.5	17.6	19.3	19.6	19.9
Kuwait					
Balance sheet growth	78,457	85,689	83,461	83,560	89,138
Annual growth rate (%)	7.9	9.2	(2.6)	0.1	6.7
Relative weight is sample (%)	22.3	21.7	19.8	18.6	18.6
Saudi Arabia					
Balance sheet growth	107,412	121,264	124,563	136,138	140,366
Annual growth rate (%)	8.2	12.9	2.7	9.3	3.1
Relative weight is sample (%)	30.6	30.8	29.6	30.3	29.2
United Arab Emirates					
Balance sheet growth	86,212	94,202	107,392	118,014	129,471
Annual growth rate (%)	16.2	9.3	14.0	9.9	9.7
Relative weight is sample (%)	24.6	23.9	25.5	26.3	27.0
Total	351,118	394,026	421,401	448,992	480,176

Source: S&P Global Ratings, banks' financial statements.

© Standard & Poor's 2018.

Table 2. Muslim Population by Regions

	2010		2030	
	ESTIMATED MUSLIM POPULATION	ESTIMATED PERCENTAGE OF GLOBAL MUSLIM POPULATION	PROJECTED MUSLIM POPULATION	PROJECTED PERCENTAGE OF GLOBAL MUSLIM POPULATION
World	**1,619,314,000**	**100.0%**	**2,190,154,000**	**100.0%**
Asia-Pacific	1,005,507,000	62.1	1,295,625,000	59.2
Middle East-North Africa	321,869,000	19.9	439,493,000	20.1
Sub-Saharan Africa	248,544,000	15.0	385,939,000	17.6
Europe	44,198,000	2.7	58,209,000	2.7
Americas	5,256,000	0.3	10,927,000	0.5

Population estimates are rounded to thousands. Percentages are calculated from unrounded numbers.
Figures may not add exactly due to rounding.

Pew Research Center's Forum on Religion & Public Life • *The Future of the Global Muslim Population*, January 2011

Appendix 1. Investment Policy Risks

Islamic financial instruments are complicated in nature and limited investment activities, Islamic banks face several risk categories:

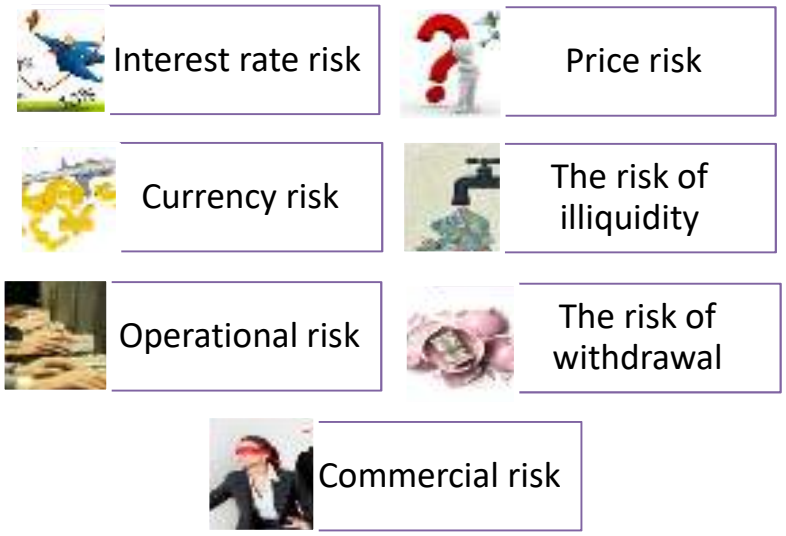
Credit risk

This type of risk will be associated with losses in the event of a borrower defaulting to repay its bond or credit on the due date. Indeed, the Islamic bank confronts this risk because of the poor performance of the partner by either offering funds to customers in a previous way as in the case of contracts "Salam" and "Istisna'a", or in offering goods as in the case of the "Murabaha" contract.

With regards to the problem of late payments, the teachings of the “Shariah" law forbid the imposition of penalties for profit. Indeed, Islamic banks keep them in the funds of "Zakat". However, some jurists consider that this imposition is legal because it represents a kind of compensation to minimize the potential losses of Islamic banks.

At Market Risks

Figure 3. Typology of Market Risks



Appendix 2. The Difference between Efficiency and Productivity

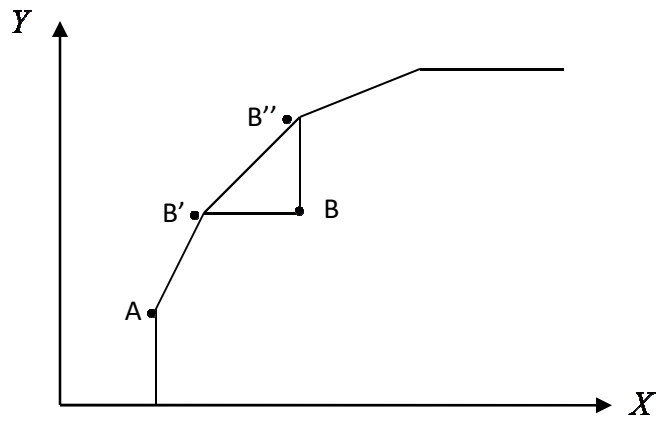
The concepts of efficiency and productivity are different. Efficiency is defined in terms of inputs, and measures the difference between the observed use and the optimal use of inputs for a given level of production. On the other hand, the partial (or overall) productivity is defined as the ratio of the realized (or all outputs) to a particular (or to a set of) input. However, the two concepts are complementary.

With the combination of the two concepts, we can study the technical efficiency for a given level of production and a minimum level of inputs, and we can also diagnose the efficiency of scale through the decision making unit. With a global productivity indicator, the production unit is compared to the most productive unit, even if it uses a different technology. A measure of the productivity of each production unit can be performed by the output/input ratio.

In figure 3, we have a production plan that uses a single input to produce a single output. In this case, we have one production factor over a single output. The production technology that converts the input into output can be summarized in two forms:

- A production technology with constant returns to scale
- A production technology with variable returns to scale

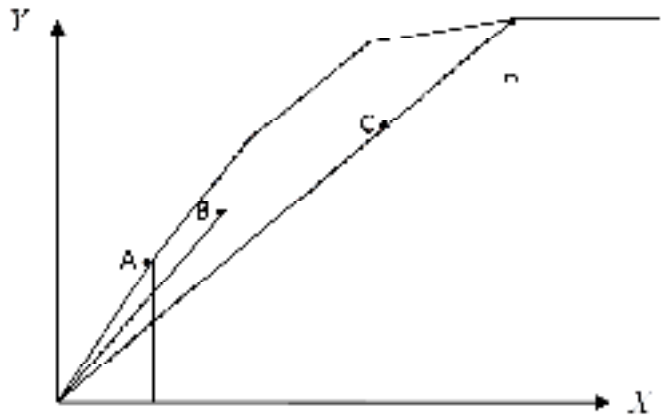
Figure 4. A Production Plan on the Entire Production



In Figure 3, the points A, B' and B" are production plans allowing a production unit to maximize output for a given X input factor. All points lying to the interior of the production frontier – point B – are considered inefficient, because by using the same amount of factor X, it can increase the level of output (point B"). In contrast, if the production unit wants to keep the same level of output, there is always a possibility of reducing the consumption of the input factor (point B').

In Figure 4 below, we have graphical representation of the difference between the concepts of productivity and efficiency. In this figure, the production units A and D are considered efficient because they are part of the production frontier. Whereas units B and C are inside the frontier and are considered to be inefficient.

Figure 5. Distinction between Productivity and Efficiency



There are 3 scenarios that demonstrate the distinction between the two concepts:

- Unit B is more productive than unit D, but it is less efficient than unit D
- Unit D is more efficient than unit C, but the two points have the same level of productivity
- Unit A is more productive than unit D, but the two units have the same level of efficiency.

Appendix 3. The Parametric Deterministic Approach

The parametric method was firstly introduced by Farrell in 1957. Indeed, Farrell has proposed calculating a convex hull of the observed set of input/output ratios. Not all the functional forms are used today, where it is recommended to use the Cobb-Douglas function to set the hull. Aigner and Chu (1968) were the first to implement the propositions of Farrell. They specified a homogeneous production frontier of Cobb-Douglas form, which requires that all the observations to be positioned under or over the frontier. Their model can be described as follows: $\begin{cases} ln\, y = ln\, f(x) - u \\ ln\, y = \alpha_0 + \sum \alpha_i ln\, x_i - u, u \geq 0 \end{cases}$ **, (1)**

Initially, the model was estimated by linear programming methods. This was to minimize the sum of squared residuals, under the constraint that each residual is non-negative. This model can be written as follows:

$$\begin{aligned} & Min \sum_{i=1}^{N} \left[y_i - f\left(x_i;\beta\right) \right]^2 \\ & s.c. \quad y_i \le f\left(x_i;\beta\right) \end{aligned} \quad \textbf{, (2)}$$

According Aigner and Chu (1968), this problem can be solved by the quadratic programming method or by introducing the absolute value $\left| y_i - f\left(x_i;\beta\right) \right|$ instead of the sum of squared residuals which leads to the following linear program:

$$\begin{aligned} & Min \sum_{i=1}^{N} \left[y_i - f\left(x_i;\beta\right) \right] \\ & s.c. \quad y_i \le f\left(x_i;\beta\right) \end{aligned} \quad \textbf{, (3)}$$

Schmidt (1976) shows that this linear approach is equivalent to estimating β by the maximum likelihood method, with the provision that the residuals are half normal distributed (i.e. with only the positive part of the normal distribution). With these methods, estimators do not have the statistical properties that may refine the analysis (standard deviation, t-ratios,) because no assumption was made regarding the distribution of the error terms. To remedy this problem, it has been suggested in the literature to propose the following assumptions:

- u_i were distributed identically and independently
- The variable x was exogenous and independent of u.

Formally, we call this type of frontier, a deterministic parametric frontier. These frontiers can be estimated in three ways:

- The Correct Ordinary Least Squares (COLS)
- The Modified Ordinary Least Squares (MOLS)
- The Maximum likelihood (ML).

Winsten (1957) but usually attributed to Gabrielsen [1975], does not require any assumptions about the functional form of u_i , as it estimates the technology parameters of (6) by OLS and

corrects the downward bias in the estimated OLS intercept by shifting it up until all corrected residuals are non-positive and at least one is zero. The residual obtained from the COLS are then used to calculate the productive efficiency, which by this method, is between 0 and 1.

The MOLS methods were introduced by Richmond (1974) and requires assumptions about the functional form of u_i (half normal, truncated normal, exponential, etc.). MOLS proceeds by estimating β of equation (6) by OLS and estimates OLS intercept by shifting it up by minus the estimated mean of u_i , that is extracted from the moments of the OLS residuals. Finally, the OLS residuals are modified in the opposite direction, and used to estimate the efficiency score.The pitfall of this technique is that there is no guarantee that the intercept will be shifted up enough to cover all the observations and it will be possible, for some of them, to have $E_i > 1$, which will be very difficult to justify.

Furthermore, other forms can be used, but require estimating two additional parameters which are the following:

- The truncated normal distribution (Stevenson, 1980)
- The gamma distribution (Greene, 1980)
- The Weibull distributions, log-normal or log-logistic

The main disadvantage of this method is that it does not guarantee the value of the intercept initially estimated by the COLS, which will increase the production frontier that covers all the observations. If an observation is very high with a positive residual, the technical efficiency may be greater than 1. This makes this technique somewhat unsuitable for estimating the performance of individual production units. The second problem with this method is that the correction of the interept term is not independent from the chosen distribution for u .

Finally, the ML method was suggested by Afriat (1972), and used by Greene (1980) and Stevenson (1980). This method can be implemented by making an assumption about the functional form of the distribution component of a negative or zero inefficiency(u_i), and estimating simultaneously all the parameters of the equation (4) and the parameter (s) according to the distribution chosen as for the MOLS. Thus, the residuals can be used to

estimate the individual productive efficiency scores, which by construction are inclusive between (0) and (1). Note that the choice of distribution of u is important because the ML estimators, like those of MOLS, depend on the fact that different assumptions about the distribution of u leads to different estimators. This is problematic because there is no rational argument to favor particular distribution. Using the ML method for the production frontier estimation poses a second problem. The amplitude of the dependent variable, i.e. the output, depends on the estimated parameters as shown by Schmidt (1976). This calls into question the fundamental theorem that the ML estimators are asymptotically efficient. It follows that the ML properties must be reviewed (Greene, 1980).

The latter has shown that the usual asymptotic properties of ML estimators are preserved if the density function u satisfies the following conditions:

- It is zero at the point $u=0$
- Its derivative according to the parameters tends to zero as u approach zero.

As shown by Greene (1980), the density of the gamma function satisfies that criterion and is used here. Finally, it must be said that the three methods stated above are doubtful because they do not take into consideration the existence of a random component and attribute the entire distance between the observation and the frontier to technical inefficiency. The COLS and MOLS combine the incremental default only, adjust the intercept smoothing β identically to their values derived from OLS. The result is that the technological structure of the efficiency frontier is the same as that of the least efficient production units. This structural similarity invalidates the explanation that the efficient production units are efficient because they exploit opportunities for economies of scale. Conversely, the ML method enables this structural difference between the results produced by the MCO and the efficiency frontier.

The previous method implements a complex econometric regression technique that requires strong assumptions about the errors and a simultaneous estimation of partial differential equations. Berger and Humphrey (1991) adopted a different perspective, less demanding in terms of the hypotheses but more simple. They argued that the ad hoc assumptions of the

previous method on the nature of the errors are questionable because ascribing a particular probability distribution to some disruption influences the nature of the empirical results. Berger et al. (1993) have partially mitigated the problem by developing the concept of the "extended" frontier.

Instead of imposing specific restrictions on errors or functional form, these authors conducted an assessment in two stages. Starting from a given sample of production units, Berger et al. (1993) first estimated a (Translog) cost function formed on a sub-sample of units considered as the most efficient (the lowest average cost quartile). Then, they proceeded to the estimation of another cost function for a subsample of units considered inefficient (the highest average cost quartile).

The difference between the cost functions of the two most distant quartiles is a measure of bank efficiency, while the curve described by the cost function with the lowest average cost quartile defines an efficiency frontier. This method has no theoretical innovation and is experimentally reliable. Unfortunately, the relaxation of the restrictive assumptions on errors of the previous model was achieved at the cost of a concession on grounds of discrimination between groups of efficient production units and inefficiency. Certainly the partition of the sample classes is intuitive – it is likely that the most efficient units will have a lower average cost – but the empirical definition of the composition of the quartiles is unsatisfactory from a formal point of view.

Appendix 4. The Method of Maximum Likelihood and the Method of Correction by Moments

The writing of the likelihood model requires assumptions about the distributions of u_i and v_i:

- v_i is assumed to follow a normal distribution with a variance σ_v
- u_i follows, in most cases, a half-normal or double-exponential.

The joint distribution can be defined between u_i and v_i. The method is to express the marginal distribution e_i of integrating the joint distribution between u_i and v_i.The likelihood of the

model can be calculated and the parameters estimated. The resolution of the optimization program requires a Newton or Fletcher Powell algorithm, which is another algorithm was proposed by Greene (1982).

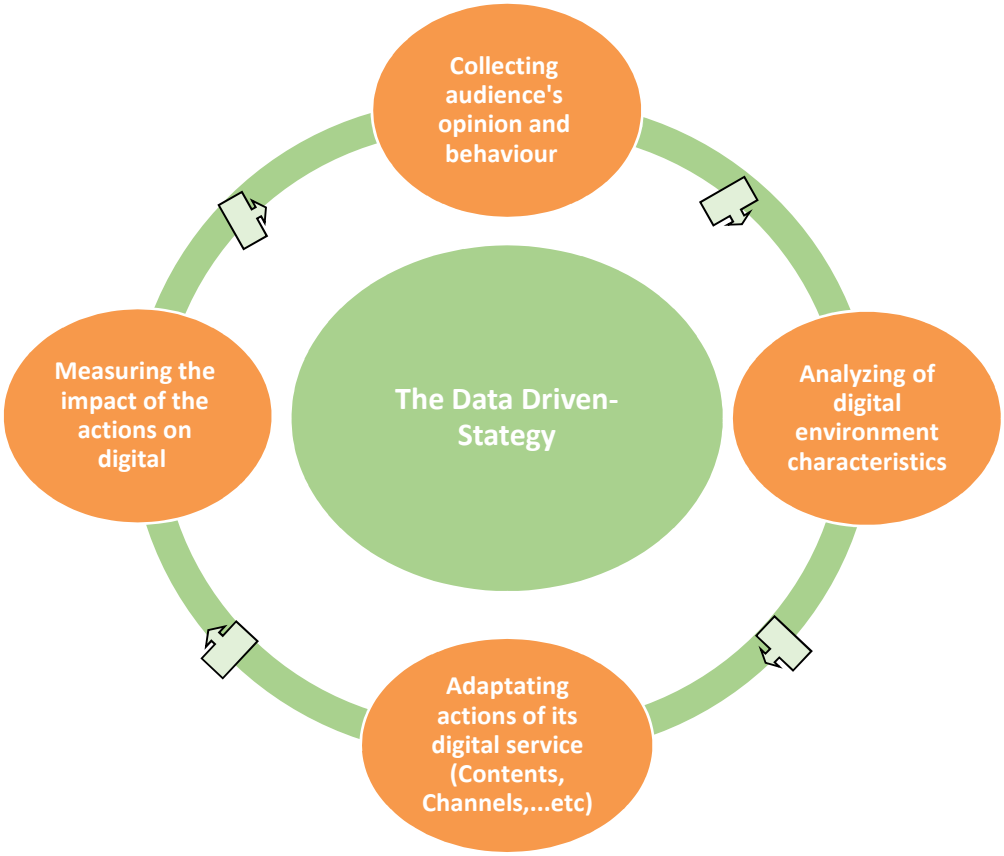
A justifiable solution to this problem was suggested by Jondrow, Lovell, Materov & Schmidt (1982), who argue that while $E(u_i)$ remains elusive to estimate, the residuals ε_i still contain information about the inefficiency, such that a conditional estimator is feasible. To this effect they derive the conditional distribution of $u_i|\varepsilon_i$ and suggest either the mean or mode of this distribution to be utilized as the firm-specific inefficiency. The authors show that the conditional inefficiency is distributed as $u_i|\varepsilon_i \sim N^+(\mu^*, \sigma^{*2})$, truncated below at zero. The conditional expectation is written as (Greene, 1991):

$$E(u_i|\varepsilon_i) = \mu_i^* + \sigma^* \left[\frac{\phi(\mu^*/\sigma^*)}{1+\phi(\mu^*/\sigma^*)} \right] = \sigma^* \left[\frac{\phi(\varepsilon_i\lambda/\sigma)}{1+\phi(\varepsilon_i\lambda/\sigma)} + \left(\frac{\varepsilon_i\lambda}{\sigma} \right) \right] \quad \textbf{, (4)}$$

The economic interpretation of the measurement of inefficiency is more intuitive. A production unit is considered efficient if it is above the estimated frontier (strictly positive residual). Otherwise, its efficiency is measured by the value of the residual corrected by the amount of variance of the inefficiency term in the total variance of the residuals.

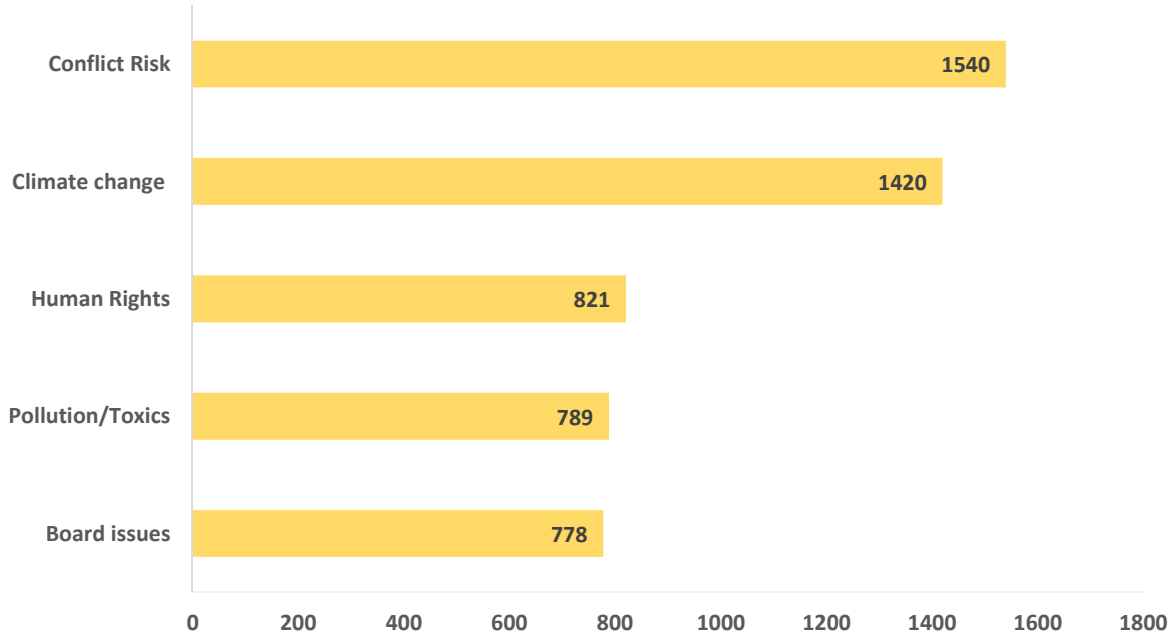
This technique allows individual estimation of inefficiency but as emphasized by Schmidt and Sickles (1984), any statistical value can be given, is an estimate based on a single observation. This limit can be exceeded by estimating the production, cost or profit frontier using panel data.

Figure 6. Data-Driven Algorithms



Source : Author's computation, Bolero (2017)

Graph 2. Money manager assets main distribution channels in Billions of Dollars

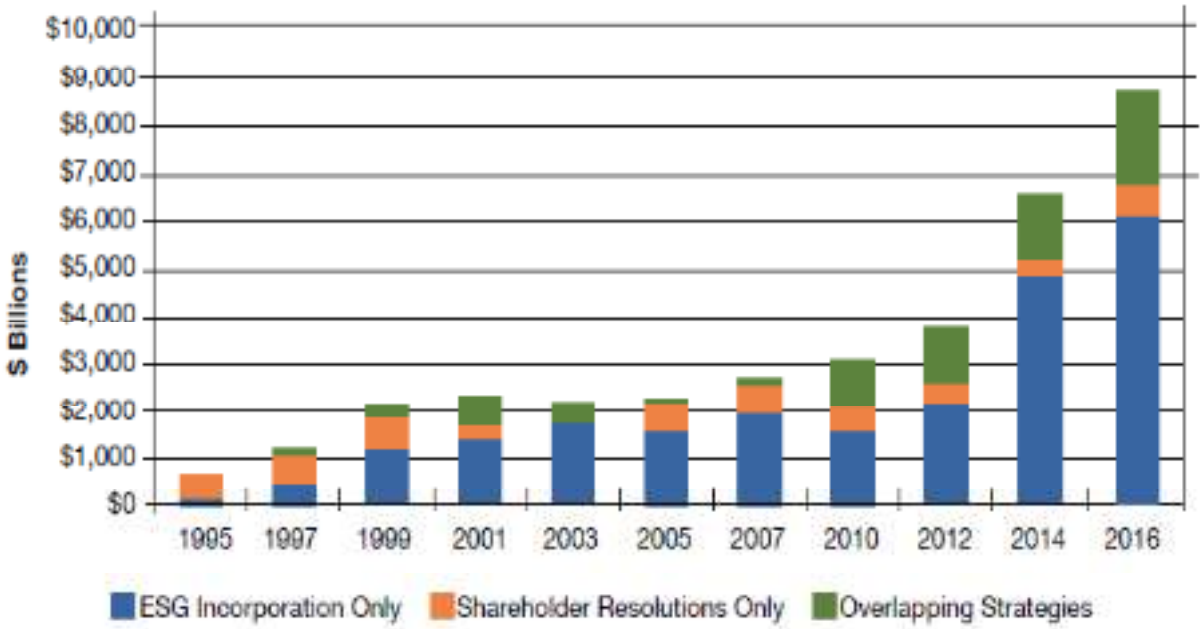


Source: Author's structure, US SIF Foundation (2016)

Graph 3. U.S. ESG Growth (at the start of year)

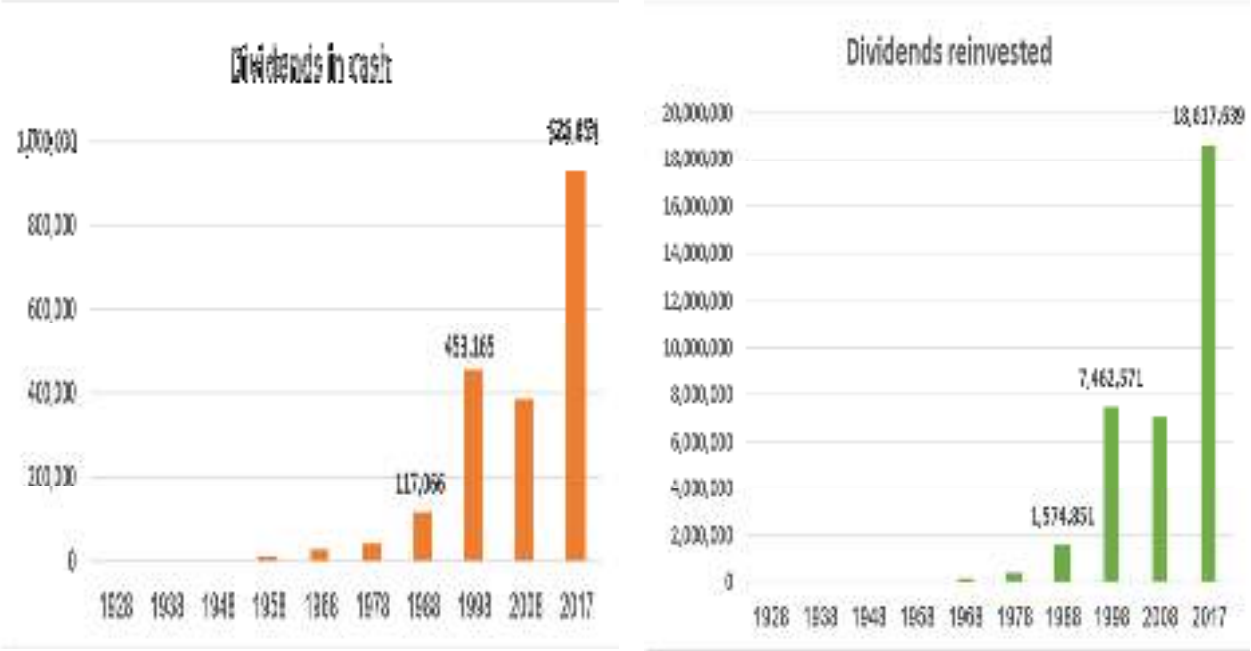
Source: Author's structure-Oppenheimer Funds (2016-2017)

Graph 4. Sustainable, Responsible and Impact Investing in the U.S (1995-2016)



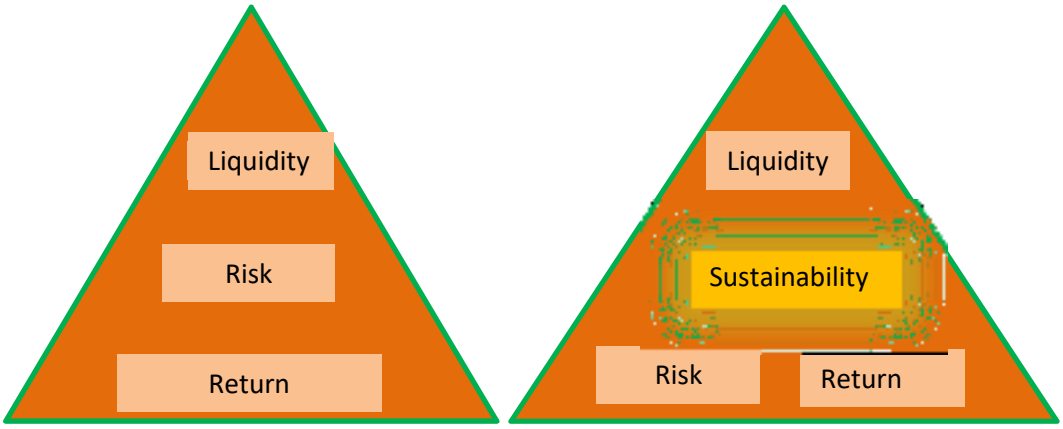
Source: US SIF Foundation (2017)

Graph 5. Pioneer Fund Class A Shares: 1928 – 6/30/17



Source: Author's Structure- Amundi Pioneer (2017)

Figure 7. Pyramid representing investors needs during an investment

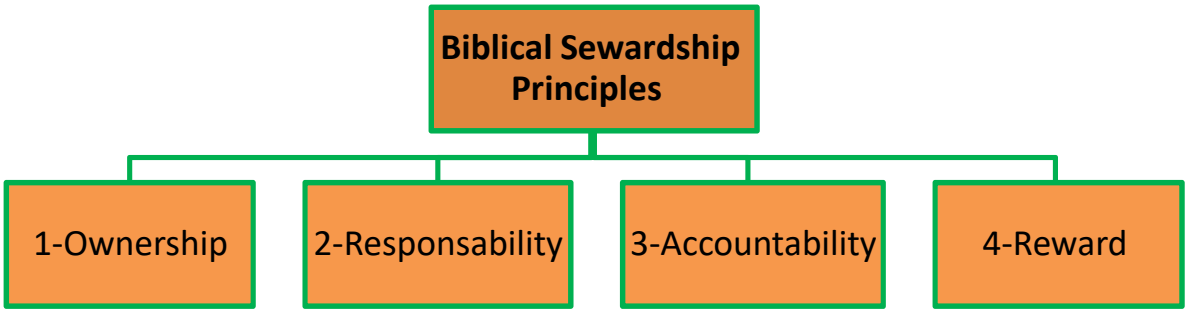


Source: Author's Structure- Cengiz et al. (2010)

Appendix 5: Ethical investment from monotheistic religions angle

Historically, ethical investment dates back to biblical times. The laws and teachings of Judaism insist on the importance of ethics in investment. There are four main doctrines related to the concept of biblical stewardship.

Figure 8. Four main principles about "Biblical stewardship"



Source: Author's Structure- Institute for Faith, Work and Economics (2012)

First, ownership is the essential principle in Biblical teachings. God is the owner of everything in this world and humans are only working on his behalf. Hence, no one has the absolute right to control.

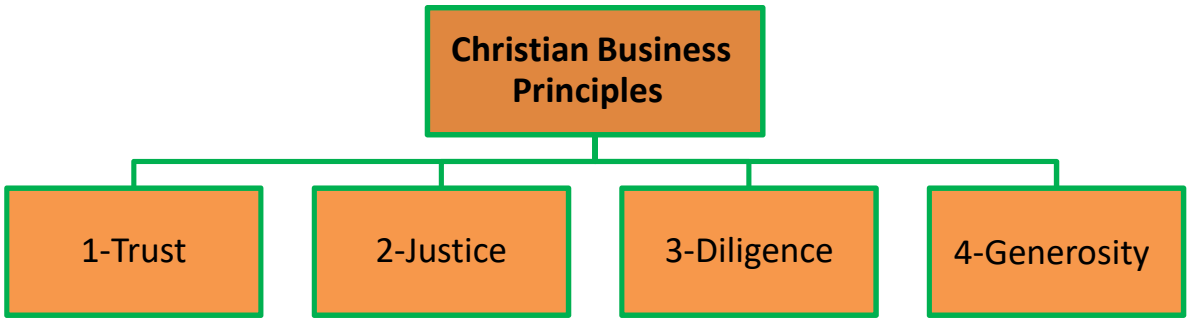
Second, the principle of responsibility reflects God's stewards. God creates everything and gives the permit to manage and enjoy his possessions. Accordingly, humans are responsible of his properties on this earth.

Third, accountability for how humans have managed God's properties on this earth. Resources and opportunities must be well exploited and humans are forced to give an account about the way of management and inputs used during their lifetime including money, time and data.

Fourth, humans who managed resources and God's possessions in accord with his will definitely be rewarded in life and paradise.

In Matthew (25:21), God says: *"Well done, good and faithful servant! You have been faithful with a few things; I will put you in charge of many things. Come and share your master's happiness!*"

Figure 9. Four main principles in Christian Business Ethics



Source: Author's Structure- Casey (2013)

Christian businesses are generally based on four main principles numerated as follows:

First, Trust is a crucial fundamental to be adopted in a Christian business. This principle is founded on a doctrine of stewardship (Genesis 1:28). Accordingly, everything on this earth is given by the Lord who is the leader of every single business.

Second, justice is also a very important principle in any business. According to this standard, employees should be well treated by giving them appropriate salaries and fair working conditions under an equitable work environment.

Third, diligence is essential to assure a project sustainability and profitability. Accordingly, hard work is highly recommended in a Christian business.

Fourth, generosity is crucial to help people in need. For example, investing in unsafe or destroyed cities to support displaced people and refugees. In addition, investors should be willing to allocate a percentage of profits in the form of donations to charities.

Table 3. Augmented Dickey Fuller and Philips-Perron Tests of sustainable and Islamic indices

	Model	ADF	PP
		t-Statistic	
DJS_US40	**Trend+Constant**	-44.46555***	-45.13431***
	Constant	-44.46817***	-45.08264***
	None	-44.40985***	-44.85215***
DJI US	**Trend+Constant**	-44.28516***	-44.28516***
	Constant	-44.29461***	-45.15700***
	None	-44.22029***	-44.83804***
DJS Europe	**Trend+Constant**	-42.50451***	-43.28125***
	Constant	-42.51174***	-43.27582***
	None	-42.52073***	-43.27951***
DJI Europe	**Trend+Constant**	-42.90741***	-43.82608***
	Constant	-42.91631***	-43.82685***
	None	-42.91867***	-43.79981***
DJS Asia/Pacific	**Trend+Constant**	-43.67510***	-43.93329***
	Constant	-43.67506***	-43.92260***
	None	-43.68385***	-43.93016***
DJI Asia/Pacific	**Trend+Constant**	-40.69984***	-40.63074***
	Constant	-40.65314***	-40.58816***
	None	-40.64389***	-40.58465

Note: *** denote statistical significance at 1percent confidence level.

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