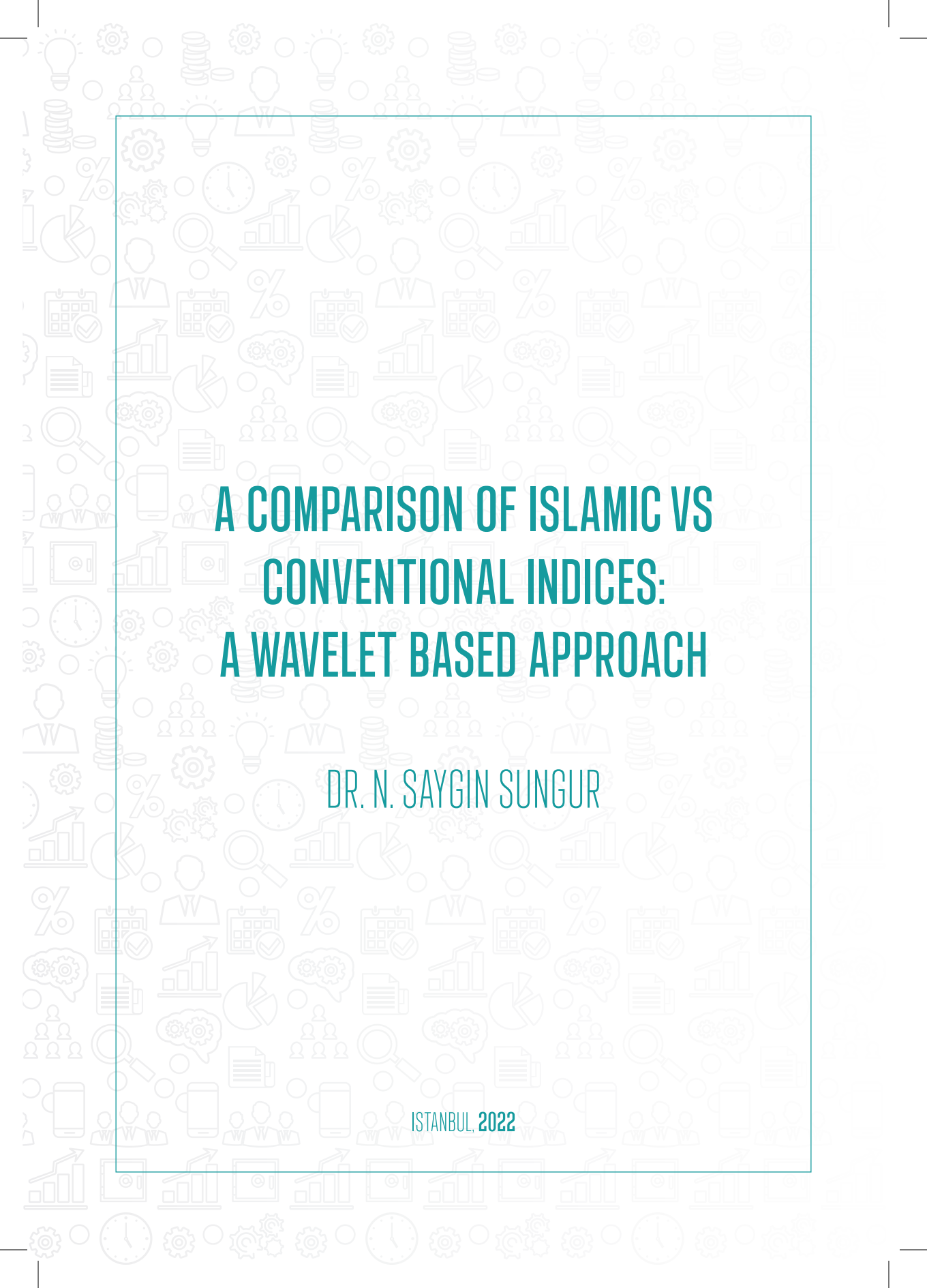


A COMPARISON OF ISLAMIC VS CONVENTIONAL INDICES: A WAVELET BASED APPROACH

DR. N. SAYGIN SUNGUR



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A COMPARISON OF ISLAMIC VS CONVENTIONAL INDICES: A WAVELET BASED APPROACH

DR. N. SAYGIN SUNGUR

ISTANBUL, 2022

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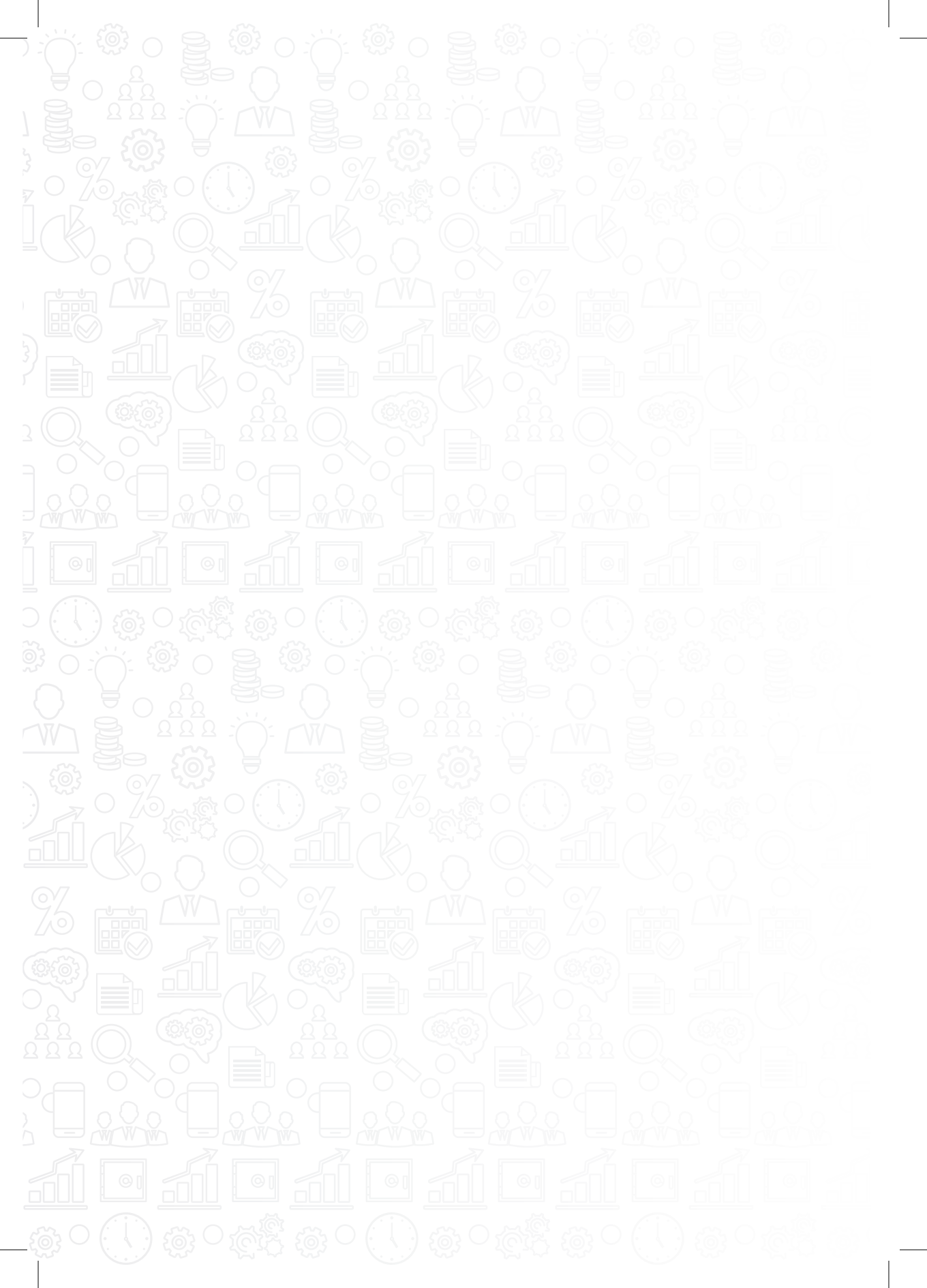


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To Mom and Dad for waiting so long to finish my journey on this work with their full support. I would definitely leave the journey of the ring like Frodo if they weren't encouraging me as Sam.

To my wife for her love and support.

And of to course to my three lion cubs.



ABSTRACT

A COMPARISON OF ISLAMIC VS CONVENTIONAL INDICES: A WAVELET BASED APPROACH

Nowadays Islamic Finance and Islamic Investment Instruments are becoming more and more popular and show a significant increase in volumes. Due to this trend, starting from 1970s significant momentum has been spotted in the academic studies, especially in the ones that compare Islamic Investments to their conventional counterparts. An important motivation behind this increase is the search and test for differences offered to investors by these Islamic alternatives which included Sharia based rules and measures. To be more precise these studies mostly tested for any impact of these Shariah measures on the volatility and returns patterns of the investors either on the negative side (creating excess loss) or on the positive side (increasing profits or creating a safer investment alternative). Studies based on the Islamic Indices are inseparable pieces of these studies. Recent years have opened a new perspective in this research area where some of the academic literature focused on a newer model which is the Wavelet Approach. While wavelets are not new to the academic world as they are utilized in several other areas (Maths, Physics etc...) they are mostly new to the finance literature. This study tries to compare Islamic Indices and tries to figure out possible linkage between same country indices in terms of a Wavelet Approach which helps us to figure out the return patterns and dynamics to forecast vola-

tility and thus estimate price movements. Our empirical results suggested almost non or very little opportunity for portfolio diversification or a presence for protection between conventional and Islamic indices as the coherence results were high. The power spectrum and correlation patterns showed very high scalewise correlation in lower trading frequencies whereas at longer terms decreasing but again high correlation was present. However, the results indicated that in countries where the financial sector equities play a dominant role such as Turkey, Italy and Spain there may be an opportunity to diversify the portfolios with Islamic index stocks as the leverage factor in the financial stocks is eliminated by the screening element in Islamic Index Construction. Further research, extending the data to region level and diversifying the underlying assets with other Islamic instruments such as fixed income Sukuks would be useful in the field.

Keywords: *Wavelet Coherence, Multi-Scale Wavelet Correlation, Continuous Wavelet Transform, Maximal Overlap Discrete Wavelet Transform, Hedge Ratio*

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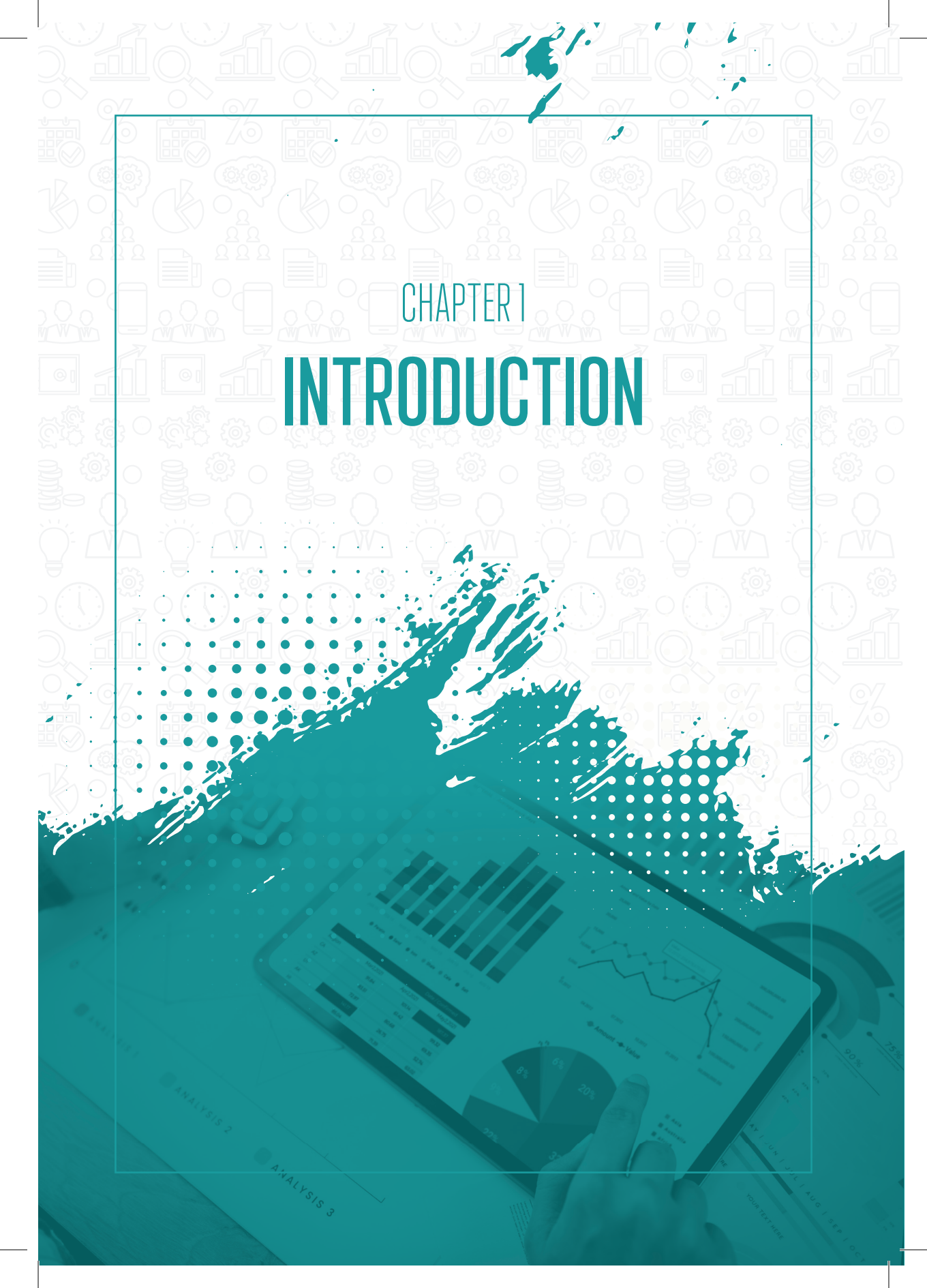
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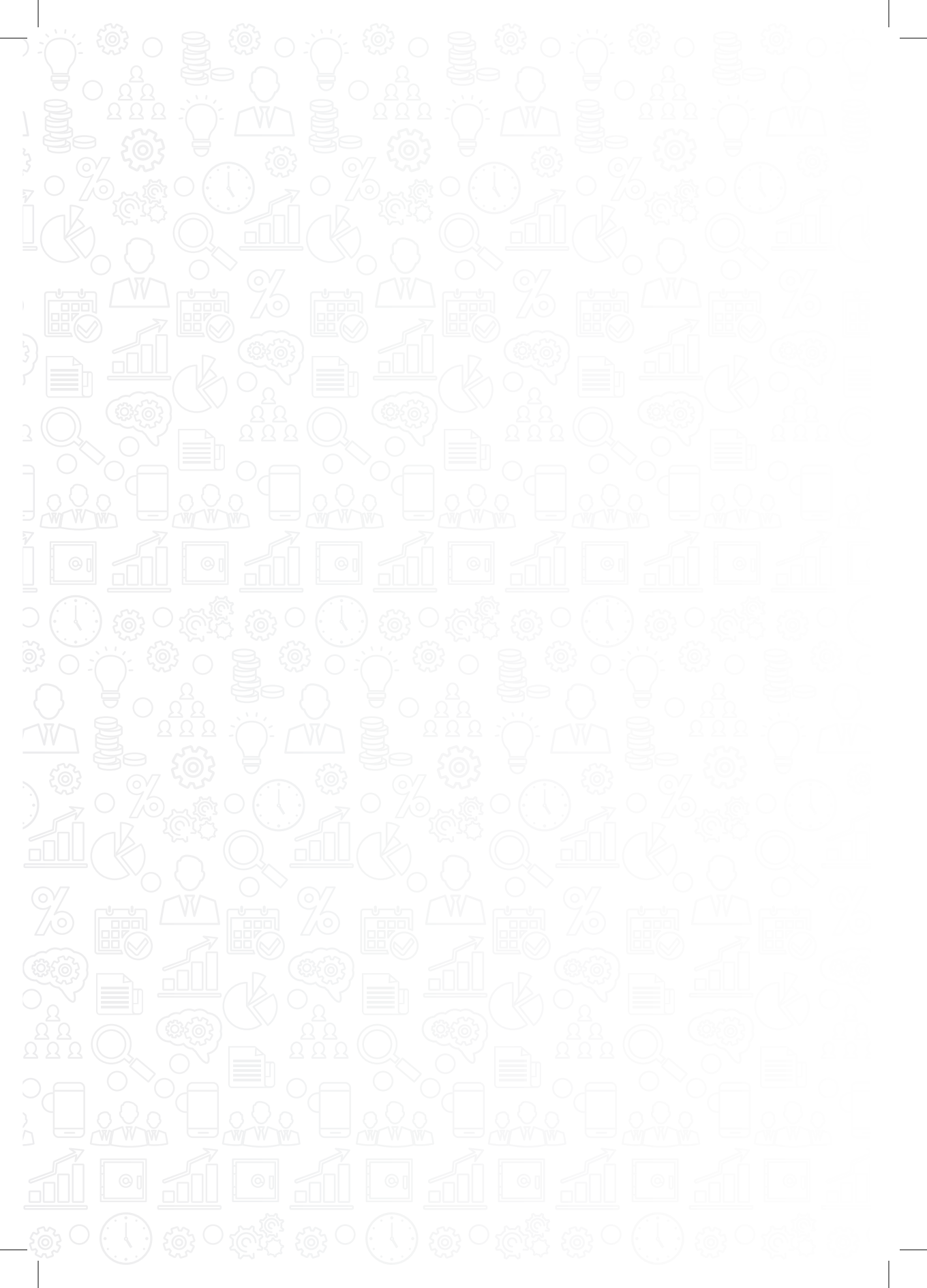
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CHAPTER 1

INTRODUCTION





INTRODUCTION

Recent years even in the Turkish Banking industry and capital markets, there has been a growing interest to the financial activities conducted under the banner of “Islamic Finance”. This scope-changing trend has shown us a significant and voluminous growth in these transactions directing several banking institutions to form new divisions or subsidiaries that mainly focus on interest free finance. Even in some countries, such as in the case of Turkey, Islamic Finance has found a place in five-year development programs to increase its share in the financial markets.¹ This in fact has paved the way for the entrance of two new players to the participation banking industry and created more interest Islamic finance originated financial products including interest free bonds (Lease certificates-Sukuk) and Islamic mutual funds. Also new Islamic based indexes under the dome of Borsa Istanbul.

Considering the recent interest on Islamic Finance for the last thirty years, attention to such investment alternatives has grown significantly. It is easy to track numerous articles and books being written on the subject, with some of them delving more into the practices of Islamic Law while others mainly channel on forming Islamic derivatives based on underwritten Islamic products. Most of the time such construction of products is maintained by means of modified premodern financial contracts such as sales, leases and similar. The underlying designs most of

1 For a full definition of Islamic Finance within the scope of forming a Financial Center under the Turkish Government 10th development plan see www.sbb.gov.tr

the time are viewed by finance professionals, lawyers, and scholars with a background on Islamic Sharia. In terms of formulation of Islamic based financial products, most of the time Sharia boards work closely with finance professionals to maintain the health of the system. Some may consider the arguments that in some cases such practices of attempting the replicate the substance of contemporary financial products in modern terms and contract forms has considerably failed to serve the objectives of Islamic Law. The argument backs the idea that wherever the substance of contemporary financial practice is in accordance with the Islamic Law, adherence to premodern contract forms (even with modification) leads most often to avoidable losses, thus violating one of the main objectives that defines classical Islamic thought. Such cases nevertheless create inefficient and unwanted products for the utilizers of such transactions and fall short sighted in today's financial markets where the conventional finance enjoys unlimited horizons for forming structured finance. Islamic Financial practitioners see that unless Islamic finance finds a way to compete with the conventional site in terms of not only generating more products but also expected returns that are attractive to investors (even to investors without a sensitivity for riba free belief system), it is not sustainable in the long term, because of (1) inherent dangers of unsophisticated structured finance methods in Islamic countries with relatively low end regulators (2) competitive pressures that dictate convergence to efficient conventional finance modes.

The case of Islamic Products operating under the current financial markets is closely related with the arguments summarized above. Conventional Players have certainly spotted the attraction of investors with such belief-based tendencies and have become a player in the industry. Such driving forces have contributed to the development of the Islamic Finance industry with more acceleration than the Conventional Side. Several factors have contributed to the strong growth of Islamic finance, including strong demand in many Islamic countries for Shariah-compliant products; progress in strengthening the legal and regulatory framework for Islamic finance; growing demand from conventional investors, including for diversification purposes; and the capacity of the industry to

develop several financial instruments that meet most of the needs of corporate and individual investors. It is estimated that the size of the Islamic banking industry at the global level was close to 1 trillion US. The case of Turkey sadly is another one, as the last thirty years could not give significant market share to competitors. On the other hand, last two years, even with the introduction of two new participation banks the market share shrink from %5 to %4.87 which shows there is still way to go in terms of Islamic way of banking. This seems awkward considering the population to be 99% Muslim but can be explained with the inefficiency of Islamic Banking Industry.

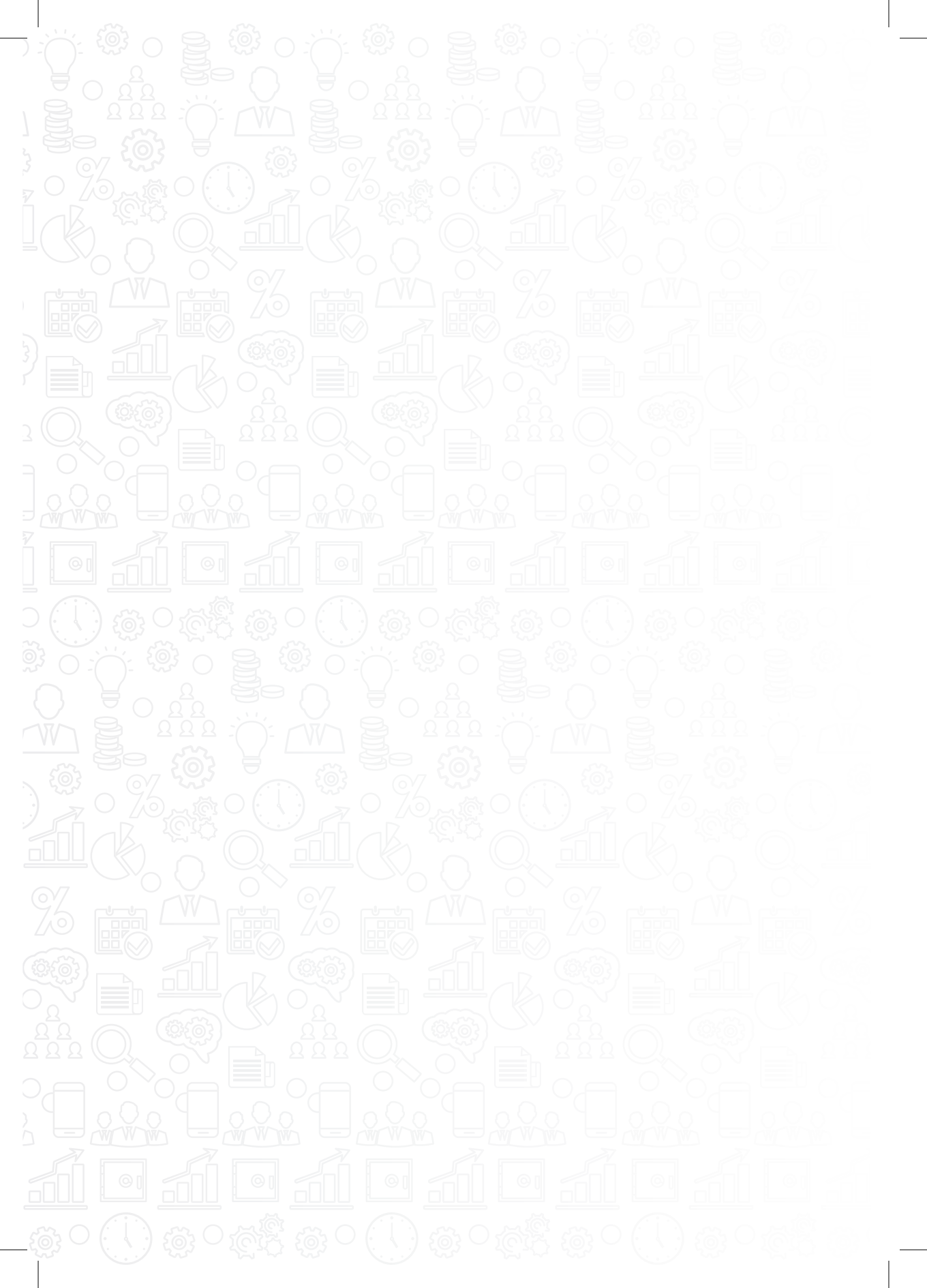
Islamic Indexes are mainly a part of the growth in this industry. Several key players including MSCI, Dow Jones, SP and others have constructed their Islamic indexes based on the Islamic rules sets and these indexes help the derivation of several products underwritten over the index performances. Turkish example of the following indexes is the “Participation Index” formed in 2008. Since the construction of these indexes the arguments on their effectiveness and expected returns have arose. Some scholars argue that even with the cleaning of sectors that are not Islamic, returns of these indexes mimic the returns of conventional counterparts and track the same anomalies. Looking at the historical returns it is certain that there are no doubt returns follow a very close difference that may prove these arguments. The underlying thought is that considering the main motivators of the market indexes are banking, financial, and industries that are mainly prohibited by Islam for their speculative arrangements and interest linkage, the returns of Islamic Market indexes should digress from the conventional ones. However, one can also think that the returns derive from the fact these indexes lacking the speculative industries have a more conventional and safe sides that protect them from high jumps and volatility thus offering absolute returns to investors mean converging at the ultimate horizon with conventional indexes.



CHAPTER 2

LITERATURE REVIEW





LITERATURE REVIEW

2.1 ISLAMIC FINANCE AND ECONOMICS

With Islamic Finance being a rather new and growing player in the world of finance it is nevertheless a weak one but instead seems to empower itself throughout the world's capital markets. With several players seeing opportunities in the area, conventional finance actors in not only Muslim countries but also in the others (such as London being one of the biggest financial centers) has established Islamic Finance based operations. Fang and Foucart (2014), Nazim and Ibrahim (2012) argue that Islamic Banking is forcing its presence through the financial sector in the last two decades while making it a recognizable competitor by the Western financial agents. (Fang & Foucart, 2014) This as, Kassim (2016) points, is due to considerable growth rates ranging from 23% to 32% p.a from 2007 onwards (Kassim, 2016) Islamic Financial industry. While this awareness is mainly due to performance issues, Fang and Foucart addresses the thought that growing presence of the Islamic Finance and utilization of it by the investors has brought the "Ethical Investment" issue to the door of Western Financial Agents. (Fang & Foucart, 2016) Thus, non-Islamic conventional players start to brew their products portfolios adding Islamic Products to their customer menus.

However, the main question here is how successful these brews? Are their returns better than their conventional counterparts? Alternatively, are they just replicate the conventional ones with a twist by just remov-

ing speculative measures or non-Islamic elements? Are they converging to something else with different rule sets or just mimic the nature of conventional finance? In basis the main question to be asked are they Islamic? Some research on these questions argue that Islamic financial principles make a positive contribution to Macro economic framework including banking and financial sector. Gheeraert (2014) found strong and consistent empirical evidence of this positive contribution as growing Islamic Finance, in countries where applicable, resulted in growing banking sector practices. This is mainly because of the increase of the banking sector's wallet share through inclusion of the unbanked consumers due to Islamic faith and the innovative practices to fulfill the gap for need of products for those who are interest sensitive. (Gheeraert, 2014) Several others contributed to these findings with Weill (2001) Beck et al. (2013) stating the positive contribution of the Islamic financial system and its underlying products to the cost efficiency of strength of a country's financial system. (Weill, 2001; Beck et al. 2013) Imam and Kpodar (2016) Abedifar et al. (2016) and Gheeraert (2014) all find strong evidence for first, a strong positive relavance of Islamic Finance to Economic Growth and the presence of Islamic Finance as an agent in the financial industry contributing to the economic welfare. (Imam & Kpodar, 2016; Abedifar et al., 2016; Gheeraert, 2014)

Despite the above arguments and findings, there are in fact many questions in the area still to be answered. In another case, the answers to the questions asked in the previous paragraph pave the way to bigger dilemmas including why in some countries with a great share of the population being Muslim still hold investments in the conventional market. Perhaps to better elaborate on this dilemma the first thing to do is to delve into the differences between Islamic and Western perceptions of Capitalism. After then it will be a clearer window for understanding major implications of Islamic Economics and finance of the development of a country's welfare status. In fact, as Elshurafa (2012) while linkages between religion and economic systems date back to 6th century with an aspect of resistance to change, some modern economic theorists see this linkage as a financial disaster in today's modern macroeconomic

scene. (Elshurafa, 2012) However, this did not get Islamic finance back from developing inside the Western Economic system that is called Capitalism. (Elshurafa, 2012) In order to fully compare the Western and Islamic senses of Capitalism, a brief definition should be made. Rodinson (2007) and Elshurafa (2012) define western capitalism as a whole package including private ownership, means of production, the structure of the monetary system, capabilities and means of production and finally the degree of freedom the firms operate. Most of the findings on the comparative literature depend on these aspects. (Rodinson 2007 ; Elshurafa 2012) Usmani (2010) defines the basic difference between the Islamic and Western Capitalism as the assertion of human factor whereas secular capitalism strips the divine and human factors of the power of economic decisions solely focusing of the profit motivation and private ownership. (Usmani, 2010) The main principle of Islam is to provide justice among all the citizens and the recognition and protection of property rights of all members of the society. It is important to note that conventional economic thought mainly focuses on the self-maximization of utility whereas Islam mainly creates a balanced relationship between individual and the society. Self-interest and private gains of the individual are not denied, but they are regulated for betterment of the collectivity. Maximizing an individual's pursuit of profit in enterprise or satisfaction in consumption is not the sole objective of society, and any wasteful consumption is discouraged. (Greuning & Iqbal, 2008) Another important notion to evaluate here is by Chapra (2000) stating that Conventional Economic thought is a not a product that has evolved in one night but a complex structure that has shifting through centuries of rigorous processes and thus evolving into a well-developed and fully fledged discipline. (Chapra, 2000) As a result, it is not surprising for most of the economic actors to follow Western sense of Capitalism and become heavily reliant on the Western system.

Chapra (2000) and Khan (2010) argue that this reliance fusing with the Technological superiority of the Western World has caused failure for most the Muslim Countries in their struggle for achieving higher growth, utilizing their potential. This also means less orientation to the practicing

of Islamic Capitalistic notions as the main ambition is to utilize potential for achieving higher growth. (Chapra 2000 ; Khan 2010) Comparing Islamic and Conventional Capitalistic ways of economic growth, El Shurafa (2012) concludes that Islamic Capitalism seems to share characteristics with Venture Capitalism, and it should not be isolated from its conventional counterpart. As summarized above still there is plenty of time for Islamic Capitalism to develop and bring front complex interdisciplinary models such as Conventional capitalism but the latest decades show good efforts in such evolution. (En Shurafa, 2012)

According to Islamic Faith, Sharia based on the Qur'an's teachings provides the necessary set of rules and ethical behaviors that the Muslims are required to obey. These rule sets mainly revolve around several important notions that is directly linked with what conventional finance pillar itself on. Sharia protects property from any exploitation through unjust and unfair dealings. Prohibition of riba (interest), elimination of gharar (contractual ambiguity), and restrictions on other forms of exploitation are some of the implications of this core principle. For banking and capital markets the notion of being interest free is important as Islamic transactions are called upon as such in a world where conventional finance has main models pillared upon the main element of interest and derives its returns as such. The most important and salient part of the Islamic Banking arena is that Islam prohibits interest payments in transactions, and the undertaking of any disruptive action or industry such as alcohol, pornography or gambling.

These are the main pillars of the Islamic Financial guidelines. However aside from these common guidelines, rule sets may vary country wise according to the scholars or regulators that are maintaining control over the Islamic banking or financial markets. Al Mannai and Ahmed (2019) define Sharia compliance within two important risk elements, one being Sharia based and the other legal issues. They argue that both risk factors are interlinked, and they should be maintained together to avoid unexpected consequences in both financial and non-financial domains. (Al Mannai & Ahmed, 2019) As Hamza (2013) concludes both legal and sha-

ria, compliance failures may result in reduction of reputation through the business environment making underlying institutions vulnerable. (Hamza, 2013) In order to define these risks, bring a common denominator to practitioners and maintain sustainability, international standard setting institutions such as AOOIFI and IFSB¹ are established. These institutions define the guidelines and the parameters for sound Sharia governance and most of the Advisory Boards in several countries follow these guidelines. However, going one step further the problem starts with the individual Advisory Boards of Islamic Financial Institutions as they can come up with different interpretations for the same underlying issues. Al Mannai and Ahmed (2019), Grais and Pellegrini (2006) and Malkawi (2013) argue that with economic benefit is on stake for the institution, the freedom of the Advisory Boards can be affected. Also, as most of the information flow on the products and services come from the business, the advisory Boards usually are restricted to decide and give approval within this limited information. (Al Mannai & Ahmed 2019; Grais & Pellegrini 2006; Malkawi, 2013) Because of these considerations, full independence of Advisory Boards is still under question and an operational audit system for Islamic Finance Institutions needs to be established. An interesting article on this issue is by Azmat (2014c) where the author argues that the Sharia compliance issue not only depends on market competition and regulatory framework but also directly related with the investor's consciousness on ethical investments. With Islamic finance becoming a strong player in the economic scene, the issuers more and more need Islamic scholars to give approvals to the financial instruments. As a result, fatwa market is created where the financial instruments sometimes become non-compliant with the Sharia principles. Thus, the investor preference and awareness is one of the primary defense line to such practices. (Azmat, 2014c)

There are examples of financial intermediaries that are Islamic on foundation whereas there are others to be converted from conventional ones. The nature of the institutions in this manner heavily depends on the na-

1 AOOIFI stands for Accounting and Auditing Organization for Islamic Financial Institutions and IFSB stands for Islamic Financial Service Board

ture of the country they operate. (On most of the cases, however in countries with higher Muslim populations the general case is that Islamic Banking acts as a supplementary institutional market alongside with the Conventional counterparts. (Abdul-Majid et al. 2009) The Malaysian and Turkish cases are examples of this case where the citizens can utilize both Islamic and Conventional financial institutions. There are on the other hand some countries whereby country regulations prohibit the presence of conventional financial intermediaries and thus banks had to convert from conventional to Islamic nature. (Abdul-Majid et al. 2009) (These countries include Iran and Sudan.)

One important thing to consider is that, when Islamic Finance is called interest free, most of the times it is thought to bring with zero or no return. However, when one delves into the issue, it can clearly be seen that this is in fact the case. Islamic rule sets do not forbid to derive returns but instead prohibit a fixed pre-determined return for a certain factor of production. (Ahmad, 1994) The underlying motivation behind this is that any pre-determined benefit attached to the capital is not halal according to the Sharia principles. On the other hand, as Islam permits profit sharing with a predetermined profit-sharing ratio but an undetermined expected return ratio. Thus, in fact investors can derive returns from Islamic investments. (Lodhi & Khalim, 2005)

Some of the literature on the Islamic vs Conventional Finance literature have proposed that due to the difference in objectives and motivation resulting in different operational characteristics, the potential output that is to be produced should vary heavily. One of the main examples to this argument is the limitation on certain financial instruments and hedging mechanisms because of the interest element on them. Articles on the issue suggest that this limitation reduces the output level in a manner and therefore argue that it is appropriate to control for Islamic banking as a financial intermediary specific characteristic that directly influences the estimated frontier and hence the potential output rather than as a factor that directly influences estimated inefficiency. (Anal, 2010)

The expansion of Islamic Financial services is within and exponential framework. Some of the scholars have suggested that within a considerable time span Islamic Finance will constitute nearly %40 of the total savings of Muslim populations worldwide. (Zaher & Hassan, 2001) Here it is important to conclude that considering the article makes this estimation in 2001, the growth of the Islamic Operations worldwide has reached to a significant portion if not %40. This is mainly because in some countries like Turkey still the Islamic financial intermediaries could not throw their initial infancies. On the other hand, today several big financial companies have constituted their Islamic Finance Divisions-including HSBC, Goldman Sachs, BNP-Paribas, Citibank and more. (Sundrarajan & Enrico, 2002) Especially on the banking, side Islamic Participation banking has shown considerable growth. According to the Ernst&Young Islamic Banking Competitiveness Report 2016, the participation banking assets have growth to 882billion US in 2014²

Table 1. Breakdown of Islamic Finance Segments by Region in billion US (2015)

Region	Banking Assets	Sukuk Outstanding	Islamic Funds and Assets	Takaful Contributions
Asia	209,3	174,7	23,2	5,2
GCC	598,8	103,7	31,2	10,4
Mena (Exc. GCC)	607,5	9,4	0,3	7,1
Sub Sharan Africa	24	0,7	1,4	0,5
Others	56,9	2,1	15,2	-
Total	1496,5	290,6	71,3	23,2

Note. Source: Islamic Financial Services Board, 2016

It is undeniable that most of the past studies on the issue have foreseen such potential on the growth of Islamic Finance. Utilization of Islamic

² For the details of the report see [http://www.ey.com/Publication/vwLUAssets/ey-world-islamic-banking-competitiveness-report-2016/\\$FILE/ey-world-islamic-banking-competitiveness-report-2016.pdf](http://www.ey.com/Publication/vwLUAssets/ey-world-islamic-banking-competitiveness-report-2016/$FILE/ey-world-islamic-banking-competitiveness-report-2016.pdf)

rule sets in contrary to the methods in conventional finance have been a discussion topic of past research and several studies especially on the case of stagnation and economic crises have been conducted on the issue. For example, Islamic Banking system was seen making a useful contribution to economic growth and development particularly in a situation of recession, stagnation, and low-level growth because its core transactional background is oriented towards productive investment (Scharf, 1983) Islamic Finance principles in some academic papers were stated as bearing striking resemblances to proposals made in the literature for reforms in financial systems in many of the countries. (Khan, 1986) An Islamic system that is based on Sharia rule sets was to be thought as not only feasible for utilization but also profitable for most of the participants in the market (Scharf, 1983)

With all the prospects counted above, still being at the infancy, Risk attributed to Islamic Finance is still in question. There are several important differences between conventional financial intermediaries and the Islamic ones, and these differences mainly constitute a question mark in terms of the practices of the industry. Major important aspects that constitute the differences can be summarized as the liquidity management and preference of IFIs, Income Allocation practices, integration of risk-sharing principles into the financial system and rights of Governance to be issued for the fund owners through investments.

All the instances mainly affect the Islamic Financial industry's prospect for growth and create solid challenges for the regulators of Financial Industry. In the case that the country maintains a hybrid system, like the one in the Turkish case, and only a single banking and capital market regulation that monitors both, it becomes a highly complex situation. In this case Islamic Finance being the lesser known one takes the hit as it generates mixed perceptions on the risks it introduces. To some extent, this paves the way to Merton's (1995) point that "less apparent understanding of the new environment can create a sense of greater risk even if the objective level of risk in the system is unchanged or reduced". (El-Hawary, 2007) Thus Islamic finance viewed as financial innovation is

generating concerns on its inherent risks and their possible spillover on the rest of the financial system.

2.2 ISLAMIC DEFINITION OF RISK

As we define risk in the typical finance literature as the probability that an investment's actual return being different than expected. This includes the possibility of losing some or all of the original investment, most of the literature revolving on Islamic finance assumes that Islamic Financial institutions not only face the type of risks that conventional banks face, but they are also confronted with "new and unique risks as a result of their unique asset and liability structures." Much of this new borne risk is due to the Sharia compliance nature of the Islamic financial products and services. In most of the literature covering risk management in Islamic Finance, it is concluded that due to the differentiation of risk factors that these institutions have exposure to, they need different risk identification procedures and different risk management approaches and techniques and require different kind of supervision as well. The changing nature of risk also affects the composition of capital and asset size compositions argued that the capital minimum requirement needed to for risks coverage should be higher in Islamic banks that in conventional banks because their profit and loss sharing assets are not collateralized. There may be sometimes other types of risks differing from the ones that the investors are vary of such as the undertaker risk meaning that in some countries where Islamic financial products are heavily used (such as Middle East, South Asia, etc...) there may be no secondary market due to the appetite in those countries for Islamic financial products and investors sometimes may bear the risk of clinging to a certain investment and holding into that financial products over a certain period of time. It is also important to notice that different structures Islamic financial products carry different related risks and returns, and each type of product is modeled based on the product specifications. We can certainly point out that there are different aspects of the risk factors on the Islamic Finance. Market Risk, Liquidity risk, Credit Risk, Funding Risk all have different implications when projected on the

Islamic Financial Products and thus have different aspects of returns when compared to other conventional systems.

2.2.2 Perception of Risk and Risk Factors in Islamic Finance

Risk management in Islamic Economics and Finance mainly depends on the principles of Qu'ran and Hadith. As Hassan (2019) points out, Islamic mainly use these principles scholars to control risk exposure and take precautions aiming to lower the risk. (Hassan; 2019) Risk is an important element in Islamic teaching as Islam need risk exposure for a Muslim to derive profit from a certain transaction. Literature has shown that in order to mitigate risk while trying to derive profit, Islamic banks try to use tools that are screened under Sharia rules. Agha and Sabirzyanov (2005) concluded that Islamic Finance practitioners could manage risk through transferring them to third parties, hedge these risks with other instruments and finally manage them internally by certain contracts. The common point of all these risk management alternative practices is that they should be based on different Sharia based contracts. (e.g Salam contract for example is a general Islamic contract for hedging purposes) (Agha & Sabirzyanov; 2005) While these contracts help mitigate the risks, they also bring challenges. One of these challenges is the Shariah compliance challenges in certain products that are common for the conventional but hard to construct for Islamic finance. Azmat et al. (2013) argue that due to costs associated with the Islamic Instruments the premiums that are paid to the Sharia based risk instruments are higher. (Azmat et al. 2013) Also as Haniffa and Hudaib (2014) found evidence ethical identity and reporting standard of Islamic financial tools are not as standardized as the conventional finance methods, there can be evidence of discrepancies inconsistent with the desired risk management effect. (Haniffa & Hudaib ; 2014)

Kozarevic et al. (2014) summarized the sources that risk can emerge for the Islamic Institutions which are risks based on the usage of certain Islamic contracts, risks due to non-standardization of products and insufficient regulatory framework and finally due to the unknown nature of the non-standardized Islamic Products. (Kozarevic et al; 2014) In order

to deal with the risks associated with these sources they offer five successive risk mitigating strategies including risk identification, quantification of risk and capital, collecting or merging of similar risks, previous risk controls, and monitoring. (Kozarevic et al.; 2014)

There are different types of risk factors that are to be dealt with in terms of Islamic Finance. These risk factors are not much different from the conventional sense, which can be summarized as Credit Risk, Liquidity Risk, Market Risk and finally Operational Risk. Khan (2004) has conducted a study on the ranking of these risks as their presence in Islamic Banks. Evaluating the results derived from 15 largest Islamic Banks in the world they found evidence that the highest ranking is with the market risk as profitability and other risks are directly related with volatility of the market. (Khan; 2004) Next to market risk is the operational risk that arises due to inadequate or lowly controlled internal processes, managing of people or lack of necessary technology. Izhar and Ali Hassan (2013) argue that in terms of Operational Risk adaptation of core risk management principles including identification, measurement, and mitigation and monitoring, is an important aspect. They point out the fact that risk-mitigating methods for operational risk should be considered with regard to the source where the operational risk factor emerges. (Izhar and Ali Hassan; 2013) Aside from the main nodes of risk, there are some other risks associated with the financial transactions dealt with the Islamic Finance actors. Khan and Ahmed (2001) summarize these risks as, mark-up risk (risk associated with the change in benchmark rates and thus the risk of lower mark-up generation) Asset-price risk (risk that arises as a result of financing due to the change of the bank's holding commodities for certain contracts including salam, ijara or musharakah.) Legal risk (the risk associated with practicing different legal framework through different countries), Fiduciary (breach of contracts by the Islamic banks and Withdrawal risks (change in the depositor's behavior and taking out the withdrawal decision due to changes in the markets conditions) (Khan & Ahmed; 2001)

Mitigation of Risks are thought to be harder in Islamic Banks when compared with the Conventional case. Khan and Ahmed (2001) argue that

this is due to mainly two reasons. The first one is the fact that unlike conventional banks the prohibition of trading-based instruments and equity financing increases the exposure of Islamic Finance books more credit risk and market risk. Secondly, as the authors propose, the nature of risks can interchange during each stage of transactions, which makes it harder to control. (Khan & Ahmed; 2001)

Most of the literature covering the risk management issue had focused on the risk exposure and performance relationship in Islamic Banks. Saaed and Izzeldin (2014) found evidence in this bank performance issue that decreasing risk exposure to credit risk is associated with lower bank efficiency levels. (Saaed & Izzeldin; 2014) Mollah et al. (2016) argued that the higher the degree of a well-formed governance structure is present in the institution, the higher the aim to take higher risks and thus achieve better performance results through utilization of complex products and transactions mechanisms. (Mollah et al; 2016) In terms of risk taking Grira et al. (2016) Alqhtani et al. (2016) and Azzam and Rettab (2013) tested the degree of risk tolerance finding evidence that Islamic Banks are being risk-averse compared to the risk-neutral nature of the conventional finance sense. (Grira et al. ;2016, Alqhtani et al.; 2016, Azzam & Rettab ; 2013)

Effective managing of risk is as important in Islamic Finance as it is in the Conventional sense. Along with this importance it is undeniable that it is harder to manage risk with less tools available to the Islamic institutions as they are to be Shariah compliant. Kozarevic et al. (2014) summarize for effective risk management in banks in terms of Islamic Banking as; maintaining enough capital to cover all risks thus reduction in a possible moral breakdown in Profit and Loss Sharing contracts, maintain the trust of the depositors in the institution as the funding for credit allocation is directly tied to these depositors flow of reserves, constant addition of customers to the portfolio to offset the possible loss of the existing customers and finally monitoring of all the funding sources with caution for a possible interruption in any of them (Kozarevic et al.; 2014)

The sections will shortly summarize the three major risk factors in terms of Islamic Financial sense.

2.2.2.1 Credit Risk in Islamic Finance

One of the important pillars of the Islamic Finance Practices is the obligation to back any transaction by a tangible, identifiable, underlying asset meaning that at least in theory most of the Islamic Financial Instruments back their risks with the appropriate collateral. Islamic finance in traditional terms has deep roots in Credit Risk factor. This is mainly because the activities related with Islamic principles are mainly on loan growth basis and this loan growth increases the relevance of assessing Credit Risk. Recent research has shown that the volumes of Islamic Financing contracts are growing rapidly. Abedifar et al. (2013) Kahn (2010) and annual reports of the big four audit companies (Ernst & Young and PwC) point out that Profit and Loss Sharing contracts and trade based Murabahah contracts has taken a %80 share in the overall volumes of the Islamic Banking Industry. (Abedifar et al. 2013; Kahn 2010; E&Y 2015,2016 and 2017 Islamic Banking and Finance Reports) This in real terms results, when compared with the conventional financial institutions, usually in a higher collateral coverage ratio. In terms of credit risk, this is one of the main points for consideration when we compare these Islamic financial institutions with the traditional banks. Sobarsyah et al. (2020) in their recent study found evidence that loan growth increased the exposure to credit risk prior to one year ahead. Their findings also supported the fact that lower capitalization banks should be more prudent in lending behavior compared to ones with higher capitalization due to the probable increase in the credit risk. (Sobarsyah et al. 2020) In terms of loan quality and thus exposure to credit risk Kabir et al. (2015), Mobarek and Kalonov (2014) and Mollah et al (2016) argue that Islamic Financial institutions have significantly lower credit risk compared to the traditional financing methods due to the level of collateralization. (As Islamic Principles, require financing of good & services) Also their findings in terms of credit risk share the same conclusions which proposed the fact that loan quality of Islamic Banks is not as sensitive to interest rate shocks. (Mobarek & Kalonov 2014, Mollah et al 2016)

Zamir and Iqbal (2008) argue that most of the techniques used to avoid or decrease credit risk, which arise from the chance of a possible debtor

to skip the repayment of a loan, are similar in Islamic Banks. (Zamir & Iqbal, 2008) They point out there are both advisory principles from international institutions such as IFSB that can be used by the Islamic Financial institutions. (Zamir & Iqbal, 2008)

Contrary to conventional banks, whose customers are not obliged to disclose the purpose of their borrowings, Islamic banks finance the acquisition of identifiable assets of which they have legal ownership, in most cases, until maturity and final repayment. For example we take a traditional Islamic financial instruments such as “ijara” which is typically resembling the leasing practice of the conventional banks (the practice of purchase of the underlying asset and renting it to the customer with monthly installments including a final optional sale at the end of the maturity at the junk value) , the bank, as the legal owner of the asset, is therefore in a favorable position to foreclose on this asset (in the case of a default), and sell it on a secondary market. This in fact in theory means better management of credit risk for the underlying Islamic institution.

Although an Islamic bank is in theory in a position to evict a customer from a property and resell it in the case of a default on the loan backed by the property, this would be unlikely to happen in practice owing to its “social responsibility” This in fact sometimes may be challenging when linked to the Islamic principles. The practices applied in such cases differ among the Islamic countries as Sharia boards of different financial institutions give out different rulings in terms of managing such foreclosures and credit risk One advantage here is that considering the application principles in most of the terms the property or asset underlying is registered under the name of the financial institutions which makes it easier to roll back in terms of bankruptcy or financial distress on the side of the borrower. Certain transactions carried out by Islamic banks can bear above-average credit risk. For instance, some Islamic banks are involved in “musharaka” (venture capital financing) and “mudaraba” (trust financing), which are equivalent to participation transactions, increasing the risks carried by the bank. In addition, in “murabaha” (mark-up financing) and ijara, the existence of full collateral could lead Islamic banks to be less vigilant when assessing the creditworthiness of their borrowers.

2.2.2.2 Market Risk in Islamic Finance

The dimension of market risk is one of the hardest risk factors for the Islamic Financial Institutions to manage. As discussed above Khan (2004) proposed Market Risk as the most exposure risk factor in terms of Islamic Banking sector. (Khan; 2004) Market fluctuations have different impact on the Islamic Banking degree of market risk. This is mainly due to the This is mainly because of the limited number of risk management tools or instruments available to them due to the Islamic fundamental principles. There are both pros of cons of such circumstance. For example, in terms of positive effect Fakhfeh et al. (2016) for example showed that negative flow of news has a lower impact on the Islamic banks than conventional banks. (Fakhfeh et al.; 2016) While diversifying risks, conventional banks are at better advantage as they can use different market tools and derivative instruments to hedge their risks. On the Islamic Financial instrument side, however, there is little room for maneuver through the usage of such instruments as derivative instruments and speculation through financial markets is strictly forbidden in Islam. The positive aspect of this prohibition is that as speculation is forbidden, the trading risk of the Islamic financial instruments is relatively tempered, and they are more protected against market fluctuations. As discussed above while creation of such instruments may allow the conventional banks to deal with market risk, they also cause triggering of financial meltdowns.

There are three broad dimensions of risk categorized under the market risk. The very first of these dimensions is the margin risk that is constituted through a mismatch between the yields earned on the bank's assets and that served on its liabilities. Different Islamic financial institutions try to cover up this margin risk by using different coverage of yields and diversification of their limited portfolio tools. Another dimension of market risk is the investment risk which is the risk derived from the prohibition of speculation through the usage of different derivative products. This limited portfolio selection however offers protection to the Islamic Financial Institutions from the investment risk. Islamic institutions are forbidden from speculating, which means that trading risk is limited.

In addition, as most complex structured products are usually not considered Sharia compliant, IFIs cannot invest in them. The exposure of IFIs to investment risk is therefore limited to that stemming from equity markets, Sharia-compliant debt products (such as sukuk), and real estate. The last dimension of the market risk is consisting of the foreign exchange risk, which again includes the vulnerability through limited ability of hedging the risk. As for conventional banks operating in emerging markets, IFIs' exposure to foreign exchange risk can be harmful. While conventional banks can easily hedge themselves through swaps or other hedging instruments, these are generally forbidden in Islamic finance, making the situation more challenging for IFIs.

Most research on Market risk is based on the financial stability and financial crises issue. Performance comparison based on the resilience of both Islamic financial sector and conventional counterpart has become a topic of several research. Rosman et al. (2014) found mixed results in terms of efficiency. (Rosman et al 2014) In addition, results on the endurance of both system against financial shocks is mixed. Kaleem et al (2006), Kassim and Majid (2010) argued that there is no difference between the two systems in terms of being vulnerable to market risk. (Kaleem et al; 2006, Kassim & Majid; 2010) On the other hand, other authors such as Khan (1985) Abduh et al. (2011) found evidence of the contrary stating that Islamic Finance offers more stability to financial sector players as Islam prohibits instruments like derivatives and limits leverage factors which is turn lowers uncertainty. (Khan; 1985 Abduh et al; 2011)

Chakroun et al (2010) examined spillover effects and tested the differences between Islamic and conventional resistance to market risk in terms of systematic risk factors and volatility. Their conclusion was Conventional banks being much riskier than the Islamic counterpart in terms of volatility of systematic risk is. Due to the reasons above this meant market risk is a factor that more directly affects the conventional fiancé than Islamic institutions. (Chakroun et al 2010)

2.2.2.3 Liquidity and Funding Risks

Liquidity is one of the most important and critical issues in terms of Islamic Financial Institutions and that is why in the Islamic Finance literature it is one of the most researched topics. Zamir and Iqbal (2008) summarizes liquidity risk for Islamic banks into two major types with one lack of liquidity in the markets and second lack of access to the funding sources. The implication of the first is due to accumulation of illiquid assets whereas in the second type the institution has disability to raise the necessary funds through the actors of funding. (Zamir and Iqbal 2008) Boukhatem and Djelassi (2020) conducting an empirical analysis on the Islamic banks in the Saudi Market concluded that Liquidity risk indicators of Islamic Banks are affected differently compared to the Conventional ones. They propose for Islamic Financial Institutions capital structure is directly related with the Liquidity risk as and increasing capital may have different and contradictory effects. An increase in capital both encourages Islamic Banks to refinance from wholesale markets while better capitalization eases the access to funds from money or deposit markets thus lowering liquidity risk. (Boukhatem & Djelassi ; 2020) This finding is important when combined with other research in the Islamic finance area. Beck et al (2013), Olson and Zoubi (2011) when investigating bank performance have found evidence that Islamic have higher asset quality and are better capitalized meaning that they could derive more quality funding in theory. (Beck et al; 2013, Olson & Zoubi ; 2011) On the other hand, liquidity is not only related with the capitalization of financial institutions. Smaoui et al (2020) found evidence investigating the risk-taking behavior of both Islamic and Conventional banks that the degree of risk taking is directly related with the liquidity risk as lower funding liquidity risk leads to an extent of higher risk taking by the institutions. (Smaoui et al 2020) Results of their study showed the lesser the degree of funding risk the more risk taker the financial actors are. However, the results also proved the Islamic Banks to be more risk averse and thus constitute the difference between Islamic and Conventional Finance. (Smaoui et al 2020)

Zamir and Iqbal (2018) argues that one of the factors that are closely related with the Liquidity Risk is shallow secondary markets. (Zamir & Iqbal, 2018) Considering and comparing the size and scope of the secondary markets for managing liquidity in terms of Islamic and Conventional Financial institutions, still Islamic ones has more potential to increase. However, there is one important aspect of the Islamic Finance, the assets utilized according to the Islamic Financial principles are generally not sellable on a secondary market and because of Shariah limitations there are restrictions on investing on the fixed income securities for treasury purposes. In some of the countries such as the Gulf region or as in the case of Turkey where the returns are attractive, this may be damaging watching the conventional banks taking advantage of these convertible debt instruments. An important development on this liquidity and funding risks is the establishment of a general market for these institutions where they can enjoy financial instruments that are standardized and complied with the Islamic principles. In 2002, in Bahrain the International Islamic Financial Market was established for this reason and because of such establishment many of the Islamic institutions rushed in to use such standardized instruments. Although in Turkey there is no such kind of initiative and the participation banks working under the banking regulation have no such advantages in some Gulf countries in addition to this financial market, Islamic banks have set up bilateral agreements with their respective central banks to address.

Funding is also an important aspect of liquidity as the only two alternative funding methods of Islamic Institutions are the deposits from the customers and in some cases foreign murabaha syndicates that are based on commodities. The deposits gathered from the customers are treated on a special basis and are slightly different from the conventional bank deposits. The terms and conditions of these deposits provide for depositors being entitled to receive a share of the bank's profits, but also obliged to bear potential losses pertaining to their investment in the bank. This profit-sharing principle based on sharing both the rewards and risks at the same time is one of the core five pillars of Islam. One recent addition to the funding methodology (which is not still accepted

among the Turkish participation banks) is the sukuk products. This is mainly important for the diversification of funding sources and it is generally accepted as a long term and stable funding source (sukuk is like conventional bond issuance with slight differences) Issuance of these instruments has increased rapidly over the past three years, reaching almost \$100 billion.

Along with the alternative funding methods above another important point is as Boukhatem and Djelassi (2020) address, which is the depositors' liquidity behavior and bank's funding strategies. Both measures are important elements in managing the liquidity risk. The authors argue that based on profit maximizing motives, Islamic Financial Institutions have three important determinants in liquidity management. The deposit revenue sharing ratio, the financing return rate and the Islamic Money market return. (Boukhatem & Djelassi ;2020)

Finally, an interesting research on the Islamic Finance Liquidity Risk measures is by Abdul-Rahman et al. (2018). The authors investigated whether the financing structure of the bank influences Islamic Banks' liquidity risk. Conducting Static Panel Regressions on 27 Conventional and 17 Islamic bank's data between 1994 and 2014, they found evidence-increasing number of real estate financing and short-term FS stability of the Islamic banks might increase both their short- and long-term liquidity risks showing that liquidity risk behavior differs between conventional and Islamic Finance. (Abdul-Rahman et al.; 2018) Another conclusion they derive from the study is that as the exposure channels to liquidity risk for conventional and Islamic finance differ, they should insert different governance measures for dealing with liquidity issues in both in the long and short run periods. (Abdul-Rahman et al.; 2018) Still with inability to reach derivative instruments for hedging purposes and narrow funding sources to the Sharia compliance principles Liquidity Risk issue is still a challenge for the Islamic Finance. (Smaoui et al 2020)

2.3 ISLAMIC EQUITY AND BOND MARKETS

Due to infancy stage of the Islamic Financial industry, it seems hard to unattached the Islamic financial markets from conventional ones. Early

studies indicate that in most cases the programs to develop Islamic rule set based equities is parallel to ongoing islamization processes in the Muslim World. (Tahir, 1988) The status shows that unrelated with the population's general tendency of being Muslim at large scale, most of the Muslim countries have well established and developed financial markets. These markets tend to be rather replicates of Western Conventional counterparts and they tolerate principles that may not strictly obey the Islamic Principles. (Naughton & Naughton, 2000) Some countries like Malaysia, where Islamic Financial transactions have grown significantly, has initiatives of establishing the necessary regulatory and infrastructure-based framework to facilitate trading on Islamic rule definitions. Followed by the establishment of Islamic broking houses and Islamic Funds, interest in the definition of Islamic Capital Markets by the investors is growing in an accelerated motivation.

Definition and operation of purely Islamic Capital Markets is rather difficult considering the nature of the Islamic Principles as close monitoring for compliance with these principles is to be maintained. Before the considerations of risk and return perceptions of the investors, there are various important compliance elements to construct equity markets that are Islamic in nature. The first of these elements is the clearing of interest (Riba) based factors. The crucial part here is that the definition of interest in Islamic terms does not end with the time value of money and earning of excess profits but also cover other practices where one agent through other means derives returns based on superior information, such as in the case of presence of asymmetric information, disrupting the harmony of the markets and thus the society. Some authors also argued in their works that convergence of riba based systems into Islamic ones tend to differ based on various principle that govern business environment in an Islamic economy. The political principles that match with the Islamic state defines how this convergence of riba free economy can be achieved in the long term. (Gambling & Kamal, 1986)

Another important dimension for the construction of Islamic Capital market is the elimination of both excessive uncertainty and speculation (Gharar) and gambling (Qimar) Western literature on all of these ele-

ments see these elements as necessary factors for the presence of an equity market as speculators are the ones that improve liquidity in the market by watching the fluctuations according to the news embedded in the prices and it is important to track the interaction between the interaction of rationale investors, those that trade on “true” information relating to the stock, and speculators, who trade on “noise”, help to keep the market efficient in a Western sense. (Figlewski, 1979) (Black, 1986) Considering such importance of speculative elements, construction of a fully functioning equity market without it is highly questionable in terms of price convergence and trading volumes. Some authors argue that due to such restrictions Islamic Markets should not be envisaged as speculation free markets. Instead, speculative, in a sense that it helps price movements in the market, should be capped to a certain degree for the health and activation of the market. It can also be seen as an important factor to activate the Islamic Stock Markets and provide less informed market participants with important trading signals upon which they give decisions of buying/selling the securities. (Askhar, 1995) Nevertheless the degree of speculation that could be allowed in an Islamic market is still a doubtful question as it is a measure that is unquantifiable regarding Islamic Principles.

The dimension of uncertainty is another case. In modern financial terms the valuation of stocks is equal to the sum of present values of future expected dividends that are discounted on the underlying company's cost of capital. Thus, in Islamic terms there are various important conditions to remove the risk of excessive uncertainty. According to El-Din if the following conditions are satisfied the supply/demand conditions in the market are able to yield consistent prices based on true expectations of a share's future dividend income stream. (El-Din, 1996)

- (1) *Making accessible all relevant information and financial indicators for the use of participants in the stock exchange.*
- (2) *Participants must acquire (or somehow seek the service of) the analytical ability to carefully process such information to obtain consistent estimates for the true expected exchange values of the shares.*

Formation of Islamic Equity markets is a long-debated issue and as Masih et al. (2018) argue, is an important milestone for Islamic Finance as there is much criticism stating that Islamic Finance is only related with debt based contractual arrangements resembling interest based financial instruments. (Masih et al.; 2018) This in fact explains the increasing volumes in investment figures in the global finance scene and therefore growing interest in terms of research and empirical studies investigating the emergence and return dynamics of these markets. (Masih et al.; 2018) It is important to note here that although the portfolios constructed with equities under Sharia rules can be classified as a constrained portfolio, investors for reasons like low leverage, and more stability due to lower volatility in some manners choose to go with these Islamic Equities. Although still these propositions are debatable as there is still mixed results in terms of performance comparison, some scholars argue that Islamic equities can be used to diversify risk. Mensi et al (2015) argue that investors can use gold and Islamic equities to in crisis times to diversify or lower risk. (Mensi et al.; 2015) This commodity and Islamic Equity market positive correlation issue is supported by the findings of Nagayev et al. (2016) as they found evidence of a persistent increase in returns correlations between the Islamic equities and commodity markets through the years after the 2008 US Financial Crisis. (Nagayev et al.; 2016)

With the growing interest in the Islamic equities during the last decades, the volume of research available has grown tremendously. Comparison of Conventional markets and Islamic Equities has become a major topic in the finance literature as more and more investors turn their face to the newly concept of “Islamic” while constructing their portfolios. Rizvi et al (2015), Hammoudeh et al (2016) Mazouz et al. and Yilmaz et al. delved into the concept of co-integration between the Islamic Markets. Rizvi et al (2015) measured the vulnerability of these markets in respect to the 2008 US crisis and results turned out Islamic banks being less vulnerable to financial crisis. (Rizvi et al.; 2015) Kenourgios et al (2016) supports this thesis deriving conclusions that Islamic financial securities are good alternatives to the conventional ones in terms of acting as a cushion

against risk and insatiability, especially in the crisis periods. (Kenourgios et al 2016) Ho et al. (2014) argued that especially in crisis periods Islamic Equities outperformed the Conventional ones. (Ho et al; 2014)

One of the research subjects in the Islamic Equities literature is based on the co-movement, spillover, and contagion issue. Numerous empirical studies are based on this co-integration question. Mazouz et al. (2016) Alaoui et al (2015) Ajmi et al. (2014) are some of the examples of research conducted on this question. The major conclusions and the common denominator of these spillover dynamics is that all of them has signs of dynamic dependence of the Islamic equities with conventional stock markets. This in fact means they co-move with their conventional counterparts and share a volatility contagion. Empirical studies also show that not only they co-move but also share return dynamics. (Mazouz et al.; 2016 Alaoui et al.; 2015 Ajmi et al.; 2014)

Islamic equity markets are also investigated upon the portfolio diversification benefits and trading strategies that could derive profitability. For the former issue Masih et al. (2018) argue that due to the practicing of Financial Ratio Screens and Sector filters on the Islamic Equities, “decoupling hypotheses” occur meaning that Islamic equity markets are different establishments with their own working dynamics that are not with in line with the conventional equity markets. They also have return characteristics and corresponding risk profiles totally different from the mainstream equities. Because of the assertions of this decoupling, the literature proposes these equities to have different diversification benefits. (Masih et al.; 2018)

In terms of profitability and trading strategies based on Islamic equities, research has given mixed and inconclusive results. Al Khazali et al (2014), Mohammad and Asraf (2015) and several other scholars have found little or no evidence of a significant method to increase the profitability of the constructed portfolios while trading on Islamic Equities. However, there seems to be cases where one outperforms the other, but the consensus is this is not based on methodology but other conditions. (Al Khazali et al; 2014), Mohammad & Asraf ; 2015) On the profitability issue and Trad-

ing based strategies Narayan and Phan (2016) and Narayan et al. (2015) argue that Islamic stocks are as profitable as the conventional stocks and trading strategies such as Momentum based ones can be used to derive profits from the trading of these Islamic equities. However, for the Islamic equities stock characteristics is a major issue that can affect these profits. (Narayan & Phan; 2016, Narayan et al.; 2015) Financial Ratio screens and Business Activity screens are important elements in terms of risk and return characteristics of these Islamic equities thus affecting the profits. Akhtar and Jahromi (2017) analyzed the Islamic and non-Islamic stocks in Malaysian markets in terms of risk, return and mean variance efficiency and their conclusions were that while business activity screens can have an adverse effect on the returns of these stocks, financial ratio screens can compensate for this adverse effect. This is mainly because these ratio screens reduce the variance of the portfolio. (Akhtar & Jahromi ; 2017, Safiullah and Shamsuddin (2017) analyzing Dow Jones Islamic Market data showed results that Islamic equities with lower cost of equity capital compared to the conventional counterparts, outperformed the conventional side based on raw returns, Sharpe portfolio performance ratio, and CAPM alpha. (Safiullah & Shamsuddin; 2017)

Aside from the Islamic Equity Markets, perhaps equally crucial instruments in Islamic Finance are the Islamic Bond (Sukuk) markets. As the Organization for Islamic Development summarizes Sukuk has been a major player in the emergence and success of Islamic Capital Markets. Most of the Muslim countries are at the stage of either enjoying a well-developed Sukuk market (as in the case of Malaysia with 41.1% of the total global Sukuk issuance as of 2016) or they are starting to climb the stairs for success in becoming a national part of the Debt instruments market. Turkey for example is in the beginner stage while with the regulatory support with the correct communiques, an attractive 4% of market share from the global issuances is achieved (COMSEC Sukuk report, 2018) It is interesting that even in non-Muslim countries such as UK, Hong Kong and US Sukuk have become a trending player. This as Hassan et al. (2018) concludes, Low interest rates and increased volatili-

ties impose a challenge for the bond portfolios diversification and optimization thus diverting the portfolio managers to alternative global investment instruments to derive profitability while maintaining the same traditional risks. (Hassan et al.; 2018)

Sukuk in terms of financial instruments is not actually a new concept. As the COMCEC report argues its origins date back to the 600s and its classical use as an intermediary for debt can be traced back to the Umayyad Caliphate. In the early texts Sukuk is referred as a certificate given in return for the placement of Commodities or grain in a certain trade house and holders of these certificates are entitled to sell them for cash before taking delivery. This model mainly explains the mentality of “underlying asset” in the origination of Sukuk. Other historical Muslim empires such as the Ottoman Empire also utilized similar Sukuk structures from 1775 onwards called “Esham” based on the income generated from the landowner’s taxes (Timar) to generate money for financing of Foreign debt and the flow to finance the continuous wars. (COMCEC; 2018) However, it is not before 90s that Sukuk has been such a favorable and attractive player in the markets. The period between 1990 to 2000, as Muhammad et al. (2018) argues; witnessed a tremendous transformation of the global Sukuk Markets. During these years’ even large corporates like Shell, started to prefer issuing Sukuk in as a means of financing. In addition, the importance of this era is that most of the theoretical background and models for Sukuk infrastructures we built. This development paved the way for the market players to be more innovative on the issue and thus new products such as Retail, Perpetual and subordinated Sukuk emerged. (Muhammad et al.; 2018) Today the market seems to be maturing daily and the investor preferences aside from a religious choice are dealing with the Sukuk Market to derive profits while enjoying most of the time the same strategies with the classical bond market.

Along with such positive scene, it is undeniable that there are some major impediments and challenges in this Market and still way to go to fully race with its brother Bond Market. Kusuma and Silva (2014) point out issues such as lack of standardization, narrow liquidity and concerns on

the insolvency, constitute major drawbacks for the Sukuk Markets for a probable faster growth. (Kusuma & Silva; 2014) The authors conclude on the issue by advising the policy makers to dissect the global experience of the Bond Markets and reflect necessary changes to the Sukuk Markets to ease their efforts in the creation of well-cooked Islamic Money Markets (Kusuma & Silva; 2014)

With its increasing popularity among the financial market players, not surprisingly the volume of research on different aspects of the Sukuk market has grown significantly in financial literature during the last decades. While Sukuk takes its place as an alternative to Conventional Bonds, its success and efficiency in this manner is debated by various authors. Mohd Zin et al. (2011) opens the debate by stating that still there is not enough research on the Sukuk Market compared to Bonds even though recent years has witnessed a growth of more than 30% per annum. (Mohd Zin; 2011) Razak et al (2019) supports this notion by stating that from 2012 onwards Sukuk market has enjoyed a high year over year growth and become a major player in the financial markets and with private getting more and more interested in the Sukuk issuance for financing operations, the future of the Sukuk Market lights up much brighter. (Razak et al; 2019)

The literature based on Sukuk covered many diverse topics. With its seminal paper in the various topics, Azmat et al. (2014) and Azmat et al. (2015) discussed the basic notions of the Sukuk Market covering issues from Sukuk Ratings to the Sukuk Compliance challenges. In real terms these issues are the basics for Sukuk Market as they are mainly related with the theoretical and practical framework the instrument base itself on. Azmat et al. (2014) argues that the characteristics of the Sukuk issuances including the advisory board, audit committee and the accounting standards are of prior cone of influence on the rating of the Sukuk issuances. (Azmat et al; 2014) The authors also adds that aside from the credit rating issue, factors affecting the issuer behavior of Islamic and Conventional organizations are different attributing the instruments totally different characteristics. (Azmat et al.; 2014)

An interesting debate in on the existence and major setbacks of the secondary markets of Islamic Bonds. Although being remarkable successful in the IPOs and firsthand issuances, still the secondary markets of these Islamic Bonds are debatable meaning that liquidity can sometimes be a major dispute among the potential investors. Ulusoy and Ela (2018) conclude stating due to several major impediments such as the scarcity of supply, hold to maturity culture and inadequate trading platforms, secondary market is still very weak. Their main proposals to develop the secondary markets include more issuance of sovereign sukuk by the governments in order to attract more investors, more standardization in terms of issuances and thus ensure the investors of a strong regulatory framework. Not offering Islamic bonds to solely corporate investors but also enriching the Sukuk market with retail investors that could invest with smaller tickets and finally rating and listing more Sukuk on the market. All of these proposals are important milestones in the transfer of some of the funds invested in the Bond Markets to the Islamic Sukuk Markets. This is because increasing efficient of the secondary market increases the trust in the investors. (Ulusoy & Ela; 2018)

The efficiency of the Sukuk Markets is one of the most researched topics in the Islamic Finance Literature. Growing volumes of issuances has brought the efficiency of these Islamic Bonds under spotlight. The level of efficient is not investigated solely on the investors side but also on the Macroeconomic majors. Smaoui and Nechi (2017) asked the question whether Islamic Bonds had a positive impact on the economic growth. They used sample of data comprising many of the sukuk issuing countries and tried to find a linkage between Sukuk issuances and economic growth. Their findings seem to include evidence, although financial deeping in the markets does not meaningfully correlated with the economic growth, the development and addition of the Sukuk markets played an important role in the stimulation of the economic growth in the longer horizons. Smaoui and Nechi (2017) As a deeper layer to this efficiency issue some scholars tested it on the company level. Mimouni et al (2019) measured the impact of Sukuk on the performance of conventional and Islamic Banks by utilizing a data set from 71 Islamic and

146 conventional banks through a period of 2003 to 2014. Interestingly they found evidence of a negative impact of Sukuk issuances on banking performance as the results confirmed Sukuk substituted for banking system. They also addressed the adverse effect of Sukuk on Islamic Banks while the issuances have no effect on the conventional banks whatsoever. The only positive effect was the quicker adaptation of the Islamic Banks to the competition in a post crisis period while it took longer for the conventional. (Mimouni et al; 2019) Smaoui and Ghouma (2020) performed a similar study investigating the linkage between Sukuk Market developments and Islamic banks' capital ratios. Utilizing a sample of 230 Islamic banks through the period 2005-2014, they tried to characterize the development issue by delving into ratios such as capital adequacy ratio, Tier 1 capital ratio and capital to total assets ratio. (Smaoui & Ghouma ; 2020) Their findings are consistent with the previous literature, stating that Sukuk market developments exerts an adverse effect on the Islamic Banking capitalization ratios. Their main rationale behind such negative relationship is the tendency of Islamic Banking sector to loosen the capital requirements to minimum levels and increase risk taking appetite as the growing volumes in the Sukuk market increases the level of competition in the Sukuk Market. (Smaoui & Ghouma ; 2020) This finding is also consistent with the Turkish market case, as with the increasing inflationary and interest period in the last year, Islamic Banks have entered into a fierce race of competition of rates in terms of new issuances to be a part of the race in a banking system where conventional has a huge share in the market.

A final issue that is to be mentioned here and is an attractive subject for the academic literature is the co-movements and relationship of Islamic vs Conventional Bond Markets. Hassan et al (2018) found strong evidence of co-integration between international bonds and sukuk market. Their findings are interesting as they conclude that there is positive conditional correlation between sukuk returns and leading bond markets such as the US and EU which increases in the terms where there are financial shocks. Especially this co-integration increases during times of recessions. A major point in the research is that although Sukuk seems

to share the same characteristics as investment grade bonds, they also provide diversification benefits to portfolio managers due to the lower leverage and volatility dynamics of Islamic Financial instruments. (Hasan et al; 2018) Bhuiyan et al. (2018) support this diversification issue by stating that investors have the opportunity to reduce the portfolio risk during a crisis by holding long term Islamic Assets. (Bhuiyan et al.; 2018) Haque et al. (2017), utilized a Wavelet approach for results indicating causal relationship between Sukuk securities and conventional bonds for a given period. The Wavelet Coherence Phase differences indicated Sukuk leads bonds in the long-term investment horizon rather than in the short term. (Haque et al.; 2017)

2.4 MARKET EFFICIENCY IN ISLAMIC MARKETS

Market efficiency is an important concept in today's literature on the financial markets. Basing itself on the works of Markowitz (1952) for efficient frontier and later studies of Fama (1970, 1972) on the segmentation of markets on three sub-segments including Strong form semi-strong form and weak form. The issue is one of the mostly debated topics on the finance literature and not in fact a main delving issue of this dissertation. However, it is important to note here that its essence is a major element that is directly related with the core of Islamic Equity Markets. The theory suggests that markets need optimal allocation and significant diversification for investors alongside with a degree of transparency and instantaneous reaction to new information. Both of the key elements here are important for investigation, should we think of an Islamic Market where the main motivation is the welfare of the players acting in the market thus protecting the harmony and enabling of all to the same provisions. The main question to be answered is that whether Islamic Finance can maintain all the requisites for efficiency and be a competitor to the conventional side. Some scholars have suggested that if it is to be seen as an alternative to conventional transactions, one would confirm the Sharia hypotheses and imply full segmentation/independency between the conventional and Islamic financial industries, meaning that IF could be a substitute for conventional finance, while inefficiency in the IF market would point to further cohabitation/coexistence between con-

ventional and IF, as the latter could serve as a benchmark for conventional finance reforms (Causse, 2012).

Various scholars' debate on a paradox of efficiency for the Islamic Financial Markets arguing that, as Islamic Finance suggests less volatility and more stability to investors by offering more fundamentally benchmarks price movements through efficient systems it should achieve better results than its conventional counterpart. Nevertheless, the main motivation behind Islamic finance is supporting and respecting dignity of individuals, social and societal values by defending moral investments and the prohibition of non-ethical industries. However, this also means evidence of less diversification among investor possible choices and thus taking more financial risk in terms of narrow selection. (Jawadi, Jawadi, Cheffou, 2015)

Studies on the efficiency of Islamic Financial Markets is rather scarce compared to the volumous number of compilations for the conventional market efficiency. Most of the academic literature cover a small portion of the issue by investigating the efficiency and financial terms for Islamic Banking and it is unfortunately not sufficient for delving the issue in depth. There are also various handicaps such as regulatory framework, which directly affects creates a diversified range of results in terms of market efficiency and results that vary country wise. Several factors can explain these differences: the absence of an authority common to all Muslim countries, lack of transparency, the issue of image and confusion between IF and Islamist matters, different stock selection processes to ensure the eligibility of companies, etc. (Jawadi, Jawadi, Cheffou, 2015)

Conclusions on the efficiency of Islamic Stock exchanges and Stock indices are rather mixed. Due to short life spans and the number of limited data, reliable results for inefficiency is not highly satisfying. An important shortage addressed by the academic literature is that diversification is rather difficult among pairs of indices as they are both computed by globally reliable indices' providers and thus benchmarks the efficiency level of Islamic indices in relation with their conventional counterparts thus sometimes giving out biased results. Research has been made on

the efficiency levels and degree of competency in some papers have shown that that Islamic indices of some worldwide known indexes such as (Dow Jones and S&P) have negative correlation value with their benchmark, which means that the favorable situation to invest in multiple businesses exist. That analysis interpreted as if indices are not getting profit or facing loss in business then at the same time other indices are gaining profit, which thus lower the overall risk of the portfolio and hence provide the favorable circumstances to invest. (Ahmad, Zahid, et al, 2015) Nevertheless, some authors found the efficiency levels of the Islamic and Conventional counterparts to be the same. On their co-integration tests based on Dow Jones, S&P, FTSE and MSCI Khalichi et al. found out those Islamic indices have the same (in) efficiencies if present as their conventional ones. (Khalichi et al , 2014)

Some scholars tried to investigate whether this efficiency issue is linked with the geographic location and the fluctuations of a certain region. Guyot (2011) investigated 18 different regional level Dow Jones Islamic indices to capture a comparative study on the price and market dynamics of regional Islamic indices to see whether Sharia rules and screening had any impact on the investment allocation and profit efficiency. Their conclusions include that Sharia rules do not apply any marginal reduction in the efficiency of investment allocation. (Guyot; 2011) Another important issue is the liquidity constraint issue. According to findings, Islamic equities seem to be as liquid as the conventional ones and thus investors should not fear an insolvency issue. However perhaps the most noticeable findings are based on the geopolitical issues. Due to the current geopolitical turmoil scheme in the Muslim World, it seems that investors using Islamic indices and equities for diversification purposes are to add geopolitical risk premiums to their portfolio risk schemes. (Guyot; 2011)

Kabir et al (2017) compared efficiency and risk-return profiles of Islamic and conventional indices to capture their difference and adaptation power in different market conditions. Using a sample data between 1996 to 2012, they found evidence that Islamic equities and markets on averaged tended to be more efficient and brought slightly better returns in

some of the financial crisis but failed in some also (successful in 1997 Asian Crisis whereas failed in 2008 subprime crisis.) They also proposed that Islamic equity markets offer investors efficient portfolio diversification opportunities. Kabir et al (2017) Al Khazali et al (2016) add this efficiency issue that with tremendous amount of Islamic Assets being carried by the sector players during the last decades Islamic Assets have become much more liquid than they are before. As a result of such numbers, transaction costs for the Islamic Markets have diminished thus making Islamic equities an alternative investment intermediary.

Related with the working mechanisms of the financial markets, comparison of efficiency in terms of banking sector performances is an important topic in the Islamic Finance Research. Banks are direct intermediaries in the success of Islamic Financial transactions and considering that several countries have financial markets dominated by Bonds and Equities that are linked with the financial industry, it is inescapable for the literature to delve into this comparison. Based on the issue Yudistira (2004) argue that Islamic banks, compared to the conventional ones are in some terms more efficient than the conventional ones. In their paper, 10 of the 18 banks examined had inefficiency at just over 10%, which is lower than the sector norms on the conventional side. However, they also pointed out that scale is an important factor in this efficiency issue and thus small-scale banks should consider M&A activities to increase efficiencies. (Yudistira; 2004) Also an interesting conclusion by them is that banks operating in the Middle East which are core Muslim countries are less efficient than the ones with hybrid faith structures. This in fact supports the above argument by Guyot (2011) stating that geopolitical turmoil affects the efficiency levels. Srairi et al (2015) calculated technical, pure technical and scale efficiencies for measuring the development of these dimensions across time domain. Although they estimated a 66% technical efficiency level, they came up with pure technical efficient of 29% and scale efficiency of 17%. This in fact shows that while Islamic Banks have the same level of technical infrastructure, they are inefficient in managerial level to efficiently control their costs and their inputs. This is also linked with the scale inefficiency meaning that they cannot also

manage economies of scale and are incapable of matching their operations and controls with their size and scope. (Srairi et al.; 2015)

2.5 PORTFOLIO CONSTRUCTION FROM CONVENTIONAL AND ISLAMIC PERSPECTIVES

Portfolio optimization and deriving returns from investing into different Asset classes has been a major issue in the financial literature. Starting from the seminal work of Henry Markowitz in 1952, selecting the most efficiency portfolio by conducting an in-depth analysis on each alternative investment scheme, has been one of the primary research topics. Measuring performance of these portfolios is an important aspect with several portfolio measurement techniques (such as Sharpe, Treynor or Jensen's alpha), while risk management techniques are inseparable parts of the whole literature. However, with the emergence of Islamic Finance, an addition to the literature has been made. Islamic Finance, bringing a new dimension to the Finance literature, which is the faith, based investment, paved the way to the discussions whether Islamic based investments or portfolios are better off for investors in terms of managing systematic portfolio risks and deriving better profits. With the addition of several Islamic Financial instruments like Islamic Mutual Funds, Islamic Banking Channels, Shariah based ETFs etc., Faith based investors can find a chance to invest as ethical and socially responsible individuals. (Renneboorg et al.; 2008) On the other hand still as these markets can only constitute a minor part of the global financial system, still much debate is present on their success to generate profits to investors at the desired level with efficient portfolio optimization and lower risks than the conventional finance system.

Dharani et al. (2019) by utilizing the Asset Pricing models performed a comparison of both Islamic and Conventional portfolio performances within a period of 2001-2017. Their major question was whether portfolios operated under Sharia compliance principle can derive better results with lower risk taking. Their findings include the existence of positive Sharia effect on the portfolios constructed with selected stocks only. Their main conclusion on this difference is based on the company struc-

ture. They argue that since Shariah compliant stocks are mainly companies more dependent on halal business and maintain optimal capital structure, they are less vulnerable to volatility in the market. This also means that portfolios constructed from these stocks incur lower risks to the holders of these stocks. (Dharani et al.; 2019)

Qoyum et al (2020) also investigated this Socially Responsible investing issue and its relationship with the diversification of Portfolios. Their findings expand the literature on the issue, by utilizing the comparative models such as the Capital Asset Pricing Model, by finding reliable results, which show that Islamic Socially Responsible Portfolios has better performance than the conventional counterparts do, and they can be used as return benchmarks for the investors. Also not only are they financially efficient but they are also beneficial to the embitterment of the society by supporting ethical values through financial and sectoral screening methodologies. (Qoyum et al.; 2020)

Optimization of portfolios and the addition of Islamic Assets in this manner is still a debated issue. Modern Portfolio Optimization theories such as Merton (1980) proposed mean-variance analysis as subject to limitations of extreme portfolio weights however mean-variance optimization still manages to become treated as the core of the portfolio optimization studies. In this manner, Trichilli et al. (2020) by adopting such strategies analyzed the differences of portfolio optimization under Islamic and Conventional asset classes. (Trichilli et al.; 2020) By investigating portfolio optimization under investor sentiment states (Their investment sentiment index is based on the construction of an index that tracks households Google search behavior in terms of certain words to give a clue of what the investors search in terms of the related research) through the utilization of Hidden Markov models.³ Their findings are mixed in terms of the investor's sentiments. It seems that in times of bullish markets the conventional portfolios opted out to be more profitable while in bearish states Islamic portfolios tended achieve superiority. They also conclude that in terms of mean variance Markowitz analysis in

3 For a detailed description of Hidden Markov Models see; <https://web.stanford.edu/~jurafrasky/slp3/A.pdf> (Link active as of 05/12/2020)

the calm and low volatility of the market investing in Islamic equities and indices gave superior performances over the conventional ones.

Dewandaru et al. (2016) also investigated the role of Islamic Asset classes in the diversification of portfolios through a Mean variance approach. By both using US and Malaysian stock market as a sample data they tried to answer the question whether the inclusion of Islamic asset classes solve the problem of investors in terms of expansion of the efficient portfolio frontiers. (Dewandaru et al.; 2016) Their findings support the conventional fund managers to explore Islamic equity opportunities in several different emerging markets to minimize their global minimum variance. However, delving deep into the question of which instruments constitute an additional marginal value to the optimization notion gave out mixed results. The authors concluded that findings do not support any benefit to the Bond investors in the short terms from adding their portfolios global sukuk while on the other hand Islamic equities brought an additional premium to the portfolios. For institutional investors, the advised instruments in the research seemed to be TIPs, REITS and high yielding bonds giving additional marginal returns as the former ones improve tangency while the latter reduces the variance. (Dewandaru et al.; 2016)

A final topic to be covered in this part is the portfolio diversification opportunities for the Fund management professionals and the equity funds by allocating a portion of their investments to the Islamic Equity markets. Islam Khan et al. (2017) found that investment characteristics and stated preferences are important effects on the portfolio diversification issue. Thus, addition of Islamic stocks to fund portfolios are not only due to the prospect of deriving of returns but sometimes directly related with the demographics of fund managers. Islam Khan et al.; 2017, Peillex et al (2019), on the active management of Islamic Funds have found evidence that that market movements dominate the other components explaining nearly 50% of the monthly return variability and that, taking together, asset allocation policy and active management explain approximately the second half of IEFs returns. (Peillex et al; 2019)

2.6 DIFFERENCES IN ISLAMIC INDICES

To fully understand the comparison between an Islamic and Conventional index it is important to delve into the basic of how and what really differentiates these two types of financial time series. As it can quickly be understood from the term “Islamic”, an Islamic index is derivation and calculation of an equity index but with an Islamic twist where Islamic Sharia based rules and regulations are applied. These rules are mainly based on company selection including industrial screening, Financial Ratio monitoring so on and so forth. In fact, these Sharia based rules are governed through Sharia boards for approval of selection of companies, which will be allowed under Islamic Law and Principles. The Sharia based regulatory bodies evaluate contracts that relate the financial products and use the method of Sharia Screening that is the classification of Shariah-compliant investments under the Islamic rules and regulations. Shariah undoubtedly describes activities which are prohibited for Muslims such as Riba (interest) and doing the Haram businesses (for example the alcoholic industry and the pork industry). As a result, any companies listed under an equity index that cannot pass through the screening process in terms of both industry and ratio-based criteria cannot be listed in these Islamic Indices and Muslims therefore are not allowed to invest in any such companies, not even outside of these indices.

The important element in construction of Islamic Indices is the fact that as Islam has different sects and there are certain different belief patterns in different countries, standardization of these indices can sometimes be harder than one might think. It is easy to accept some of the common motives such as Islam’s definite prohibition of some industries such as alcoholic beverages, gambling, porn industry, cloning based research etc... Thus, forming screening criteria around these prohibitions are easier. However, the real problem starts with the financial ratios.

Especially there is much debate on the exact While some countries for example accept numbers that are linked to Islamic tradition (For example 1/40 for zekat is applied to the halal industry threshold) others sometimes come up with numbers that seems to be the most suitable

to apply. One can see the differences even in certain indices providers including Dow Jones, MSCI or FTSE. These differences are important as they directly affect the cross-border marketability of financial products based on these Islamic Indices.

In almost all the Islamic Indices used as benchmarks for Islamic equity investments, there are two main dimensions to come up with the conclusion that the underlying index is “Islamic”. These two dimensions are 1) Business Activity or Industry Screening and 2) Financial Ratio screening. There are varieties of different applications of these two dimensions in several different mostly utilized indices and ratio metrics differ widely. It is easier to come up with a set of prohibitions and allowances on the industry screening and scholars in most of the Sharia Boards have aligned at high levels on industries with just minor twists. For example, in some of the indices human cloning or music industries are allowed while in some they are not. Nevertheless, sectors like tobacco, pornography or alcoholic beverages are sectors to be aligned for absolute prohibition.

Standardization of Islamic index criteria is harder in the second dimension, which is the Financial Screening. As I have concluded in the industry screening, differentiation between industries in terms of haram/helal aspects with respect to Islamic prohibitions is easier than to come up with financial ratio thresholds as in most of the cases Qu’ran does not set up numeric restrictions. Scholars try to derive these ratios from either Islamic Daily Rules that has been traditionally accepted (İçtihat), try to link these ratios to some Islamic principles or dig up some minor points from the hadith. (Advice of Prophet Muhammed S.A.V) A very good example of this can be tracked in the mostly accepted ratio of %33 which is derived from our prophet’s saying something is helal is its 1/3 is not contaminated.

The most difficult part of the financial screening is that due to lack of precise numeric standards or strictly written prohibitions as in the case of industry screening, it is harder to come up with globally accepted financial ratio standards. As a result, different index standard can arise based on several different conditions such as macro and microeconomic environ-

ment, differences in the views of Islamic Scholars in different countries and the degree of understanding of Islamic law to accelerate product development and decrease the risk of non-compliance with Shariah. There are several different arguments on the standardization of financial ratios. Some of the academic articles defend the idea that standardization is hard to come up, as Islamic Finance is its infancy and need time to mature. Since still most the transactions are to be approved by smaller Shariah Boards in different countries, a common framework is still to be debated. However, it can easily be concluded that under such globally accepted standards product development can be easier stripping the financial institutions from the fear of non-compliance with the Sharia standards and blowing out the monopoly of smaller Islamic Advisory Boards. Scholars argue that that the sustainable growth of the Islamic finance industry is currently obstructed by the lack of standardized rules and regulations, a vague legal framework, different scholar interpretations of Shariah and different levels of rigorousness.

Table 2: Screening Criteria for three major Islamic Index Providers

Criteria	MSCI	Dow Jones Islamic	FTSE
Business Screening (Industrywise)	alcohol,tobacco, pork-related products, conventional financial services, defense/weapons manufactures, gambling/casino, music, hotels, cinema, adult entertainment	alcohol, porkrelated products, conventional financial services, entertainment, tobacco, weapons and defense	conventional finance, alcohol, pork-related products, entertainment (cinema, casinos, gambling, music. pornography, hotels) tobacco, weapons and arms business
Debt Ratio	<%33	<%33	<%33
Interest Accruals	<%33	<%33	<%33
Accounts Receivable	<%33	<%33	<%50
Non-compliant Income	<%5	-	-

2.7 ISLAMIC VS CONVENTIONAL INDEX PERFORMANCES

With growing interest in the Islamic Investments in the recent years, research dedicated on the Islamic Indices as primary return benchmarks has expanded considerably. The markets for both conventional and Islamic investments have developed rapidly as new investment instruments over the last two decades. These investments have not only expanded in the conventional capital and money markets but also in the recently developing Islamic financial markets. (Ho et.al, 2013) With global financial assets exceedingly nearly 2 trillion USD during the 2014, it can be concluded that one of the highest growing segments in the finance industry is Islamic Financial Investments. Thus, a primary need for construction of instruments where investors can benchmark and track returns of these Islamic instruments while developing new products written on them is born. Especially studies comparing returns of these indices with their conventional counterparts have become popular in terms of discovering whether there is high covariance between these two.

As this study suggests in the previous chapter (in financial and industry screening rules), Islamic indices are mainly subsets of the mother conventional indices with companies that cannot comply with these screening rules are excluded from the calculation of the index. This in fact creates the idea that return dynamics of the mother index in most of the cases spills over to the subset Islamic index. In several country and regional index cases, this argument holds true (as studies have indicated) with volatility spilling over the return dynamics of the former to the latter. On the other hand, some studies have argued that due to portfolio limitations and lack of flexibility in investment alternatives Islamic Indexes would underperforms in the longer term compared to conventional indices. Nevertheless, some may see this as their existence as safe havens for the investors where they protect the investors from sharp down turns by excluding companies with higher volatility. (Bauer, 2005- Ho et al. 2013)

There are several dimensions tested in the literature. Some of the scholars mainly focused on the return dynamics benchmarking these two in-

indices with the Portfolio Performance Measures while some are mainly interested in the causality and volatility spillovers. Al-Khazali, Lean and Samet when testing Dow Jones Islamic Indices with Conventional ones in three different subsets, found out conflicting results with mean varying and CAPM approaches. Using both Islamic versus conventional indexes and three sub-periods (1996–2000, 2001–2006, and 2007–2012) using daily data, their findings suggest that conventional indexes stochastically dominate Islamic index in all markets except in the European market. However, the Global, European, and the US Islamic indexes dominate their conventional counterparts during 2007–2012 period, which shows that during and after the financial crisis, Islamic indexes stochastically dominate their conventional peers. (Al-Khazali, Lean & Samet, 2013)

Another study conducted by Ho et. al using portfolio performance measures of Sharpe, Treynor and Jensen's Alpha concludes that during crisis periods, Islamic indices perform better than conventional ones and are less affected by the crisis providing a hedging alternative due to their lower volatility and betas. In fact, the empirical result of this study is in line with the above opening argument where in normal times Islamic indices may underperforms but in down turns, they seem to be safe havens for the investors. This finding can guide investors in their investment decision by providing information on the risk and return relation during bear periods. (Ho et al, 2013) However, it must be caution that historical performance does not provide any guarantee for future performance.

An interesting research question investigated by Charles, Darne and Pop is the interlinkage between Sharia filtering of these indices to the degree of risk. They investigated the idea that whether the excluding of non-Sharia compliant companies contributes to a coverage of risk up to a certain extent considering both indices are subject to same extreme events such as systemic shocks.

Their conclusions majorly contradict with the above argument where Islamic Indices are safer. Empirical results of the study show that most of

the Islamic indexes have higher level of risk than the conventional indexes, whatever the sub-periods. Consequently, this finding means that the Islamic indexes are riskier than the non-Islamic indexes. Either in most cases the Islamic indexes outperform the non-Islamic indexes or there is no significant difference in performance between both indexes. The authors argue that these results can be explained because of less diversification in Islamic indexes, leading to higher concentration risk in some sectors, such as basic material, industrial and technology firms. (Charles, Darne & Pop, 2015)

Aside from the concentration, risk due to limitations of the Sharia filtering, Islamic indices can even get exposed to risks that may seem to be inappropriate with the nature of Islamic principles as they operate under the dome of global financial system. Shamsuddin in his article on the exposure of Dow Jones Islamic Index to the interest rate risk, concluded that Shariah-compliant firms with no interest sensitive assets or liabilities can avoid direct impact of interest rate changes on their discounted future cash flows. But they may not be immune to widespread indirect impacts of interest rate changes because of economic interdependence among economic agents with different ethical values. (Shamsuddin, 2014) Another important point to note here is that due to a certain extent of permission to financial leverage for the firms by Islamic Advisory Scholars, these indices are not hundred percent immune to interest rate risk but are affected to a lesser degree compared with their mainstream conventional counterparts. Shamsuddin came up with four main conclusions examining the Dow Jones Islamic Index, (Shamsuddin, 2014) His conclusions are initially the Islamic equity indices outperform their conventional counterparts since both raw and risk-adjusted return. Secondly Investors can immunize their portfolios to interest rate risk by investing in a well-diversified Islamic equity portfolio like the Dow Jones Islamic market index. Nevertheless, Investors who are keen on pursuing a sector rotation strategy may tilt their portfolio towards sectors with positive (negative) interest rate exposures during episodes of high (low) interest rates. A final quote is that the sharia screening of stocks cannot fully mitigate interest rate risk.

Sensoy et al. studied the predictability of Islamic Indices based on 12 different Dow Jones Islamic Index data covering a period of 16 years. Due to the sectoral restrictions based on Sharia filtering and exclusion of more volatile companies within a financial ratio aspect one would assume more predictability in times of portfolio construction in a time varying linear aspect. Returns should be predicted easier when investing products based on Islamic Indices. However, the authors found no evidence of such in their analysis of data. On the other hand, they concluded that findings of predictability, when taken into ARCH volatility, differ according to the dynamics of different markets. As a result, in contrast to the general supposition, Islamic markets do not necessarily need to carry a more deterministic or predictable structure compared to their conventional counterparts. Thus, investors should not intuitively decide upon whether an Islamic equity market or its conventional counterpart is more efficient than the other without since return dynamics are not only linked to the Sharia filtering or financial ratio exclusions but also the liquidity market quality, institutional characteristics and the country/continent specific investment behavior. (Sensoy, et al., 2014)

Shahzad et al. examining the return volatility of major stock indices and their Islamic counterparts through a period of 1996-2016, concluded that although Islamic Indices constitute an investment alternative to investors, they are not fully immune to the risks that are inherent in the conventional financial markets with important implication for various market participants. Due to the limitations in the portfolio selection and thus diversification, it is important for faith-based investors to diversify their portfolio with various other instruments to manage their risk. (Shahzad et al.; 2017) Also the authors have argued, for future implications, that for policy makers in the Islamic Financial Markets (especially on the regulation side) it is important to develop Islamic instruments with which the investors are able to hedge their positions. (Shahzad et al.; 2017)

Although most of the research on Islamic Indices take the indices without breaking down to the industry level, some articles tried to answer the research question of whether in the sectoral level the Islamic Indices are better than the conventional ones. Alam, Arshad, Rizvi in their article

delved into comparative analysis of 10 sectoral global indices for both conventional and Islamic counterpart spanning over 18 years. The sample period runs from 1 January 1996 until 31 December 2014. They also divided the data into four different periods for further validation of the results. Their main ambition is to test the EMH under both Islamic and Conventional sectoral indices to see whether one outperforms the other with all the rules applied to the Islamic version. Their conclusion as they argue is slightly different and majorly interesting when compare with the other research in the area. They conclude that in the shorter horizon efficiency tends to follow a similar pattern amongst the conventional and Islamic counterpart. This in the view of authors is owing to the behavioral aspect of the stock markets. The same holds for the longer horizon but the Islamic sectoral indices generally tend to exhibit a higher efficiency regime. (Alam, Arshad, Rizvi; 2016) Their linked these findings to the notion that although similar stocks in similar sectors are included in Islamic and Conventional counterparts, the change in the degree of leverage may affect the level of efficiency and performance of both indices. (Alam, Arshad, Rizvi; 2016)

One last research to quote is on the predictability of Islamic Markets when compared with the Conventional ones. Narayan et. al utilizing 12 different financial and macroeconomic predictors over a data set spans January 1981 to December 2014 and contains 2577 Islamic stocks found evidence that US Stock Market returns was the best predictor among the 12 different variables. Their data analysis showed that profits are maximized when U.S. returns are used as a predictor and the most profitable region is the emerging countries while the most profitable sector is consumer goods. (Narayan et al. 2013) This research article was important in defending the thesis that Islamic Indices are mostly interconnected and in pricing Islamic stocks the role of the U.S. market cannot be ignored. (Narayan et al. 2013)

2.8 STUDIES BASED ON APPLICATION OF WAVELET ANALYSIS

During recent years, Wavelet analysis has become popular in several areas of research, as it is a powerful tool to for compressing, processing,

and analyzing data. It can be applied to extract useful information from numerous types of data, including images and audio signals in Physics, Chemistry and Biology, and high frequency time series in Economics and Finance. In multiple recent researches, Wavelet Analysis has been utilized with its aspect of capturing one-step forward in terms of volatility measures. They also discuss its adaptive power in dealing with financial data series. The Wavelet method has gain popularity in Finance and Economics literature as the nature of data is suitable with the core assumptions of Wavelet methodology. Most of the financial instruments today are traded in high frequency measures and thus capturing the volatility in such an environment with high noise is an important element for deriving returns from forecasting the future trends.

There are three major important advantages of using wavelets for volatility forecasting which are firstly Wavelet Analysis is flexible and do not require strong assumption about the data generating process. Secondly, Wavelet Analysis provides information from both time-domain and frequency-domain and finally Wavelet Analysis is equipped with the ability to locate discontinuities in the data.

Wavelet Analysis has brought an important solution to the bottleneck of handling irregular data sets. The ability to represent highly complex data sets stripped from the requirement of knowing the underlying functional form is of great benefit in economic and financial research. Spotting time shifts or any discontinuity in the data set along with precisely locating isolated shocks to the dynamical system are important vital elements to the argument why Wavelet analysis can be a Newton's apple to a financial econometrician. Also, it is beneficiary to the Wavelet practitioners to be able to deal with the non-stationary of the stochastic measures that are a non-divisible part of the econometric time series practice. (Ramsey, 1996)

Perhaps the most important element to bring Wavelets Analysis on the spot for econometric analysis is the ability to decomposition of data by the time scale. Especially when dissecting the financial series data, it is important to note that these data sets contain variables that operate on

a variety of time scales simultaneously so that the relationships between variables may well differ across time scales. Delving into finance research conducted with Wavelets, one can spot the power of Wavelets with which the research can understand both time and frequency domains. These variables are important as they operate differently based on different time scales. Wavelets majorly play an important role to decompose these data series into different time scales before any application of econometric models can build on it to conclude on certain relationships.

Historically speaking Wavelet analysis has first appeared in the works of Alfred Haar in 1909 with the foundation of Haar Sequence. This mentioning of Wavelets in the appendix of his thesis was the first time Wavelets were mentioned in the academic World. Haar with his seminal work on Haar Wavelets contributed to the literature of Fourier Transformation, which is the original starting point of the whole idea of Wavelet Analysis. Haar's wavelets are the simplest form of Wavelets and are sequences of re-scaled "square-shaped" functions. These functions are formed through a mother wavelet function and a scaling function. One property of the Haar wavelet is that it has compact support, which means that it vanishes outside of a finite interval. Unfortunately, Haar wavelets are not continuously differentiable which somewhat limits their applications.

1930s saw the development of Wavelet argument with several different research groups in various fields working on the modelling wavelets. Paul Levy, a 1930s physicist, investigated Brownian motion, a type of random signal. He found the Haar basis function superior to the Fourier basis functions for studying small-complicated details in the Brownian motion.

Zweig (1975) and Goupillard, Grossman and Morlet (1982) have developed the orthogonal wavelets.

In 1985, Stephane Mallat gave wavelets an additional jump-start through his work in digital signal processing. He discovered some relationships between quadrature mirror filters, pyramid algorithms, and orthonormal wavelet bases (more on these later). Inspired in part by these results, Y.

Meyer constructed the first non-trivial wavelets. Unlike the Haar wavelets, the Meyer wavelets are continuously differentiable; however, they do not have compact support. Debuchies in 1988 developed Mallat's work to construct a set of wavelet functions that has become the most popular and mostly utilized wavelet applications of today (Graps, 1995)

Debuchies Wavelet transformation in most of its aspects is the same as the Haar Wavelet. The main differences are in the mother wavelet and the scaling functions.

Ramsey and Zhang (1997) are the first to contribute on financial time series implications of wavelet analysis where they have found the analysis of wavelets are particularly well adapting to the statistical analysis of financial data. They have argued that in times where limitations on the time horizon makes it harder (or even impossible) to forecast on future financial trends wavelets can resolve these issues at each scale level. However, they also emphasize that the level of detail and the noise factor is an important element on forecasting the future.

With such background, it is not surprising that there are several research utilizing Wavelet analyses to capture the returns relationship of several financial markets. Most of the studies in this area utilized GARCH models to capture volatility spillover trends. However, in recent years we can see that Wavelet analysis also started to be utilized as an alternative to these GARCH models with the aspect that they can capture time domain and thus produce better results especially in the crisis periods.

In most of the literature in capturing the relationship returns and market dimensions, GARCH models have become important staples. Their major role is to spot volatility dynamics and thus make an estimation of future returns in the most accurate way. Bhuiyan et al. argues that understanding the co-movement among asset returns is a major and critical issue in financial research as the main motivation of investors is to reduce risk while increasing their returns. (Bhuiyan et al., 2019) To achieve such, understanding volatility and thus estimate probable future market dynamics is an important aspect for these investors. Also differentiating between different asset classes and making the right choice that con-

structures the optimum portfolio returns is crucial in this manner. The dynamic nature of the markets increases the significance of the correlation estimation, especially during a highly volatile period. Therefore, investors seek diversification opportunities through investing in portfolios that have negative or lower correlation among the returns on assets. (Bhuiyan et al., 2019)

Literature on financial markets that utilize Wavelet analysis has focused on many dimensions to capture meaningful results on the efficiency of Wavelet for estimation of future return mechanics. Some articles choose a specific index or asset class whereas some has chosen to test primary mechanisms of financial markets such as the Beta. For example, Mc Nevin and Nix in their research used Wavelets to estimate scale betas for 11 different industries/sectors for a period of 30 years and looked at how these scale betas differed during these years for giving a clue to the portfolio managers for their portfolio allocation strategies.

Their major implication to use wavelet analysis in their research is to ability of wavelets to capture unique information at each horizon. High frequency changes are not contributing to market risk at the sector level perhaps because high frequency changes represent short-lived shocks that are more likely to reflect diversifiable risk that is not captured in estimates of beta coefficients. (Mc Nevin & Nix, 2018) Since the data tested, include several turmoil including Asian crises, tech bubble and 2008 financial crises, it is fair representation of the effects of high volatility to the returns.

Their main conclusion is important frequency specific information does not remain stable over time and therefore a complete description of the systematic risk of investments in sectors requires estimates that capture time varying behavior at different frequencies. (Mc Nevin & Nix, 2018) Other relevant literature in this issue also suggests that the dynamic nature of the markets increases the significance of the correlation estimation, especially during a highly volatile period. Therefore, investors seek diversification opportunities through investing in portfolios that have negative or lower correlation among the returns on assets. (Bhuiyan et al., 2019)

One of the important discussion issues is based on the asset class and their behavior in different volatility measures and the spillover of volatility including the time and frequency domain. , many of the scholars have contributed to the literature by stating that understanding the asset price dynamics in different volatility inclusions is a key element for asset allocation and portfolio management. (Filzen & Schutte, 2017) Globalization, advancement in technology and thus trading mechanisms (such as the algo trading and high frequency trading) enhanced cross correlations making it harder for portfolio managers to diversify their portfolios maximizing returns and minimizing their exposure to risk. Because of such, understanding the co-movement of different asset classes over time has become a major challenge. An increasing trend is observed in asset price co-movements across markets and across borders throughout crisis periods compared to non-crisis periods. These co-movements led many economists to ask whether “periods of turmoil” and “tranquil periods” behave as dissimilar regimes in the international dissemination of financial shocks. Within such frame, Wavelet analysis has become an important tool to understand these co-movements while capturing the time domain and reflect the results for future predictions. (Ilano & Bruneau, 2009)

An interesting study for portfolio construction utilizing Wavelets is by Bourie et al. Testing commodities, bitcoin and Gold through Wavelet methodology covering a period of 8 years they reached the conclusion that the overall dependence between Bitcoin/gold/commodities and the stock markets is not very strong at various time scales, with Bitcoin being the least dependent. (Bourie et al., 2019)

With the wavelet coherence, approach the authors try to measure dependency of the above commodities with the stock markets over a certain period. Also commenting on the issue whether any of these asset classes are thus safe havens for the investors in any given increase in the volatility. Results through the wavelet coherence approach deny a strong relationship of these assets with the stock market where Bitcoin is the least dependent and move within its own dynamics. (Bourie et al., 2019) The Wavelet VAR model focusing on tail dependence indicates the

superiority of Bitcoin over both gold and commodities in terms of diversification benefits and strongly supports the ranking found by the wavelet coherence analysis of Bitcoin as the most promising safe-haven asset, followed by gold, and the dynamics of commodities being quite close to the dynamics of the examined stock markets. (Bourie et al., 2019)

They conclude that previous research also reached similar results stating Bitcoin's isolation from other asset classes in terms of dependency. However, they also add the fact that as Bitcoin's trading mechanisms and statistical properties differ from other asset classes, it is harder to reach the true underlying asset value of it. Thus, also making it hard to measure its true volatility estimation dynamics even with a Wavelet transformation (Bourie et al., 2019) Some researchers even argued that the exponential price growth of Bitcoin raises doubts about Bitcoin's true underlying value and the possibilities of an irrational bubble or Ponzi scheme. (Bouoiyour et al., 2016; Kristoufek, 2013; Li & Wang, 2017)

Billah Dharet al. (2014) investigated the relationship between stock exchange and foreign currency markets using Maximal overlap discrete wavelet transformation which is a modified DWT where the subsampling process is avoided, leading to a higher level of information in the resulting wavelet and scaling coefficients (when compared to the DWT). They tried to investigate the relationship between these two markets in various time scales (from d1 to d5 as shown in the following graphs) Their main conclusion is that in almost all the wavelet coefficients showed the presence of a positive relationship but weak causality in the short run but indicate better causality in the longer run time horizons.

The above study is important in terms of understanding the relationship of these two markets in frequency domain as most of the previous studies trying to understand the relationship is conducted within the time domain. Frequency domain here is important as traders in financial markets usually try to construct their trading strategies at different time horizons and frequency scales. Wavelet approach is an important tool to help understand such relationship with its ability to both include time

and frequency domains in the study. (Billah Dhar et al. 2014) As previously stated in the paper, the first (d1-2 to 4 months) and second level (d2-4 to 8 months) causality is lower when compare to Levels 3,4,5 which indicates longer time horizons (8 to 64 months) However testing at the L1 and L2 periods seems to be a more traditional approach when compared to testing portfolios in the long run. (Billah Dhar et al. 2014)

In addition to this argument above, DWT (discrete wavelet transformation) by its nature handles the data analysis being a mathematical tool to deal with non-stationary time series and acts within the combined time-scale domain. Using MODWT, Polanco and Martinez divided the data into pre crises and crisis periods to investigate how the EURO area stock markets are affected by the sub-prime crisis. Using a scale of different wavelets their conclusions suggest that the first three wavelet scales (corresponding to time horizons of 1 to 8 days and intraweek to monthly periods) are more related with volatility events, whereas the fourth wavelet scale represents processes that take place at lower frequency, such as fundamental macroeconomic factors (trade, monetary policy, common shocks, etc.) (Polanco and Martinez et al.; 2018) This in fact suggests that stock market returns are time-scale dependent and can act differently in the cases of financial turmoil and presence of a volatility spillover to several linked markets. (In this, study the EURO area markets)

Abid and Kaffel in their paper using Wavelet Transformation try to investigate the local variance and the interconnection between the stock, gold, oil, Forex, and the implied volatility markets in the time/frequency domains. This in fact is a key element in answering the question whether in the short or long terms VIX is a potential leader for other markets to track or in fact, because other markets hike or fall, VIX moves with them. Basing their study to eight different markets (including gold, stocks, foreign exchange, oil etc...) and different frequency scales under MODWT, their found that although in the medium term the tested assets have similar high-power region at medium frequency scales. In most of the economic fluctuations, they act different with Gold being a haven for investors in especially financially contagious and stressful terms. (Abid & Kaffel, 2018) This finding is quite similar to the one that is discussed in

Bouire et al. the fear indexes are affected by both global financial crises and their own occasional market factors, and they present high power regions across the entire period in turmoil and tranquil periods. The implied volatility markets are integrated than the underlying asset markets. Strong multiple correlations between underlying asset markets for a period longer than 64 days are observed whereas in implied volatility markets, the observation is high multiple correlations for a period longer than 16 days. As a conclusion, they argue that The VIX (fear) index is a potential leader or follower in almost all short, medium, and longer terms (Abid & Kaffel, 2018)

There are various other research utilizing DWT and MODWT to track the relationship between various asset classes under certain conditions. Anand, Paul, and Ramachandran investigating the transmission of shocks and volatility between returns of the oil sector and Indian stock exchange (By sampling a data from 2000 to 2012) through a continuous wavelet transformation found out empirical evidence that after the outbreak of global financial crisis an increase in the volatility spillover between oil and Indian stock markets occurred. In addition, their findings showed the presence of a stronger coherency in case of higher frequencies. (Anand, Paul & Ramachandran, 2014)

A study in N11 countries⁴ by B.O. Osu et al. (2020) showed a strong co-movement among N11 countries being present. They found empirical evidence showing noise is a driver in the lower scales (higher frequencies) whereas market fundamentals are more effective in the higher scales (lower frequencies) The wavelet power spectrum shows that most of the power and variability are concentrated at the lower scales (higher frequencies). It can be seen in the stock returns that most of the power as well as the variability is seen in the lower scales 0–16 (higher frequencies) while lower power is mostly seen at higher scale 32–128 (lower frequencies). (B.O. Osu et al., 2020)

⁴ N11 countries or the Next 11 countries refers to a group of eleven countries—specifically Bangladesh, Egypt, Indonesia, Iran, Mexico, Nigeria, Pakistan, the Philippines, Turkey, South Korea, and Vietnam—which have emerging markets that could potentially become some of the world's largest economies. https://energyeducation.ca/encyclopedia/N11_countries

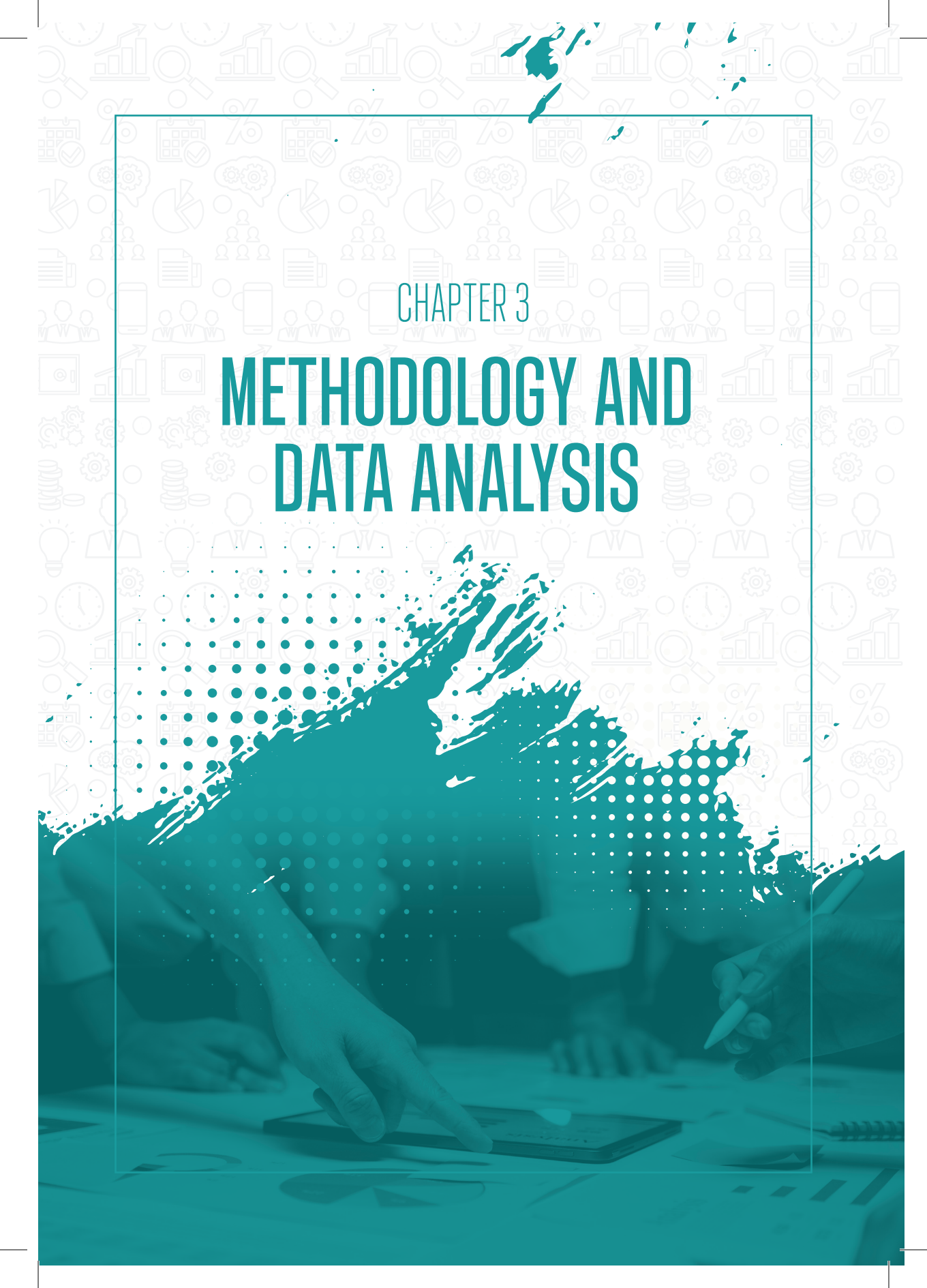
Wavelet analysis is not only used in financial market analysis, but also to analyze volatility of the macroeconomic fundamentals. A final article to discuss finalizing the literature review on sample studies conducted with Wavelet is by S. Chang, R. Gupta, S.M. Miller et al.. Using annual time series from 1917 to 2015 for volatility and income inequality and 1962 to 2014 for volatility and wealth inequality, they found the existence of a positive correlation always exists between volatility of growth and inequality. At high frequencies, causality changes direction from volatility leading to inequality leading. This implies that economic growth does not trickle down to the bottom income group as they experience more fluctuations in output growth. (S. Chang, R. Gupta, S.M. Miller et al., 2019)

It is important to consider that financial risk management consists of understanding the relationship of different market dynamics both in the short-run and long-run. This is in fact crucial in portfolio management and most of the financial managers take into different time scales for assessing risk while on the other hand practicing short scale risk measures to the longer horizons. With such practice long-run market dynamics (such as the long run covariance and correlation) are taken under investigation to see what effects these dynamics at different time scales. In and Kim discuss that with this the issue of questioning of whether the long run hedging is similar or better off than the short run hedging occurs. (In & Kim, 2020) Defined as the comparative value of a position opened with the position's aggregate size itself, most of the literature is based on what is the best empirical practice for finding out the Hedge Ratio that is efficient on both short-run and long run time scales. Conlon and Cotter (2012), In and Kim (2020) Lien and Shrestha (2007) all argue that many approaches to obtain the optimal hedge ratio has been utilized in the literature including mean-variance, static hedging and GARCH models. However they also conclude that few of the approaches consider the effect of hedging horizons. That in fact is where Wavelet Analysis becomes a handy tool for the researchers as the Wavelet approach utilizes different time scales in a multi-scale approach (Conlon and Cotter, 2012) In and Kim (2020) support the above idea asserting that Wavelet Analysis, as utilized in investigation of several other market cointegrations, helps to solve the scaling issue.

In fact, an important part of the literature has delved into the linkage and hedge potential of the spot markets with their relevant future markets. Lien and Shrestha (2007) by investigating 23 futures markets with Wavelet Analysis conclude that estimation of hedge ratios for a very long-time horizon, Wavelet Analysis partially overcome this problem to some extent as it allows us to decompose the variance at different time scales and figure out the contribution of each time scale to the total variance. (Lien & Shrestha, 2007) Chen, Chen, Chuang (2009) in their analysis of multiscale hedge ratio between Taiwan stock exchange and futures add that application of Wavelet Analysis has three salient feature which are ability to decompose the data into several time scales, ability to decompose the covariance between two stochastic processes over different time scales and finally overcoming the major problems of calculating the hedge ratio. (the hardship in computation, sometimes giving out inaccurate results and being an unreliable estimator because of a handful of independent observations generated from a long-run series) (Chen, Chen, Chuang, 2009) Maharaj et al also suggest that Wavelet analysis is a windowing technique with variable size regions, and it can give us both low and high frequency information on the behavior of data with which eases extraction of the desired information without loss of useful information. Thus, it is a good tool for estimation of hedge ratios both for short- and long-term horizons. (Maharaj et al., 2008)

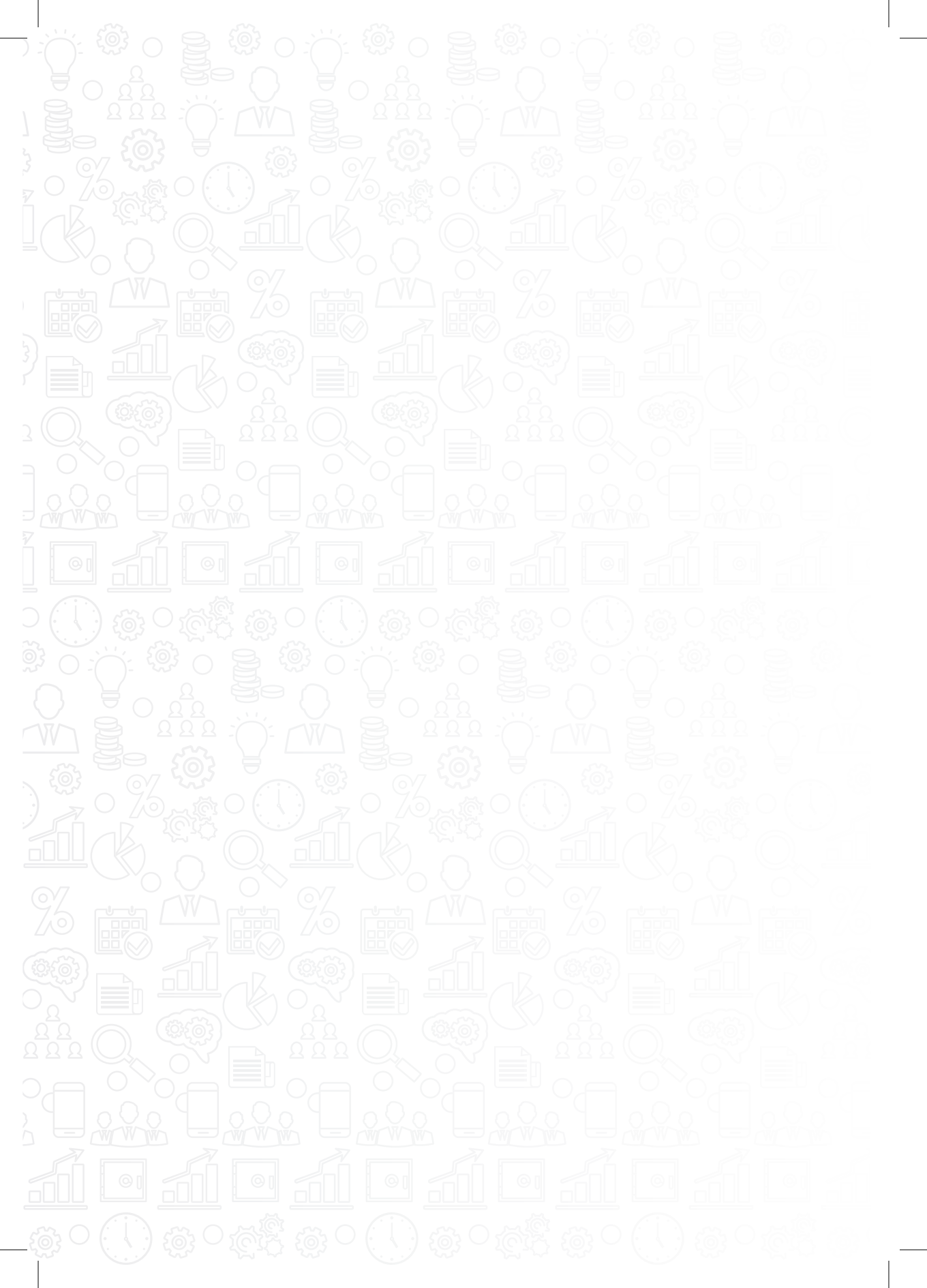
Most of the literature based on the calculation of hedge ratio through the Wavelet Analysis has found common evidence that hedge each decomposed time scale has a unique hedge ratio. In and Kim (2006), Lien and Shrestha (2007) Chen, Chen, Chuang (2009), Khalfoui et al. (2015) finds evidence of presence of a rule of thumb where the long run hedge ratio converges to one and within higher time horizons hedging effectiveness converges to one. The Wavelet correlation between the markets vary over different investment horizons but higher at the longer-term scales where it increases the hedge ratio and hedge effectiveness. In fact, this is an important finding in terms of its financial implication in portfolio construction as hedgers with a longer time horizon benefit from lower levels of risk and minimizes the costs (such as the transactions costs) associated with short term hedging. (Conlon & Cotter, 2011)

There are some studies in the literature covering Islamic Markets and their relationship with several markets including conventional stock markets, Oil and other commodities and Islamic fixed income markets. Najeeb, Bacha and Masih (2017) investigated the opportunity to hold a maturity strategy for Islamic Bond (Sukuk) Markets and conclude that although at the shorter terms Islamic Bond market can be an alternative to conventional fixed income, at longer horizons they converge and erode all the portfolio diversification benefits. (Najeeb, Bacha and Masih, 2017) Haniff and Masih (2018) with the Wavelet Analysis tried to answer whether Islamic Stock Returns can hedge against inflation. Analyzing the return series of Bursa Malaysia, they found that investors can expect a hedging horizon for up to three years and thus investments beyond this threshold may no longer be hedged against inflationary measures. Karim and Masih (2019) by measuring the implied volatility of oil prices with a time/and frequency approach through the utilization of Wavelet Coherence through Continuous Wavelet transformation concluded Islamic stocks were influencing the oil price volatility in the longer runs and thus investors should take this information while diversifying their portfolios for hedging purposes. A final but related research was on Mensi et al. (2016) where they analyzed linkages and hedging strategies between Islamic and Conventional Sector equity indices. Their study focused on dynamic correlation between Islamic stock sectors and their conventional counterparts by both utilizing Wavelet and GARCH-cDCC estimation models. Their findings include results to support portfolio management analysis were adding a conventional stock index to a well diversified portfolio improves its risk-adjusted performance and that the conventional risk exposure can be effectively hedged with Islamic Stocks. (Mensi et al, 2016) This in fact is an important result for portfolio managers as it shows Islamic stocks can be effective alternatives for investment for both hedging and deriving return purposes.

The background is a solid teal color. It features a repeating pattern of white line-art icons representing various business and data concepts, such as bar charts, pie charts, lightbulbs, gears, and people. In the lower half, there is a semi-transparent rectangular area containing a photograph of several hands interacting with a tablet device on a desk. The text 'CHAPTER 3' is centered in the upper half of the teal area.

CHAPTER 3

METHODOLOGY AND DATA ANALYSIS



METHODOLOGY AND DATA ANALYSIS

3.1 METHODOLOGY

Continuous Wavelet Transform and Wavelet Coherency

Wavelet transformation is mainly used to search and spot a signal's time and frequency patterns. Wavelet literature is based on two main functions compared to Genders which are the "Mother Wavelet = ψ " and the "Father Wavelet = Φ " These functions are denoted as.

$$\int_{-\infty}^{+\infty} \psi(t) dt = 0 ; \int_{-\infty}^{+\infty} \Phi(t) dt = 1$$

1

The father wavelet is used as a scaling function and converging to 1 whereas the mother wavelet converges to zero. The father Wavelet function uses a mother wavelet function as a basis and this function, to capture the time and frequency specifications is both squeezed and flexed. (Gençay, Selçuk and Whitcher, 2001) This "mother" function is to produce small waves expressed as a function of time t and scale s .

$$\psi_{\tau,s}(t) = \frac{1}{\sqrt{s}} \psi\left(\frac{t - \tau}{s}\right)$$

2

Where τ is time position

s , scale and $\frac{1}{\sqrt{s}}$ is the normalization factor.

The model with the Continuous Wavelet Transformation utilizes the underlying time series plotting them within the time and frequency functions and tries to identify and interpret the output two-dimensional spectrum maps for patterns of correlation. CWT used in the analysis is the transform W_x of a discrete time series $(x(t), t = 0, 1, \dots, n)$ with respect to the mother $\psi(t)$;

$$W_x(\tau, s) = \int_{-\infty}^{\infty} x(t) \psi_{\tau, s}(t) dt = \frac{1}{\sqrt{s}} \int_{-\infty}^{\infty} x(t) \psi\left(\frac{t - \tau}{s}\right) dt \quad 3$$

τ here denotes for the position of the Wavelet in the time domain whereas, s shows its position in the frequency domain. Here Also within this framework it is important to note that the energy factor in the power spectrum of the wavelet should be preserved and the variance is denoted as.

$$|x^2| = \frac{1}{C_\psi} \int_0^{\infty} \left[\int_{-\infty}^{\infty} |W_x(\tau, s)|^2 d\tau \right] \frac{ds}{s^2} \quad 4$$

The literature commonly uses Morlet Wavelet as the Mother Wavelet function, which can be defined as follows,

$$\psi^M(t) = \frac{1}{\pi^{1/4}} e^{i\omega_0 t} e^{-t^2/2} \quad 5$$

Bayracı, Demiralay and Gencer (2018) propose that time and frequency relationship can be expressed as;

$$\frac{1}{f} = \frac{4\pi s}{\omega_0 \sqrt{2 + \omega_0^2}}$$

6

With $\omega_0 = 2\pi 4$. Torrence and Campo (1998), Aguiar-Conraria et.al (2008) Bouiri et al. argue that as the Morlet wavelet with this central frequency provides good localization between time and frequency.

In order to study the interaction between the two financial time series and how they relate within a linear transformation, a bivariate framework should be constructed. As described in the literature; define the cross-wavelet power $|W_{xy}(\tau, s)|$ of two time series $x(t)$ and $y(t)$ with the continuous transforms $W_x(\tau, s)$ and $W_y(\tau, s)$ as:

$$W_{xy}(\tau, s) = W_x(\tau, s) \cdot W_y(\tau, s)$$

7

Wavelet Coherence shows how closely X and Y are integrated by a linear transformation. The cross-wavelet power shows the areas of high common power between two time series in the time-frequency space. The wavelet squared coherence between the two-time series is given by the mathematical representation as;

$$R^2(\tau, s) = \frac{|S(S^{-1}W_{xy}(\tau, s))|^2}{S(S^{-1}|(W_x(\tau, s))|^2) \cdot S(S^{-1}|(W_y(\tau, s))|^2)}$$

8

As another medium to fully understand the relationship between two signals, lead/lag relationship can also be traced. Thus, we can overcome the problem of cases where Wavelet Coherence cannot differentiate between series. The lead/lag relationship is introduced into the literature as;

$$\phi_{x,y} = \tan^{-1} \frac{\Im\{W_{x,y}(\tau, s)\}}{\Re\{W_{x,y}(\tau, s)\}}; \phi_{x,y} \in [-\pi, \pi]$$

9

The lead/lag relationship between the series is plotted in the Wavelet Coherency graphs as arrows where the direction of the arrows (both right (left) for positive (negative) correlation and up (down) lead (lag) for two series leading whichever.

Wavelet Cross Correlation

Expressing the Wavelet Coherence, the next phase is to compute the Wavelet Correlation between the Index signals to investigate the linkages at different time scales. We start with Discrete Wavelet Transformation first to evolve to the MODWT.

The Discrete Wavelet Transform is mainly a functional analysis that has wavelets that are discretely sampled. In DWT where $a \in \mathbb{Z}$ and $u \in \mathbb{Z}$ and $a \neq 0$ the scale and position parameters are from the subset $\mathbb{Z}$ (integers) This logical proposition was found by Daubechies.

Assuming x as the diatic length of the observation vectors. The discrete wavelet coefficients vector w is written as follows.

$$W=W_x$$

10

With such, W can be expressed as a $N*N$ orthogonal matrix with Wavelet coefficients of $J+1$ vectors.

$$w=[w_1, w_2, w_3, \dots, w_j, v_j]^t$$

11

Here w_j is the vector of Wavelet coefficients with a length of $N/2^j$ and is related to the changes in the scaling vector ($\lambda_j=2^{j-1}$) while v_j is a $N/2^j$ length scale coefficients vector.

MODWT is an alternative to the DWT to overcome the limitations in the DWT as by this we overcome the dyadic length requirements written above as the sampling size divisible by 2^j .

In MODWT the Wavelet Coefficients, $\tilde{W}_{j,t}$ and the scaling coefficients $\tilde{V}_{j,t}$ are at level $j; j=1, \dots, J$ are mathematically expressed as;

$$\begin{aligned}\tilde{W}_{j,t} &= \sum_l^{L-1} \tilde{g}_l \tilde{v}_{j-1,t-1 \bmod N}; \\ \tilde{V}_{j,t} &= \sum_l^{L-1} \tilde{h}_l \tilde{v}_{j-1,t-1 \bmod N};\end{aligned}$$

12

Within the above expression the scaling filters of the wavelet function $\tilde{g}_l$ and $\tilde{h}_l$ are re-scaled as $\tilde{g}_j = g_j/2^{j/2}$ and $\tilde{h}_j = h_j/2^{j/2}$ with a scale of $\tau=2^{j-1}$

The above function is then useful as the Wavelet correlation which means calculating the covariance for the two series $\{X_t, Y_t\}$ and wavelet variances for, $\{X_t\}, \{Y_t\}$. The stochastic process here is estimated using the MODWT with the scale above which is $\tau=2^{j-1}$ through equation.

$$\hat{\sigma}_x^2(\tau_j) = \frac{1}{\hat{N}_j} \sum_{k=L_j-1}^{N-1} (\hat{W}_{j,k})^2$$

13

Where $\hat{W}_{j,k}$ denotes for the wavelet coefficient at variable X at scale τ_j . $N_j = N = L_j + 1$ is the number of coefficients by boundary and $L_j = (2^j - 1)(L - 1) + 1$ is the length of the scale τ_j wavelet filter

Decomposing the variance function in (13) the wavelet correlation based on the MODWT coefficients with the scale τ_j would then be;

$$\gamma_{XY}(\tau_j) = cov_{XY}(\tau_j) = \frac{1}{\hat{N}_j} \sum_{k=L_j-1}^{N-1} \hat{W}_{j,k}^x \hat{W}_{j,k}^y \quad 14$$

Combining the wavelet variances and co-variances in (13) and (14) respectively we can define the wavelet cross correlation as follows.

$$\rho_{x,k}(\tau_j) = \frac{\gamma_{x,k}(\tau_j)}{\hat{\sigma}_1(\tau_j)\hat{\sigma}_2(\tau_j)} \quad 15$$

Where $\sigma_{x,k}^2(\tau_j), \hat{\sigma}_2(\tau_j)$ are respectively the Wavelet variances for $X_{1,t}$ and $X_{2,t}$ associated with the scale (τ_j) and $\gamma_{x,k}(\tau_j)$.

Computation of Hedge Ratios

Lien and Shrestha define hedging as the elimination of high volatility in the value of a spot position by including futures contracts in the portfolio. (Lien & Shrestha, 2007) Kim and In asserts that, given an individual has taken a fixed position in some asset in the spot market, hedging helps to lower the risk of being long of one unit of the underlying Asset without loss of generality. In fact, the investor in the long position succeeds this by taking a short position in the futures market at time t under the adopted hedging strategy. (In & Kim 2006) The motivation behind hedging strategy construction is to create the minimum fluctuation in the portfolio by minimizing the variance of the change in the value of the portfolio. In this case the minimum variance portfolio is;

$$\begin{aligned} \text{Min Var } (\Delta HP_t) &= \text{Var } (\Delta S_t + HR_t \Delta F_t) \\ &= \text{Var } (\Delta S_t) + HR_t^2 \text{Var}(\Delta F_t) + 2HR_t \text{Cov}(\Delta S_t, \Delta F_t) \end{aligned}$$

16

In this equation (ΔHP_t) shows the change in the Hedge portfolio in the given time period t whereas (ΔS_t) and (ΔF_t) are the changes in the log of the spot and future prices at the same period t HR_t . Assuming that the investor tries to form a hedging strategy, then the optimal hedge is determined by differentiating the first equation by HR_t .

$$HR_t = \frac{\text{Cov}(\Delta S_t, \Delta F_t)}{\text{Var}(\Delta F_t)}$$

17

Kim and In asserts that this corresponds to the conventional hedge ratio when changes in both stock and futures are homoskedastic and the use of HR_t assumes that covariance and the variance returns remain constant over time. (In & Kim 2006) As Chen et al. suggests the degree of hedging effectiveness is measured by the percentage reduction in the variance of the naked stock prices. (Chen et. al, 2009) The Effective Hedging Mechanism is denoted as follows.

$$EH = \frac{\text{Var}(\Delta S_t) - \text{Var}(\Delta HP_t)}{\text{Var}(\Delta S_t)} = 1 - \frac{\text{Var}(\Delta HP_t)}{\text{Var}(\Delta S_t)} = \rho_{sf,t}^2$$

18

$\rho_{sf,t}^2$ here stands for the square of the correlation between the spot and future prices.

Utilizing the Wavelet MODWT in the Hedge Ratio Analysis, the coefficients gathered through the wavelet transforms indicate the changes at a particular scale. Given the time series are stochastic in nature, the ap-

plication of MODWT produces a scale wise decomposition. Percival and Walden (2000) In and Kim (2006) propose that the basic notion under the wavelet variance is substitution of the notion of variability over certain scales for measuring variability estimated by the sample variance (Percival and Walden, 2000-Kim and In, 2006) The Wavelet variance is estimated by MODWT for scales $\lambda_j \equiv 2^{j-1}$ through.

$$\tilde{v}_l^2 \equiv \frac{1}{\tilde{N}_j} \sum_{t=L_{j-1}}^{N-1} (\tilde{d}_{j,t}^l)^2, \quad l = X, Y \quad 19$$

where, $\tilde{d}_{j,t}^l$ is the MODWT wavelet coefficients of variable l at scale λ_j , $\tilde{N}_j = N - L_j + 1$ is the number of boundary unaffected coefficients and $L_j = (2^j - 1)(L - 1) + 1$ is the length of the scale λ_j wavelet filter. From here the wavelet covariance at scale λ_j can be expressed as;

$$\text{Cov}_{X,Y}(\lambda_j) = \frac{1}{\tilde{N}_j} \sum_{t=L_{j-1}}^{N-1} \tilde{d}_{j,t}^X \tilde{d}_{j,t}^Y \quad 20$$

Wavelet covariance parts the covariance between two different stochastic series within a time scale however still it is important to calculate the Wavelet correlation for normalization purposes. Combining the equations (19) and (20)

$$\tilde{\rho}_{X,Y}(\lambda_j) = \frac{\text{Cov}_{X,Y}}{\tilde{v}_X(\lambda_j) \tilde{v}_Y(\lambda_j)} \quad 21$$

It is to note here that similar to the rules of correlation coefficient between two random variables $\tilde{\rho}_{X,Y}(\lambda_j) < 1$ should hold.

A final derivation is giving the hedge ratio from variance and covariance of the series. At scale (λ_j) ;

$$h_j^w = \frac{Cov_{s,f}(\lambda_j)}{\tilde{v}_f^2(\lambda_j)}$$

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3.2 DATA

The data that will be utilized will be the returns derived from closing prices (in USD) of 14 different Country Based indices of MSCI. (The table below summarizes the underlying indices with the shortened versions utilized for the data analysis) The data is daily and covers the period from 26.07.2007 to 27.07.2020 extracted from Thomson Reuter's data terminal. Islamic country indices data were only available to broadcast through the terminal starting from 2007 whereas the standard country indices were older. However, for matching purposes the data goes back to 2007¹.

The returns here are computed by the first differences of the natural logarithms of the closing prices of the indices.

$$R_t = \ln \left(\frac{P_t}{P_{t-1}} \right)$$

23

1 MSCI stated in the fact sheets that data older than 2007 for Islamic indices are data to be back tested for control and sampling purposes and therefore not validated. (Thus not disclosed through terminals) In order to match the Islamic data in terms of proper wavelet analysis the conventional data covers the same period.

Table 3: List of Indices Utilized in the Analysis (Daily Data between 26.7.2007-27.7.2020)

Analysis Ticker	Index Name	Analysis Ticker	Index Name
MISFR	MSCI France Islamic Price Index USO End of Day	MCOFR	MSCI France Price Index USO End of Day
MISGR	MSCI Germany Islamic Price Index USO End of Day	MCOGR	MSCI Germany Price Index USO End of Day
MISIT	MSCI Italy Islamic Price Index USO End of Day	MCOIT	MSCI Italy Price Index USO End of Day
MISNE	MSCI Netherlands Islamic Price Index USO End of Day	MCONE	MSCI Priceherlands Price Index USO End of Day
MISSW	MSCI Sweden Islamic Price Index USO End of Day	MCOSW	MSCI Sweden Price Index USO End of Day
MISUK	MSCI United Kingdom Islamic Price Index USO End of Day	MCOUK	MSCIUnited Kingdom Price Index USO End of Day
MISUS	MSCI USA Islamic Price Index USO End of Day	MCOUS	MSCI USA Price Index USO End of Day
MISSP	MSCI Spain Islamic Price Index USO End of Day	MCOSP	MSCI Spain Price Index USO End of Day
MISAR	MSCIArgentina Islamic Price Index USO End of Day	MCOAR	MSCI Argentina Price Index USO End of Day
MISCH	MSCI China Islamic Price Index USO End of Day	MCOCH	MSCI China Price Index USO End of Day
MISIN	MSCI India Islamic Price Index USO End of Day	MCOIN	MSCI India Price Index USO End of Day
MISML	MSCI Malaysia Islamic Price Index USO End of Day	MCOML	MSCI Malaysia Price Index USO End of Day
MISBR	MSCI Brazil Islamic Price Index USO End of Day	MCOBR	MSCI Brazil Price Index USO End of Day
MISTR	MSCI Turkey Islamic Price Index USO End of Day	MCOTR	MSCI Turkey Price Index USO End of Day

Looking at the Non-Islamic indices, highest mean returns are derived from Germany (0.00081) and US (0.00029) whereas there are two indices with negative mean returns are Turkey (-0.00011) and UK. (-0.00004)

Looking at the standard deviations to evaluate on the relative risk of the stock market, all of the emerging and frontier markets including Argentina, Brazil, Turkey seems to be riskier in terms of deviations from the developed markets. Malaysia is an exception to this as it has the lowest std in all the indices. More than half of the indices in the conventional side has negative skewness, which suggests that negative returns are more probable than positive returns in these markets. As can be seen from the kurtosis measures, all the series exhibit excess kurtosis, indicating that the series are not normally distributed and have fat tails, which is typical for financial series. The non-normality of the return distributions is also verified from the Jarque-Bera test statistics.

The Islamic counterparts of the indices observed has highest mean returns in US again (0.00025) with India (0.00032), China (0.00021) and Netherlands (0.00037). Italy, Argentina, and UK have negative mean returns whereas in the Islamic case Turkey has positive mean return. As the observed countries do not change but the nature of the indices changes due to Islamic screening, it seems that complying with the Islamic Sharia rules lowers the risk in terms of standard deviation. For example, the std of US non-Islamic index is (0.01309) whereas the Islamic counterpart is (0.01269) This seems to be valid for all the indices observed in this thesis except Malaysia. It is an important research question for further study since Malaysia has high degree of exposure to Islamic finance and it is interesting to see an increasing deviation in the Islamic Index compared to the conventional counterpart. Again, the Jarque Bera tests suggest non-normal distribution.

Following the descriptive the following statistical tests we will conduct is the Unit Root tests. In general, financial time series tend to show trending approach or in other words act non-stationary in the mean. Both ADF and Phillips Peron Unit root statistics for all of the indices indicated rejection of the null hypotheses that the series are stationary. (See Appendix 6.1.1 to see results table) Thus, we can conclude that the stock returns are integrated at order 1, $I(1)$ as no unit root is evidenced in the log returns.

Table 4: Descriptive Statistics for Islamic and Conventional Index Data

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3.3 EMPIRICAL ANALYSIS AND FINDINGS

3.3.1 Wavelet Coherence Results

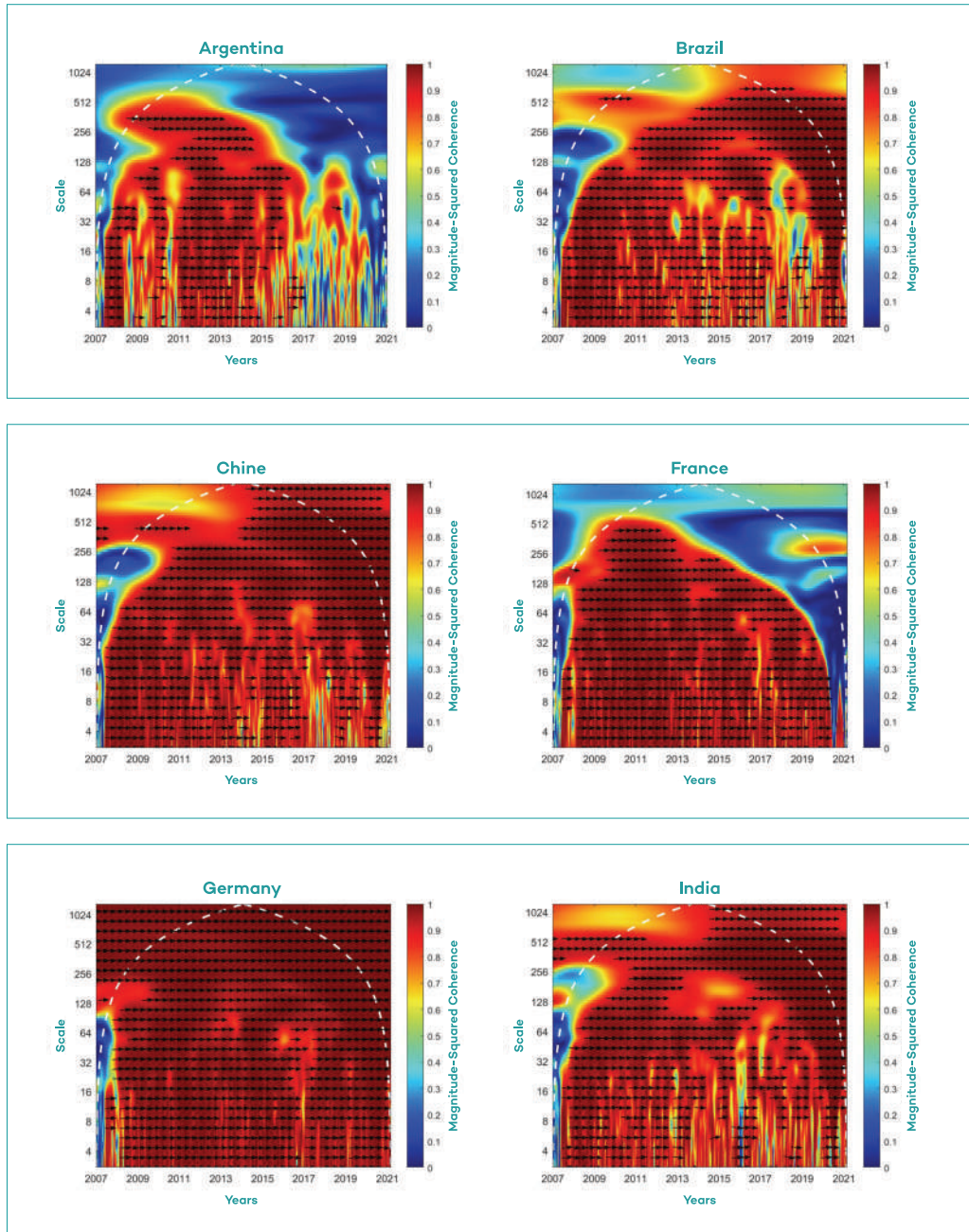
Interpretations for Whole Data Term

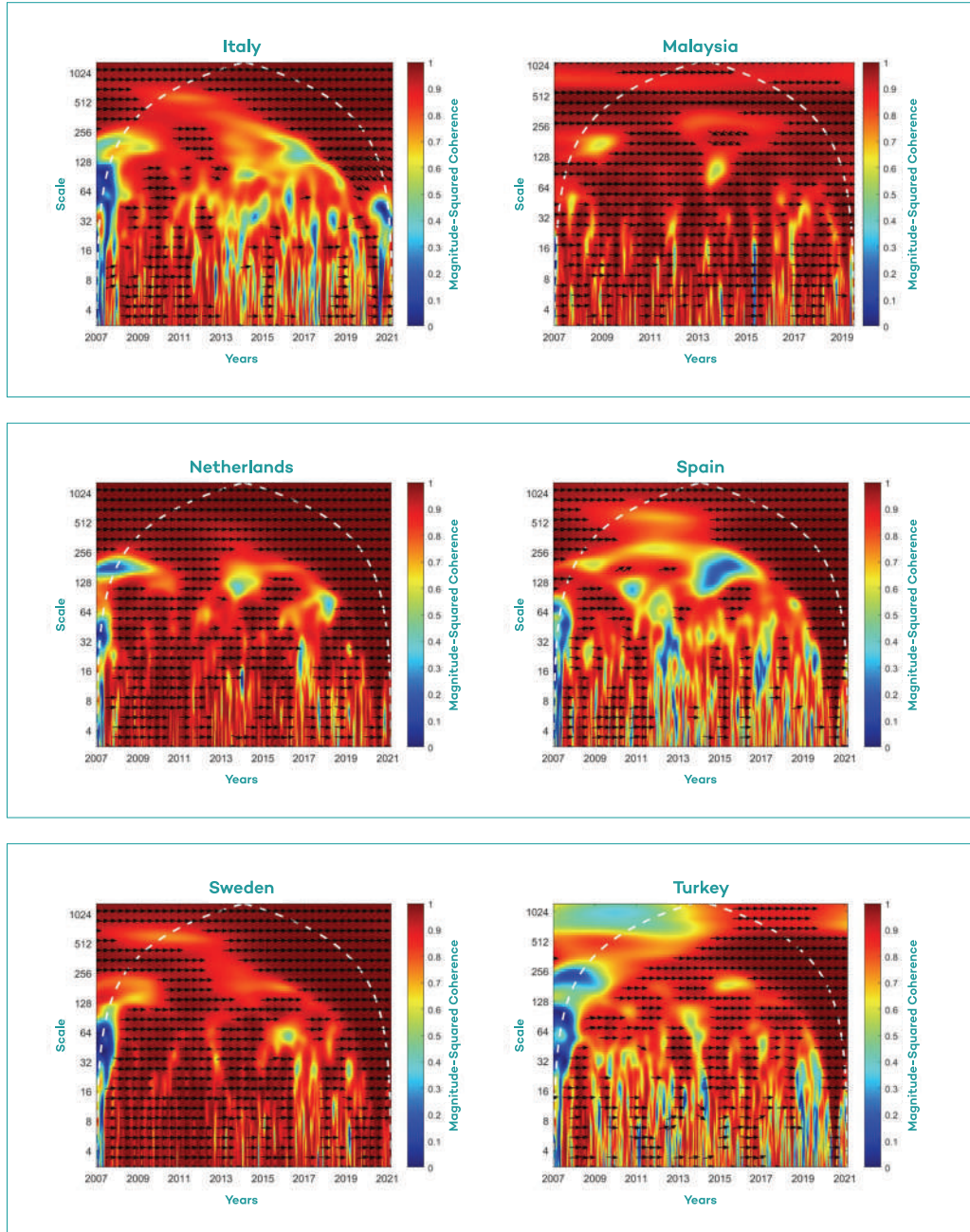
In this part, the measured Wavelet Coherence of the 14 different Country Conventional Indices with same country Islamic versions will be evaluated.² As previously discussed in the methodology part Wavelet Coherence is an identification of dependence in possible changes of the Index returns in both Conventional and Islamic domains. The coherence measures the co-movement of these index series in terms of return dynamics at high (low) frequencies and set a clue for the investors to either construct short (long) run strategies to derive profits.

The figures below are the wavelet coherence diagrams of the return signals of country based MSCI Indices. The Coherence diagram is based on high and low coherence areas closing to hotter color (red) for high coherence and getting a colder color (blue) for low coherence. The horizontal axis is the time domain whereas the vertical axis shows the scale in the frequency domain. White discrete areas denote for the 95 percent confidence intervals computed through a Monet-Carlo simulation-featuring phase randomized surrogate series. (Bayracı et al., 2018) In order to identify the lead and lag relationships between the two-index series returns the figure is marked with the phase arrows which points to right for in-phase and left for out-of-phase thus showing the main areas where there is a cyclical or anti-cyclical relationship. Dewandaru et al. argues that Wavelet Phase Difference attempts to discover the structure of financial linkages by observing the lead-lag relationship. However, it is important to note here that these lead/lag relationships do not necessarily mean that there is a specific causality between the two. In fact, they may co-move with one taking a leading role over the other but still causality would not be present. (Dewandaru et al. 2017)

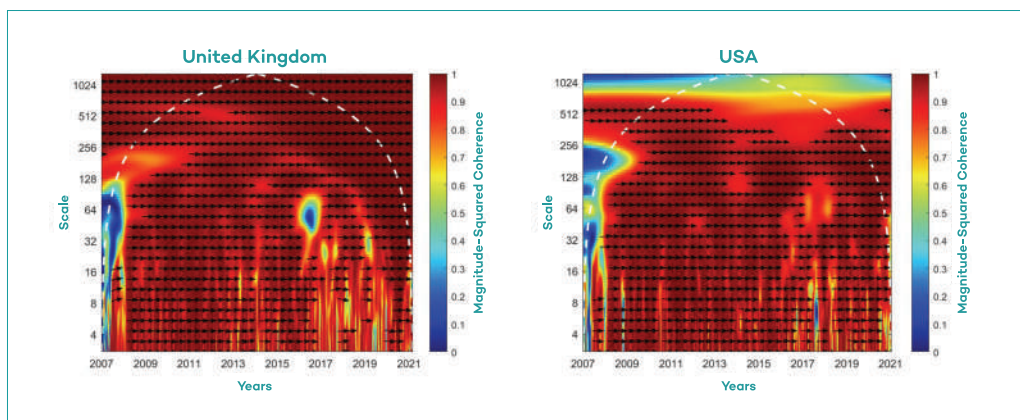
² Computations on the Wavelet Coherence is Conducted in MATLAB R2020b Wavelet Toolbox. <https://www.mathworks.com/help/wavelet/ref/wcoherence.html>

Figure 1. Wavelet Coherence and Phase Differences of Conventional Vs Islamic Indices





A COMPARISON OF ISLAMIC VS CONVENTIONAL INDICES: A WAVELET BASED APPROACH



Like the literature based on the comparisons of Islamic and Conventional indices. Our findings with the wavelet coherence diagrams show that there is high coherency between Islamic and conventional index returns. In almost all the pairings spotting the linkage, as the phase arrows indicate (phase arrows are indicated within areas with 0.90 and above coherence) an in-phase relationship meaning that both indices act together with no lead/lag relationship. Only in countries with lower coherency measures (such as Turkey, Argentina, Spain and etc...) it seems the co-movement dissipates as shown with the diminishing of the in-phase arrows.

Out of the fourteen markets that we have analyzed, most of the markets showed strong co-movement results as with conventional return patterns leading the Islamic returns. Only at the initial phases of the Islamic Market Indices (mainly in 2007 to mid-2008) the coherency patterns showed low coherency (blue areas at the left corners of the coherency graphs) This seems to be an important pattern that can be explained by the infancy of the indices at the time being. This however is at the maximum 64 holding days and then the index patterns converge to strong coherency patterns at higher frequencies. The only exceptions to this pattern are the Spanish and Italian Markets showing a mixed pattern of coherence. Both markets at their initial construction phases of country Islamic Indices showed no coherence at all until 256 days holding periods but start to show signs of co-movement after that.

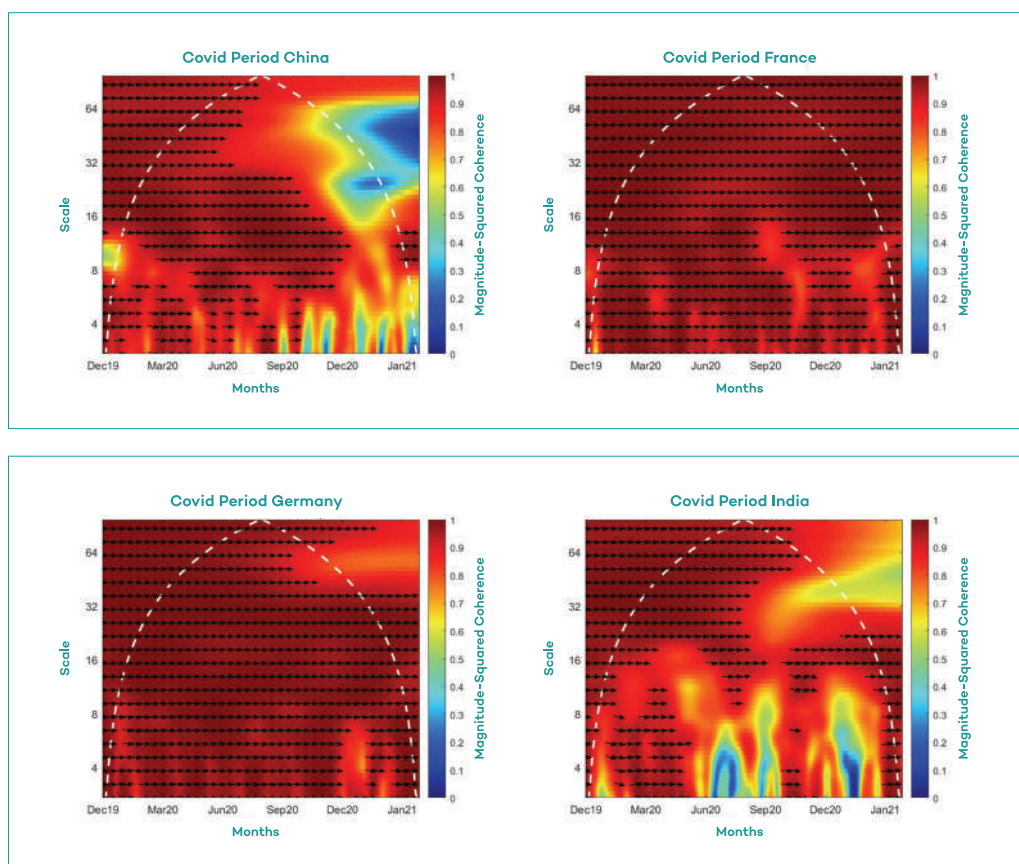
The Spanish coherency diagram clearly shows signs of the Spanish Banking crisis that has continued from 2009-2014. The blue is at the center of the graph corresponds with the peak of the crisis, which disrupts the returns and causes a distortion in the coherency graph. Another good example is with the Turkish Market as the turmoil in the financial system caused the financial sector stock returns, the graph clearly shows the non-co movement of the indices at several holding periods. Like the findings of Bayracı et al. (2018) with their works based on the interaction of stock returns and bond prices, the majority of the markets except the Italian and Spanish markets showed significant in-phase and cyclical interactions indicated with the arrows pointing to the right. (Bayracı et al. 2018) Turkey, Spain and Italy showed similar characteristics in the coherence diagrams giving out mixed results unlike the other countries tested. UK showed a pocket of no-coherence in 32-128 holding days for a very small amount of time, which coincides the Brexit vote. A similar pattern in the Indian market around the end of 2018 to the beginning of 2019 can be tracked where the Indian market faced the possibility of entering a recession with the deterioration of the Indian GDP falling to a five-year low. Finally with the Argentinian economy having hard times in recent years the the coherency between Argentinian Islamic and Conventional Indices got lower at converged from high coherency to lower both in shorter (4-32 days) and longer holding periods (256 days)

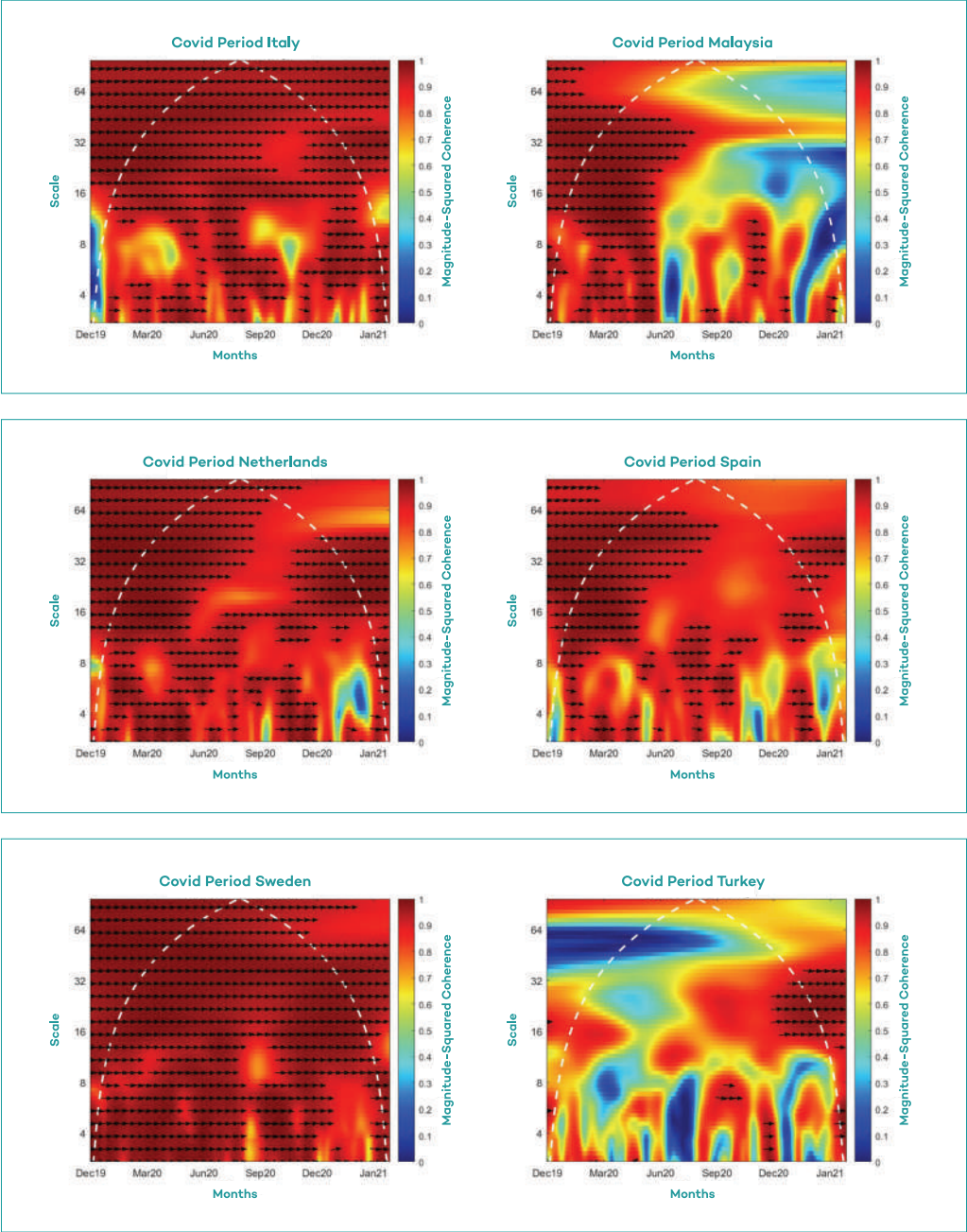
An interesting discussion here is that our findings for the co-movement of Islamic and Conventional returns contradicts with the coherency research but aligns with the Islamic vs Conventional stock performance (safe have hypotheses). Aloui and Hikiri (2014), Dewandaru et al. (2017) Bayracı et al. (2018) have found evidence of a contagion effect where in shorter frequencies emergence of a financial crisis high power areas of co-movement especially in the shorter holding periods emerged. The underlying motivation here is that high volatility with a span of price swings increase the degree of financial contagion. However, our coherence graphs showed that in case of Islamic vs Conventional stock returns it is the opposite as at these times the co-movement of the returns dilute especially at shorter holding periods but then converge in a lagging way. Bacha et al. (2016) found similar results comparing the

MSCI Islamic Indices for Asia region with USD Markets. They conclude that as Islamic indices lack high advantage factor and excessive risk taking through Shariah compliant measures of ethical, financial screens this lagging behavior in terms of financial contagion occurs. (Bacha et al, 2016) This finding is also consistent with Ho et al. stating that with almost all of the Portfolio Performance measure (Sharpe Ratio, Jensen's Alpha, Treynor Ratio) Islamic Indices performed better than conventional peers especially in crisis periods. (Ho et al, 2013)

Post-COVID Period Interpretations

Figure 2: Wavelet Coherence and Phase Differences of Conventional Vs Islamic Indices during COVID-19 Period (Dec-19 to Jan-21)





As it can be tracked from the coherence results, Argentina is one of the most affected economies among the emerging markets and witnessed a shift towards the frontier market axis. In almost all the scales from 2-4 days to 64 and above results show that coherence between the Islamic and Conventional Index considerably decreased. Only during January there is strong correlation (above 0.90) in 16-32 trading days and with the start of the pandemic the correlations are severely cut-out. This is probably due to the recurring nature of the Argentinian economy finding itself in a debt crisis and the deterioration of the Argentinian peso bringing along the rate hikes. (Argentina is one the leading countries in terms of policy rates) With Islamic index avoiding leverage and the financial sector it is not surprising to see that the interconnection between the Conventional and the Islamic Index is not so strong. Turkish case seems to be quite looked- alike with the Argentinian one. Turkey offering the second highest interest rate and having a market dominated with the financial industry shows lack of correlation between Islamic and Conventional indices. However interestingly starting with the second half of the year and with the uptrend in the Borsa Istanbul the correlations started to heat up again in 16-32 trading days. However, it seems that the phase differences are lower than the desired levels being able to show either of the indices leading the other.

Malaysian case seems have interesting results as the starting from the intensifying of COVID cases, the correlations in the indices seem to decrease in almost all trading scales. Although prior to March'20 a strong correlation was present, after the COVID-19 peak the correlation only can be spotted in the short terms trades up to 8 trading days. Again, however there is no leading phase relationship. Indian conventional index after March continued to have strong correlation with the Islamic counterpart but not in a leading way. 2-4 and 4-8 trading days the correlations lacked any significant correlation whereas stating from June'21, the conventional index started to take a leading role in the relationship in terms of returns. While Chinese MSCI Conventional and Islamic Indices still hold correlation in the short terms up to 16 days, they were unable to show any similar return coherence in the longer runs such as 32- and 64-day trading periods.

All the developed country indices including US, UK, Netherlands, Sweden still show strong correlation patterns in almost all trading frequencies with conventional index returns leading the Islamic ones. Only in short term periods during the end of the year the correlations in the US Market seem to decrease but this may be due to the low trading volumes of the Christmas Holiday Period. Among developed country indices Italy and Spanish cases showed different patterns that our prior analysis for the longer period. Both indices this time showed strong correlations up the 64 days. Only in the Spanish case, after March we lacked to spot any leading relationship.

The return patterns in the indices show that the pandemic had much higher impact on the emerging country markets which is in fact to their more fragile nature. There are however two important things to note. This study should be broadened to a further set of countries and it should even be expanded to a regional scope to better understand the dynamics.

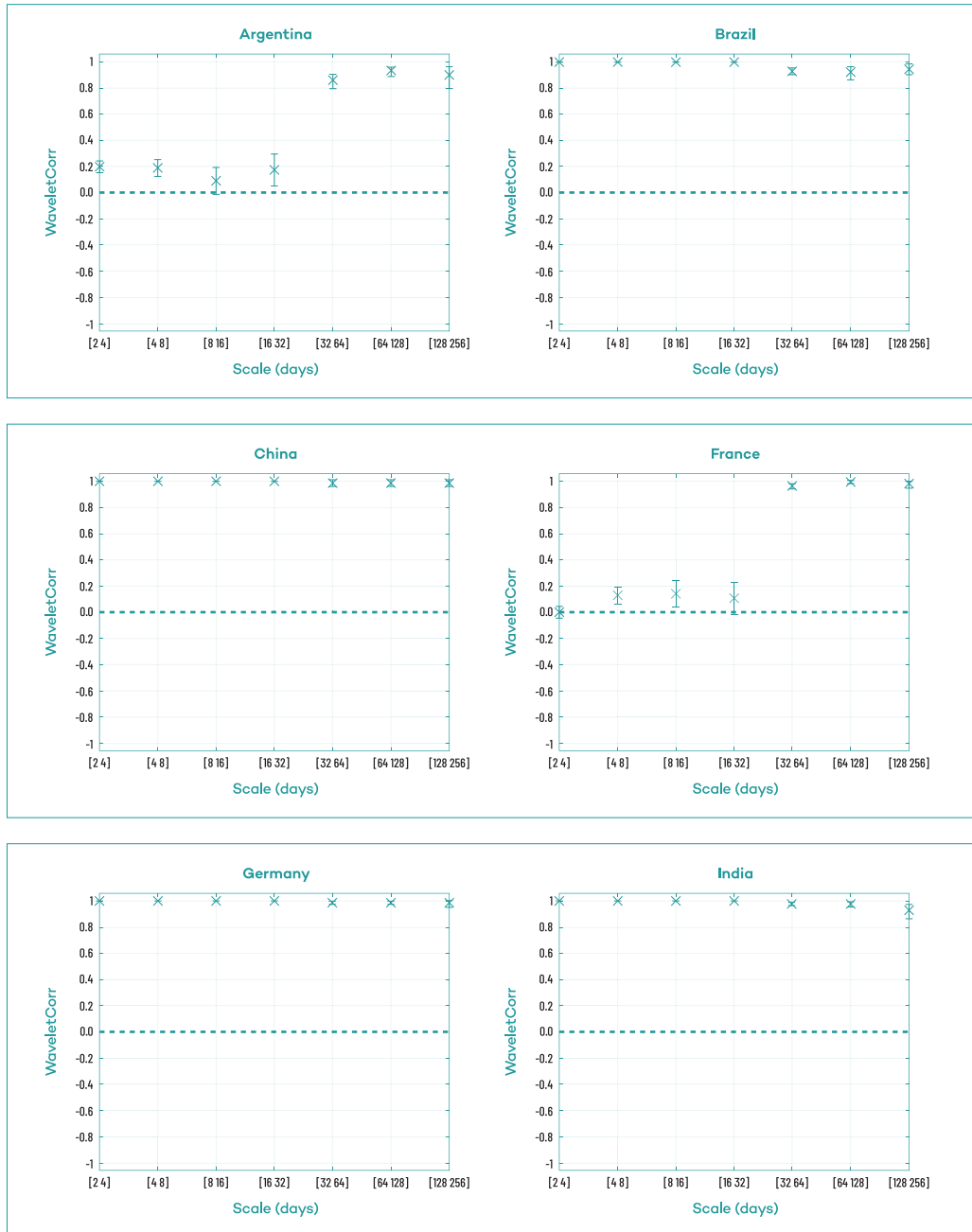
3.3.2 Wavelet Correlation Results

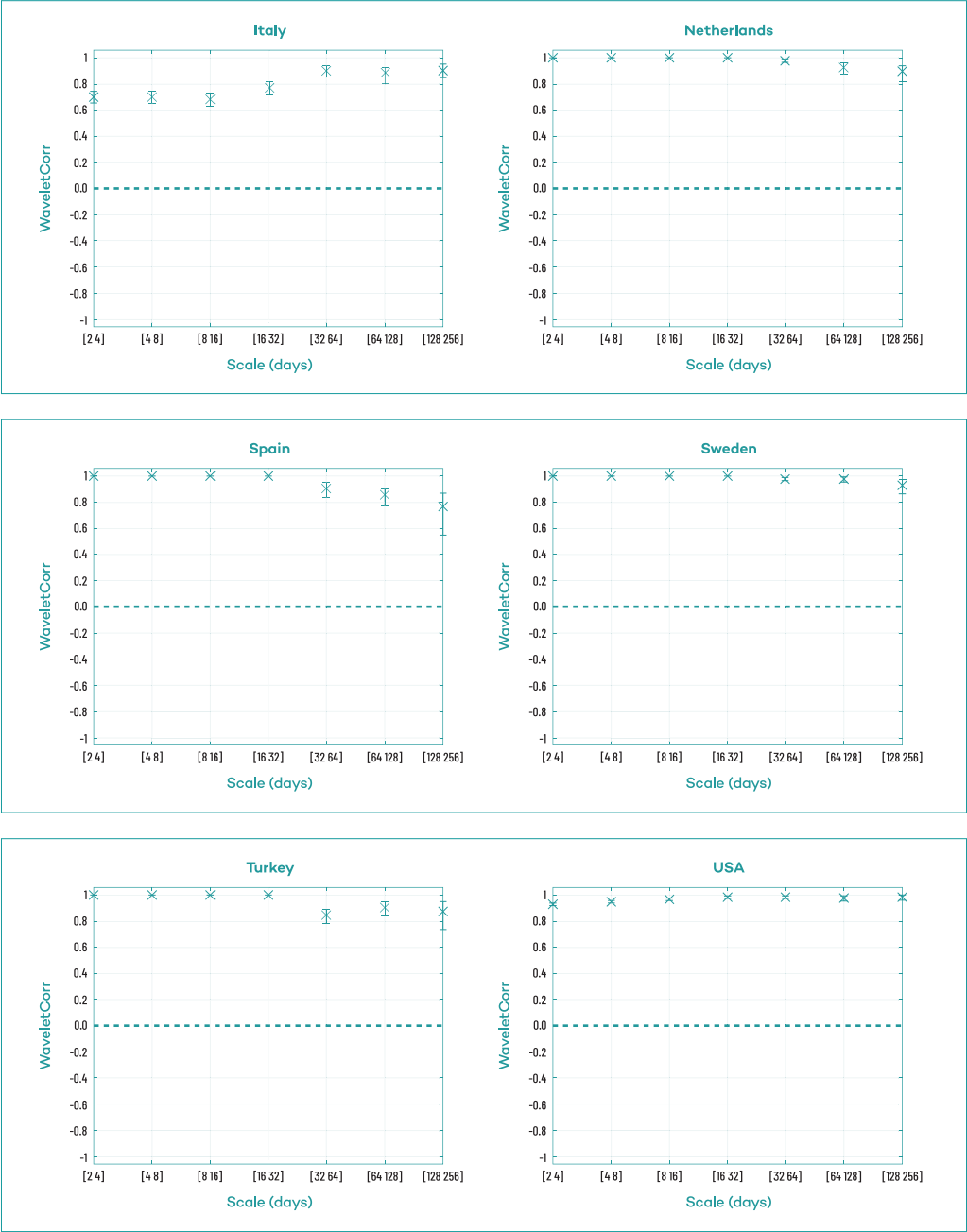
While the Wavelet coherence results show strong linkages between the same country Conventional and Islamic Indices, a further investigation of the time dependent nature of this correlation is to be conducted through the Wavelet Correlation analysis. As described in the methodology part, the wavelet correlation between two time series $\rho_{XY}(\lambda_j)$ is defined as the ratio of the wavelet covariance, $\gamma_{XY}(\lambda_j)$, and the square root of their wavelet variances $\sigma_X(\lambda_j)$ and $\sigma_Y(\lambda_j)$. (Dewandaru et.al, 2016). The analysis is conducted with the Daubechies Least Asymmetric Filter with a length of 8 (Matlab symmlet Wavelet) within a scale of 8 corresponding to 128 days³ and a trading scale of [128 256] trading days.

For computation of the correlation in different scales Maximal Overlap Discrete Wavelet Transform is used and the results are plotted in the below Matlab Graphs.

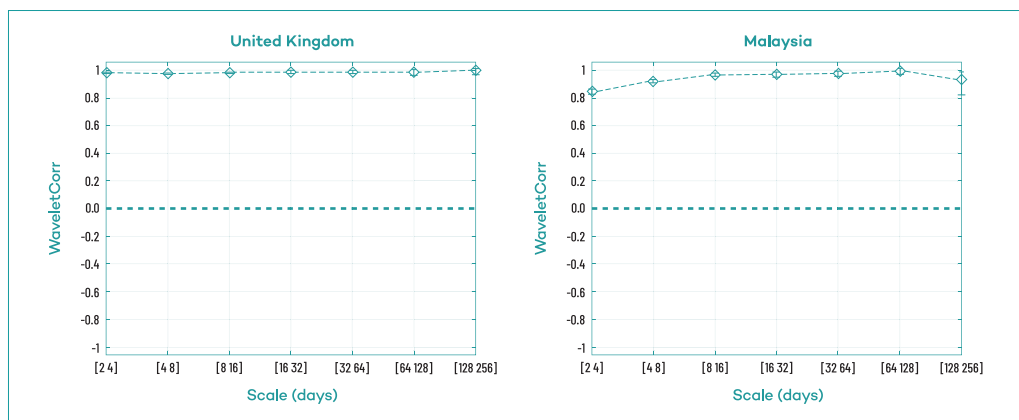
³ Bayracı, Demiralay and Gencer (2017), Gençay (2011) shows that with while using scale time period relation the wavelet scales are in dyadic 2^{n-1} scales such that Level $d_1 = 2^{1-1} = 1$, this also represents the return dynamics over 2 to 4 days.

Figure 3: Wavelet Multiscale Correlation Graphs





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The results show that in almost all the country samples the results show positive and high correlation in all the trading scales. Countries with high market caps and mostly developed stock markets such as US, UK has nearly perfect correlation starting from d1(2-4 days) to d8 (128-256) days. This is like the coherency spectrum diagrams where the red zones show the perfects interconnection of returns between the two markets indices. Italy and Spain showed mixed results as Italy showed a decrease in correlation between scales of d4 (16-32 days) and d5 (32-64 days) but reverted to higher correlations in the higher scales. The Spanish Case is also interesting where within the lower scales Spanish returns higher correlation when compared with higher scales. At higher investment horizons (512-1024 days) the interaction between the Islamic and Conventional Market returns diminishes totally in the Spanish Case. Malaysia, India, and Turkey where Islamic tradition are an important aspect of the population, the return linkages start lower and get higher at the d4 (16-64) and higher scales. Except Italian and Spanish Cases, it can be concluded that most of the tested countries show similar correlation schemes.

Table 5: Total Conventional Index Return Covariance in different Scales

Countr Index	2 Day Returns	4 Day Returns	8 Day Returns	16 Day Returns	32 Day Returns	64 Day Returns	128 Day Returns	Total Variance
Argentina	3.408	1.665	0.897	0.437	0.197	0.077	0.063	6.745
Brazil	2.857	1.395	0.764	0.278	0.109	0.065	0.035	5.502
China	1.347	0.735	0.388	0.170	0.069	0.028	0.021	2.759
France	1.411	0.712	0.349	0.136	0.057	0.025	0.011	2.699
Germany	1.326	0.685	0.354	0.142	0.060	0.031	0.014	2.613
India	1.388	0.744	0.426	0.154	0.086	0.031	0.013	2.841
Italy	1.875	0.905	0.455	0.177	0.089	0.048	0.017	3.565
Malaysia	0.449	0.268	0.152	0.064	0.032	0.016	0.010	0.991
Netherlands	1.150	0.605	0.294	0.110	0.053	0.021	0.007	2.240
Spain	1.683	0.912	0.472	0.189	0.081	0.042	0.016	3.395
Sweden	1.813	0.916	0.443	0.174	0.062	0.023	0.012	3.442
Turkey	2.322	1.232	0.706	0.332	0.120	0.066	0.029	4.806
UK	1.133	0.590	0.293	0.111	0.044	0.016	0.005	2.192
US	1.064	0.381	0.191	0.072	0.032	0.010	0.003	1.752

Table 6: Total Islamic Index Return Covariance in different Scales

Country Index	2 Day Returns	4 Day Returns	8 Day Returns	16 Day Returns	32 Day Returns	64 Day Returns	128 Day Returns	Total Variance
Argentina	3.758	1.795	0.964	0.506	0.240	0.078	0.060	7.401
Brazil	3.312	1.666	0.860	0.329	0.127	0.079	0.041	6.414
China	1.572	0.844	0.437	0.188	0.074	0.031	0.025	3.170
France	1.428	0.695	0.319	0.134	0.058	0.022	0.011	2.668
Germany	1.361	0.707	0.362	0.141	0.057	0.030	0.014	2.673
India	2.685	1.012	0.470	0.162	0.093	0.031	0.008	4.462
Italy	2.106	0.935	0.425	0.192	0.088	0.035	0.020	3.801
Malaysia	0.579	0.296	0.154	0.063	0.032	0.016	0.009	1.148
Netherlands	1.176	0.570	0.279	0.108	0.051	0.017	0.006	2.206
Spain	1.562	0.784	0.403	0.145	0.068	0.024	0.010	2.996
Sweden	1.915	0.943	0.430	0.175	0.066	0.018	0.012	3.560
Turkey	2.141	1.267	0.701	0.304	0.118	0.065	0.020	4.616
UK	1.362	0.694	0.327	0.125	0.050	0.019	0.006	2.583
US	1.023	0.360	0.170	0.067	0.031	0.009	0.004	1.664

3.3.3 Wavelet Variances and Hedge Ratios

The final analysis in this thesis is to figure out whether Islamic Market Indices can create a hedging alternative for their conventional counterparts. As discussed in the literature Hedging Ratio is mainly defined as the comparative value of an investors open position's hedge with the cumulative size of the portfolio itself. Most of the studies conducted on the calculation of hedge ratio consider the future contracts of the underlying securities tested as they are investment vehicles allowing investors to lock their underlying security's spot price at some spot at the time $(t+x)$ where x shows the days outstanding for the price in the future.

We used MODWT over DWT for estimation of the variances as Percival and Mofield (1997) and argues that it takes out the limitations of the DWT, such as the sample size issue, creating a more efficient method for decomposing the variance of times series. As discussed in Gençay et al. (2002) Daubechies least asymmetric filters with a length of 8 is the best practice for approximation to an ideal band pass-filter. (Gençay et.al, 2002) Figure 4-A and 4-B show the decomposed variance of returns in different time scales. This decomposition is mainly to calculate the contribution of each time scale in the wavelet domain to the total variance. The results for total variance decomposition include different time scales for both conventional and Islamic MSCI Country Indices starting from a scale of 2 day returns to 128-day returns.

Evaluating the variance results show us that the variances are in a declining trend for both the Islamic and Conventional Indices. The highest contribution to total variance is in the lower scales with 2 and 4 days showing out the highest decomposed variances. Almost %50 of the total variance is within a 2-day scale.

Like the coherence and correlation results, it seems not striking that the variance decompositions of the conventional and Islamic indices are not differentiating much in terms of total variances. In most of the

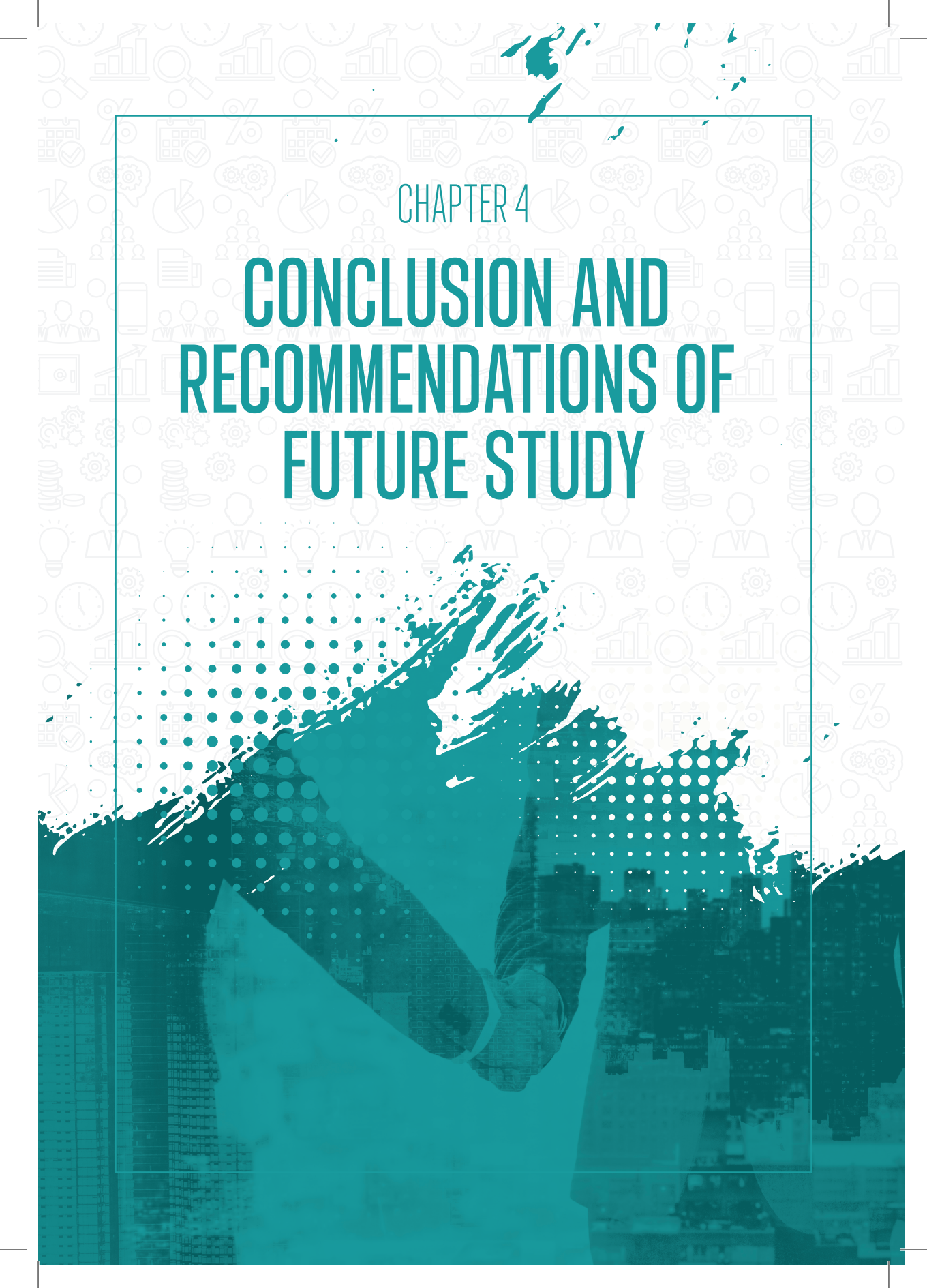
countries the conventional indices had higher variances in each of the times scales than the Islamic ones of the same country showing us that Islamic Market indices are less volatile. However, the magnitudes do not differ dramatically to come up with the conclusion that they are safe havens for the investors protecting them from high market fluctuations. It is also important that considering these are same country indices working within the same market conditions and the stocks they are being structured with are traded at the same country markets, if the arbitrage conditions hold both set of returns should be close to each other. Only in countries like Turkey where the Market is being dominated by financial sector stocks, one would think a dramatic differentiation in the returns, but when the variance results are compared the results does not hold this argument with a variance that very similar (4.8 vs 4.6)

As a last point in the analysis, we consider the results of the Optimal Hedge Ratio Calculations, hedging performance improves in the longer periods especially going to 64 days. For most of both country and Islamic indices the results indicate that the Hedge Ratios begin to deteriorate after 64 days and has lower performance at 128 days. This may indicate that the hedging horizon between the Conventional and Islamic Markets is 64 days where an investor favor wavelet hedge strategy. The magnitudes of the hedge ratios show that Islamic indices seem to indicate an opportunity to hedge investor positions that are in line with the conventional indices. With a scale of 64 days, for the investors that is practicing hedging opportunities the convergence of the hedge ratio to one shows a consistent hedge which also helps to eradicate the costs associated with transactions due to the changes in the hedge ratio at shorter horizons.

Table 7: Wavelet Hedge Ratios by Different Scales

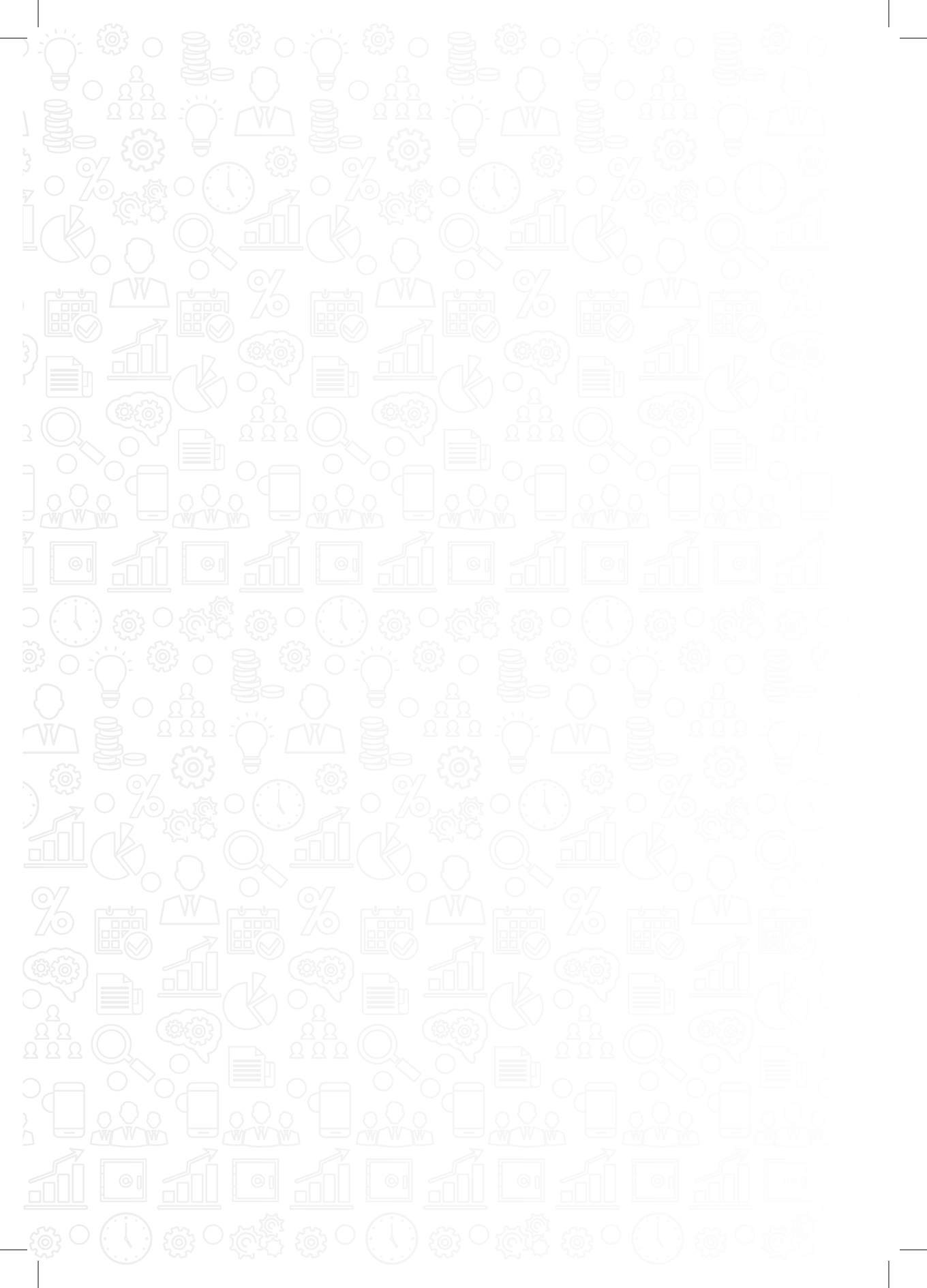
Countr Index	2 Day Returns	4 Day Returns	8 Day Returns	16 Day Returns	32 Day Returns	64 Day Returns	128 Day Returns
Argentina	0.799	0.798	0.815	0.822	0.801	0.920	0.952
Brazil	0.869	0.857	0.893	0.854	0.840	0.855	0.889
China	0.873	0.893	0.913	0.922	0.939	0.936	0.912
France	0.972	0.988	1.024	0.981	0.968	1.044	0.964
Germany	0.930	0.933	0.941	0.982	1.007	1.008	1.004
India	0.503	0.700	0.874	0.917	0.929	0.965	1.176
Italy	0.860	0.881	0.935	0.850	0.864	1.042	0.837
Malaysia	0.725	0.854	0.935	0.956	0.952	0.989	0.976
Netherlands	0.931	0.969	0.968	0.957	0.972	1.011	1.011
Spain	0.889	0.938	0.957	0.948	0.940	1.141	1.018
Sweden	0.939	0.944	0.978	0.958	0.924	1.066	0.930
Turkey	0.860	0.825	0.868	0.919	0.876	0.923	1.051
UK	0.875	0.877	0.907	0.908	0.908	0.885	0.871
US	0.965	0.983	1.027	1.012	0.984	0.971	0.921





CHAPTER 4

CONCLUSION AND RECOMMENDATIONS OF FUTURE STUDY



CONCLUSION AND RECOMMENDATIONS OF FUTURE STUDY

4.1 CONCLUSIONS DERIVED FROM THIS STUDY.

This study is tries to investigate possible linkages between conventional country and Islamic country indices on the return and price dynamics utilizing a Wavelet based approach. The first two parts of the thesis is for opening the discussion first trying to elaborate on the emergence and development of Islamic Finance and Islamic Markets adding an explanation of all the risk dimensions. Following this part is an extensive literature review both on the Islamic Market vs Conventional Market comparison studies and academic research on the financial studies conducted with Wavelet Analysis (testing different markets including Oil, Bitcoin etc...)

The main aim of this study is to show, if present, an opportunity to use Islamic Indices as means of alternative investments schemes in order 1) to derive alternative returns 2) protect returns from financial meltdowns using portfolio diversification. Most of the investors think and act as if the Islamic Investments are safer and less volatile due to their lower leverage nature. which are to analyze the co-movements of the Conventional and Islamic Market Indices. Wavelet tests however failed to identify significant difference among the tested markets. Developed Markets with high market cap, trading volumes and product variations (US, UK, Germany, France) have shown in phase and highly correlated results.

Only Developed markets with less product variability, (Italy, Spain etc...) and Emerging Markets (Turkey, China, Malaysia etc...) showed lower correlations. This was an expected outcome for countries like Turkey where conventional market dominated by a sector that cannot be included in the Islamic index (such as the Banking sector in the Turkish Stock Market)

Wavelet squared Coherence Analysis (obtained through the Continuous Wavelet Transform) to capture the possible linkages on the time and frequency domain. As expected, the coherence power spectrums showed high and positive linkages in almost all the investment horizons except the Italian and Spanish cases. The results were like previous research on the issue proving that Islamic stock markets are mostly integrated into the conventional markets. As the coherence diagrams state, the co-movement starts weak at the first instance in the shorter terms but grows stronger at the longer investment horizons because investors adjust their portfolio structures over time to derive the best effort returns from the market. An important element in the Wavelet analysis that the country pairings showed is that financial domination of in the country indices affects the safe haven theory and co-movement. Italian, Spanish, and Turkish markets are all defined by the financial sector which in fact proved the lower coherency especially especially in terms of financial meltdowns in the country. Especially Turkish and Argentinian cases are exempling of this financial nature. Turkey for instance is shaped with financial equities and in times where there is high interest rate risk and volatility, the financial equities collapse. On the other hand, with Islamic indices dealing with no such financial equities seem to be more stable in times of crisis. This is like the findings of Ho et al (2014) stating that Islamic indices outperformed conventional counterparts in times of financial crisis terms whereas the difference in returns dissipate in non-crisis periods. (Ho et al. 2014)

Table 8: Weights of Financial Sector and Leading Industry in Selected Country Exchanges

Country	Market Name	% Weight of Financials** in Index	Largest Sector in Trading
Argentina	MERVAL	%33,0	Financials
Brazil***	BOVESPA	%27,26	Materials
France	CAC 40	%9,7	Industrials
Germany	DAX	%14,86	Materials
India	SENSEX	%45,13	Financials
China	Shangai	%14,45	Consumer Staples
Malaysia	FTSE Bursa Malaysia	%2,15	Industrials
US	S&P 500	%10,34	Tech Companies
UK	FTSE	%18,44	Consumer Staples
Turkey	BIST-30	%33,3	Financials
Sweden	OMX	%21,56	Industrials
Netherlands	AEX	%8,17	Oil&Gas
Spain	IBEX	%26,25	Financials
Italy	FTSE MIB	%30,45	Financials
** including insurance,banks and financial services. *** Although Financials are the first sector in total listing among the top 10 constituents trading volume in this sector is only %11,40			

The above table in fact supports the financials case. Among the 14 markets, the ones that differentiated in the coherence results were Argentina, Spain, Turkey, India, and Italy. As it can be tracked from the table above in all these countries the main weight of the index is on the financials side and based on the trading volume Financial sector stocks lead the exchange dynamics. Only in Brazil the index is mainly constructed by the financials but, as our analysis shows due to low penetration of these financial stocks in the top 10 trading volume creates differentiated results. All countries to have lower coherence results had more than twenty-five percent inclusion of financial sector in the total index. Malaysian case is here should be interpreted differently. It seems that Malaysia also had coherence results that shown potential hedging opportunity in specific terms as the coherence diagrams differ from the other significant market indices. However, while investigating the Malaysian exchange (FTSE Bursa Malaysia) we found evidence that it is not by the

inclusion or leading of the financial stocks but instead due to the nature of the economic foundation in the country. Recent studies show Islamic Finance has nearly %40 percent market share in the total economic system.¹ The results of the analysis reflect such inclusion of Islamic Finance in the country's economic foundation. Financial sector stocks on the other hand only constitutes %2.15 of the total index which seems very negligible. It is also important here to note that due to this high percentage of Islamic Finance in the Malaysian economy, the banking system which constitutes the lion's share of the financial industry works also in relevance with the Islamic principles at the same level resulting a balanced economic system between conventional and the Islamic financial systems unlike other country cases. (Turkish case for example is not a balanced one as the ratio is %92 conventional to %8 Islamic which in turns makes it harder to talk about the real effect of an Islamic financial ecosystem in the country)

Further investigation in terms of Multiscale-Correlation with the MOD-WT approach is utilized to show how the correlation of the markets differ over different time scales. The major question here is whether with all the screening and sharia-based rules; the indices would differ in terms of returns over different time scales. Again, the correlation results showed, even with the screening rules, there is a high positive correlation in almost all the indices due to the interlinkage between the same country markets. Interestingly even in markets like Turkey where the stock market is dominated by the financial and banking industries and thus the composition of the indexes may vary, the correlations tended to be higher than expected. One of the important implications of both results in terms of coherence and correlation between these two types of markets is that, as co-movement between the two-return series exist, Islamic markets can be attractive alternative investments to portfolio managers, that try to derive returns for people with sensitivity to interest bearing securities and those who want to follow investment alternatives that are Sharia compliant.

1 <https://www.theedgemarkets.com/article/malaysia-seen-within-reach-40-islamic-financing-target> (Link active as of 6th of May 2021)

The covariances and hedge ratio results indicate that Islamic Markets can be alternative investment intermediaries for investors that 1) want to hedge their positions 2) want to diversify their portfolios with different investment vehicles. Although as discussed in the limitations section more research with a broader data set (in terms of regional, sectoral and more country based) should be conducted it can be evaluated from the results of the study that Conventional and Islamic markets are becoming more and more integrated in the latest years. Reading the analysis results Islamic Stock Indices fairly constitute an alternative investment opportunity and seem to be good looking alternatives for market practitioners as they tend to move together and benefit from the same diversifications measures.

The results of this thesis indicate two major results, 1) Co movement of the Islamic and Conventional indices depend on the characteristics of the country or region they operate. 2) In terms of portfolio diversification, under the presence of a homogenous equity the performance difference is not so sharp as to use them as investment alternatives. However financial dominance and leverage factors (especially a dominant banking and financial sector equities eco system) Highly affect this hedging factor. The findings of both correlation and coherence results pair up with El Aloui et al (2018) and Asfrac et al. (2017) empirically finding that leverage is an important element that worsens the portfolio returns and thus lower leverage due to financial screening of the Islamic Indices create better portfolio returns. (El Aloui et al 2018, Asfrac et al., 2017)

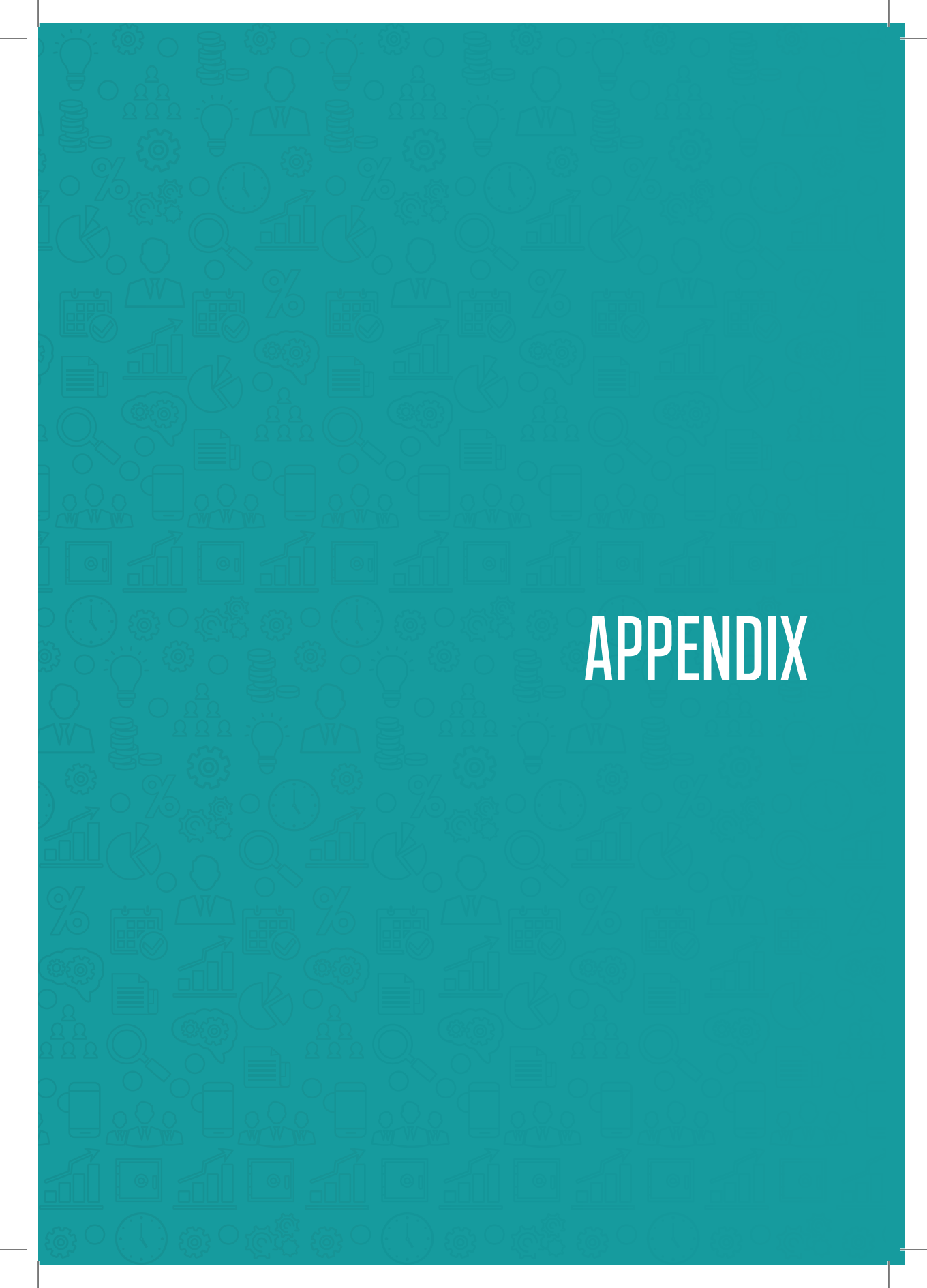
4.2 RECOMMENDATIONS AND PROPOSITIONS FOR FUTURE STUDIES

Before delving into recommendations for future work, it can be concluded that the most notable limitation of the study is the lack of historical Islamic Index data compared to Conventional indices. Due to the lack of historical data in the Islamic series as most of these index series originated at the second half of the 2000s with the increasing popularity of Islamic Finance, it become an important restrictive element to conclude with a higher data period. (That may be suitable to inspect return dimensions in several crisis periods like 1997 Asia crises, the tech bubble in

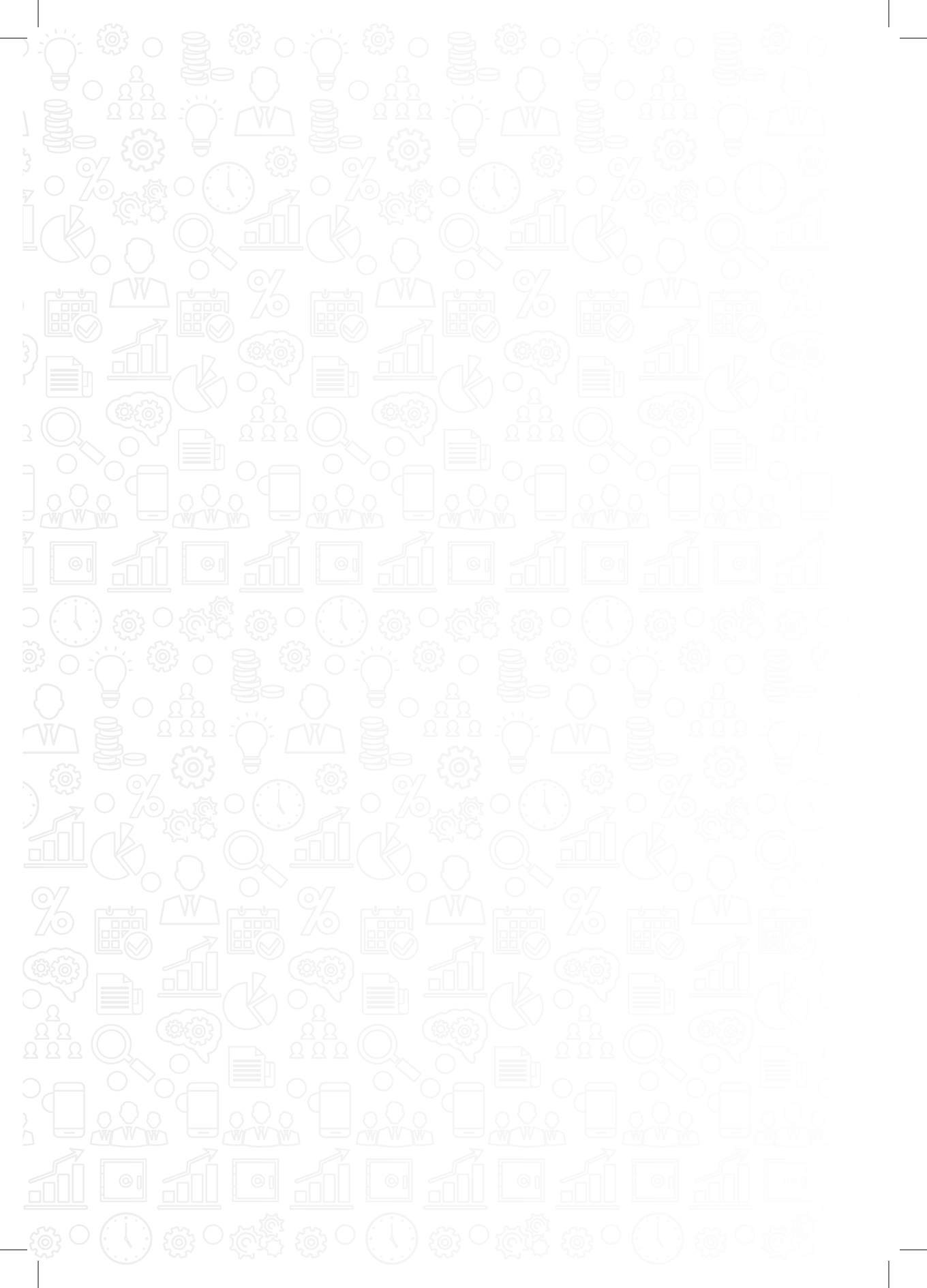
the 2000s etc....) Also, the only index provider to provide country and region wise indices is MSCI whereas the others prefer to calculate combined indices (Ex; Dow Jones Market Titans Islamic Index) These two restrictions make it harder to come up with higher number of data series to test every possible outcome in the linkage between Islamic and Conventional Indices.

Future work would be testing more MSCI indexes in both country level and region level and even with regional structures level such as the EMU or Asia Pasific group (MSCI has indices such as Asia Pasific-excluding Japan or EMU excluding Germany etc.) Wavelet Analysis with the advantage of utilizing the frequency domain is an important analysis tool to decode the relationship of Islamic and Conventional indices in these different country and region levels.

An interesting study that in the literature was Wavelet Analysis and high frequency trading. Measuring coherency at the minutes and hours level is a fantastic seminal work. Future work on a single market such as the Turkish Market where the Islamic index “Katılım Endeksi” in terms of KATLM30, KATLM50 and Active Model Katılım Portfolio Index can be a perfect candidate for an international Journal article candidate for the market interaction not only on a daily basis but intra-day trading basis.



APPENDIX



APPENDIX

APPENDIX A- ANALYSIS STATISTICAL TABLES

Unit-Root Tests (Stationary tests)

(A)- Non-Islamic Indices

	Augmented Dickey Fuller (t-test)	Probability (p)	Phillips-Pe ron (Adj.t-te st)	Probability (p)
MCOAR	-5.710.229	00001	-5.711.334	00001
MCOBR	-588.874	00001	-5.892.654	00001
MCOCH	-5.665.624	00001	-5.663.897	00001
MCOFR	-6.129.164	00001	-6.160.662	00001
MCOGR	-8.098.818	00000	-1.378.966	00000
MCOIN	-5.570.385	00001	-5.573.455	00001
MCOIT	-4.847.603	00001	-7.595.956	00001
MCOML	-5.277.763	00001	-5.285.079	00001
MCONE	-278.193	00000	-5.912.032	00001
MCOSP	-7.041.788	00001	-7.195.422	00001
MCOSW	-5.977.853	00001	-604.741	00001
MCOTR	-5.619.195	00001	-5.616.113	00001
MCOUS	-6.754.597	00001	-6.777.572	00001
MCOSUK	-6.600.836	00001	-6.741.079	00001

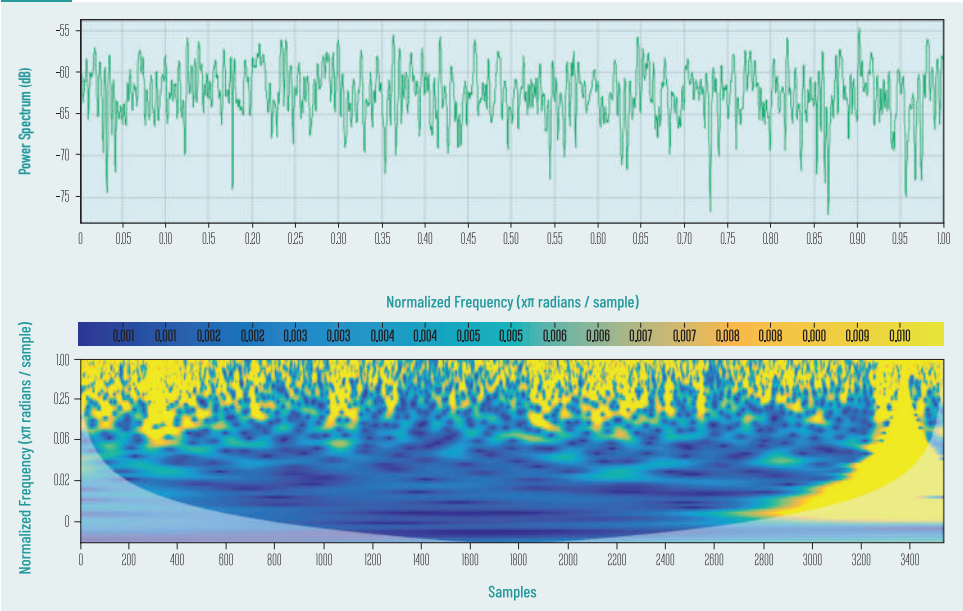
(B)- Islamic Indices

	Augmented Dickey Fuller (t-test)	Probability (p)	Phillips-Pe ron (Adj.t-te st)	Probability (p)
MISAR	-5.659434	00.001	-5.661.928	00.001
MISBR	-5.891.903	00.001	-5.900.525	00.001
MISCH	-5.703.603	00.001	-5.703.201	00.001
MISFR	-6.034.098	00.001	-6.051.218	00.001
MISGR	-5.763.691	00.001	-5.763.691	00.001
MISIN	-6.768.059	00.001	-677.542	00.001
MISIT	-6.117404	00.001	-6.117.387	00.001
MISML	-5.740.716	00.001	-5.743.596	00.001
MISNE	-5.992.029	00.001	-6.007.329	00.001
MISSP	-5.878.726	00.001	-5.895.197	00.001
MISSW	-4.402.297	00.000	-6.076.092	00.001
MISTR	-5.437.243	00.001	-5.425.341	00.001
MISUS	-6.772.284	00.001	-6.808.393	00.001
MISSUK	-5.830.152	00.001	-5.834.381	00.001

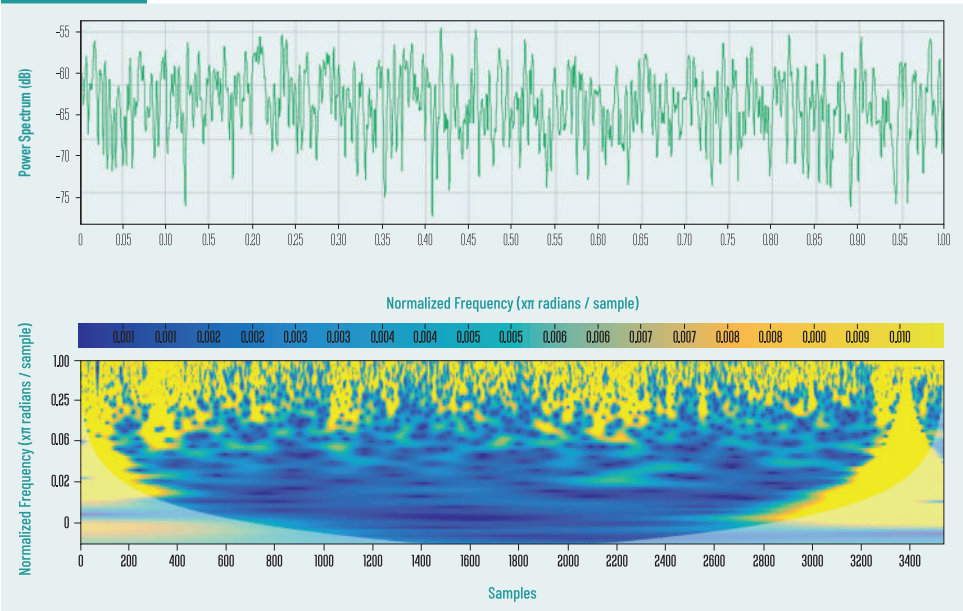
APPENDIX B-GRAPHS

Wavelet Power Spectrums

BRAZIL

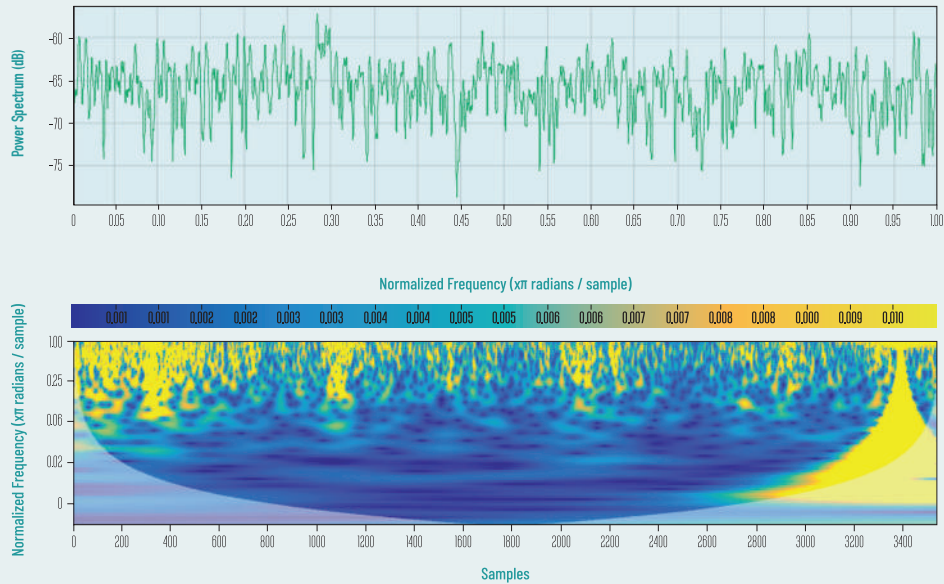


BRAZIL ISLAMIC

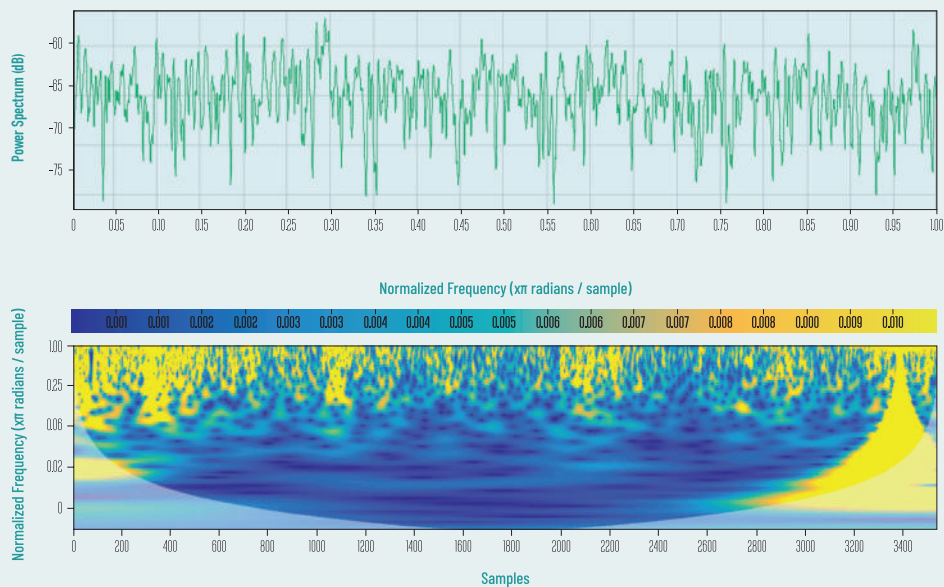


A COMPARISON OF ISLAMIC VS CONVENTIONAL INDICES: A WAVELET BASED APPROACH

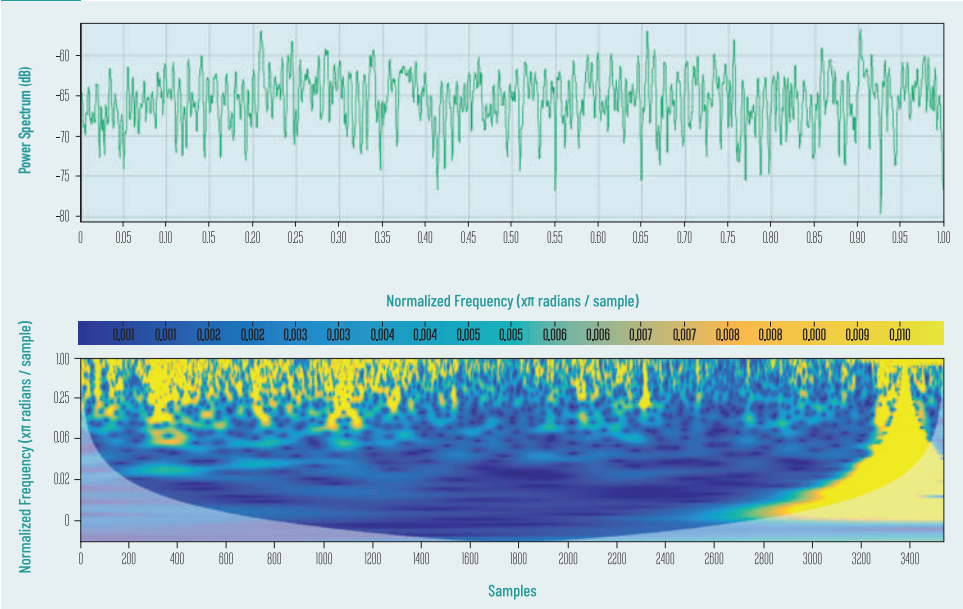
CHINA



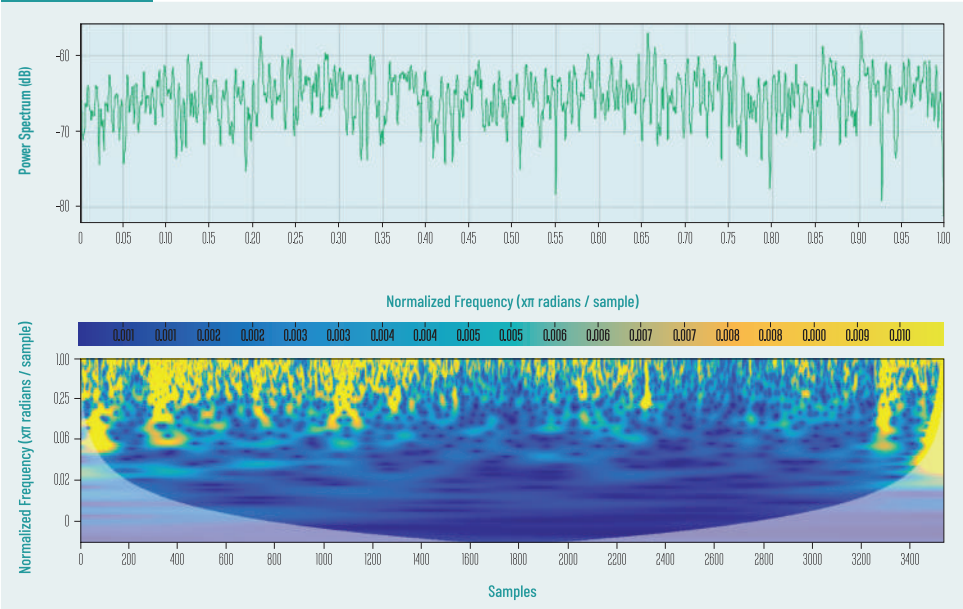
CHINA ISLAMIC



FRANCE

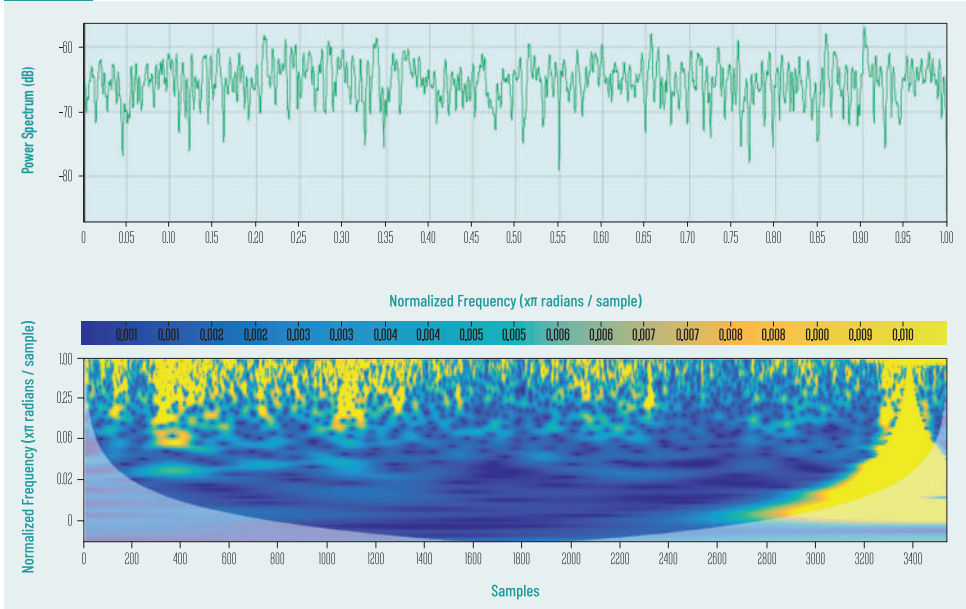


FRANCE ISLAMIC

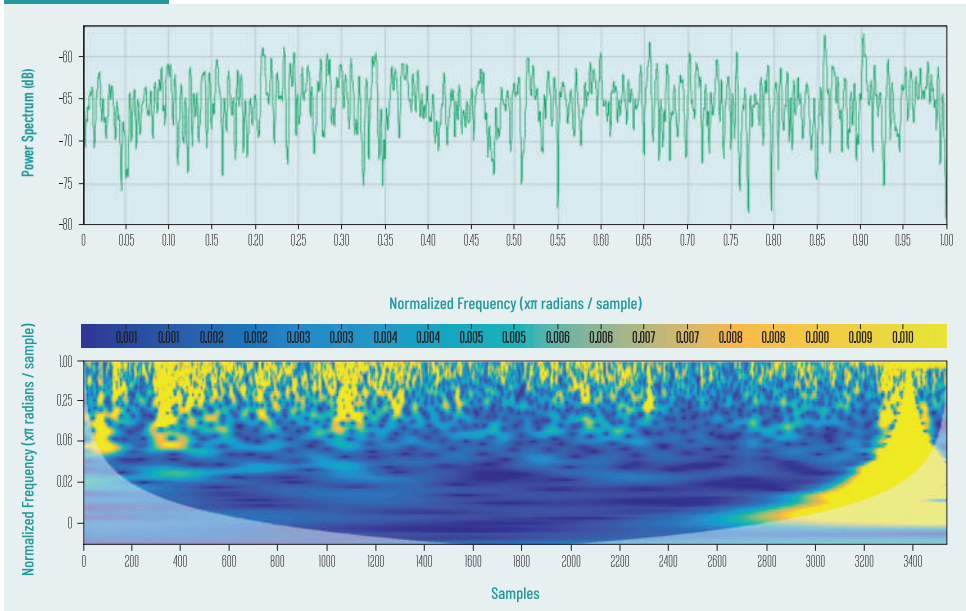


A COMPARISON OF ISLAMIC VS CONVENTIONAL INDICES: A WAVELET BASED APPROACH

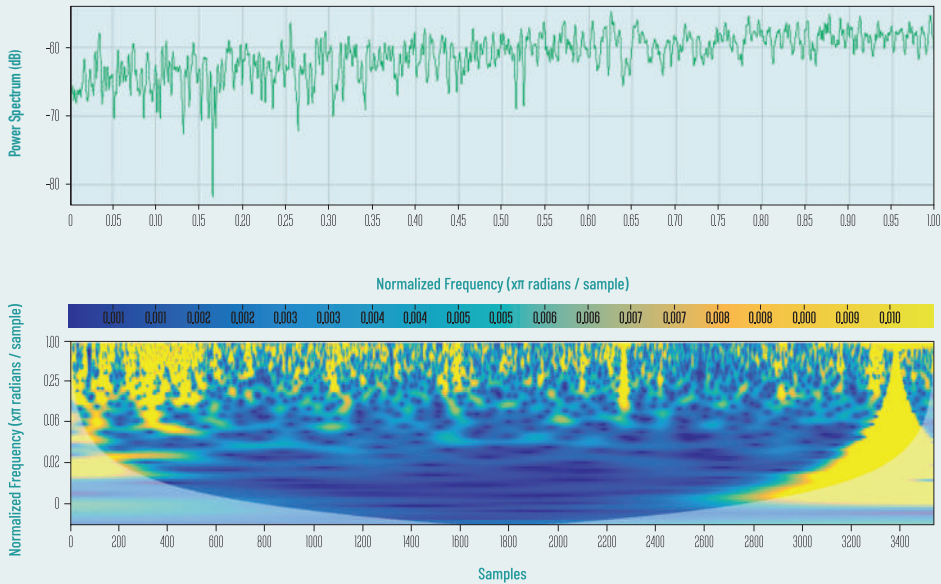
GERMANY



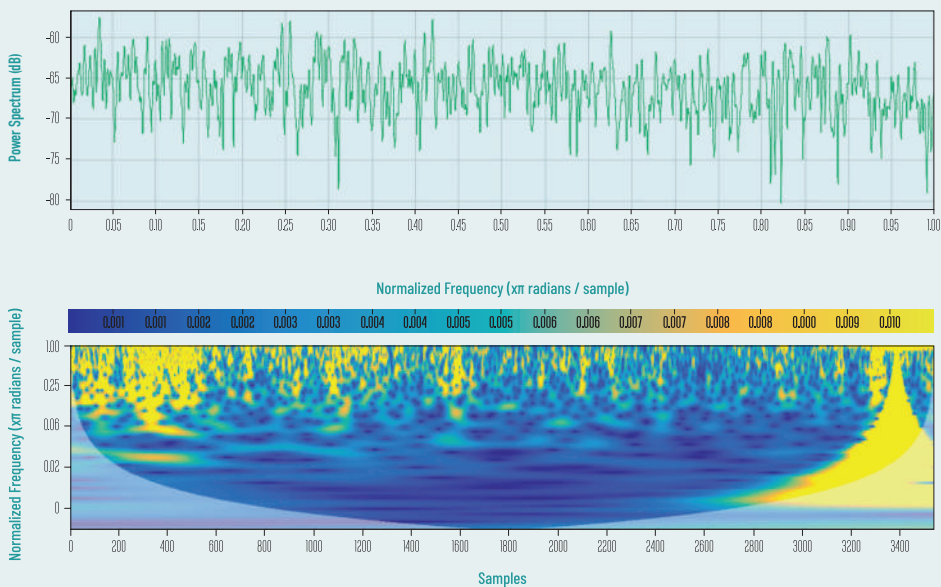
GERMANY ISLAMIC



INDIA

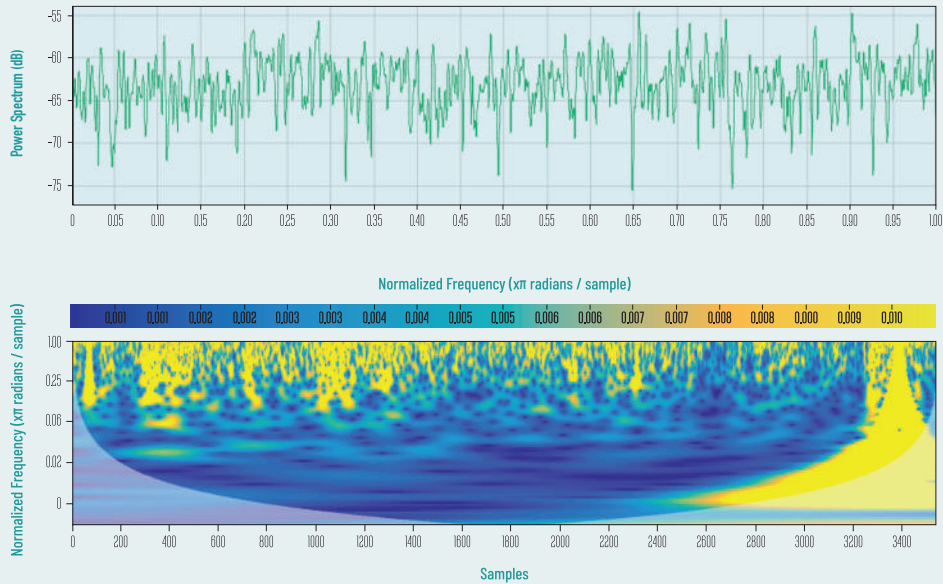


INDIA ISLAMIC

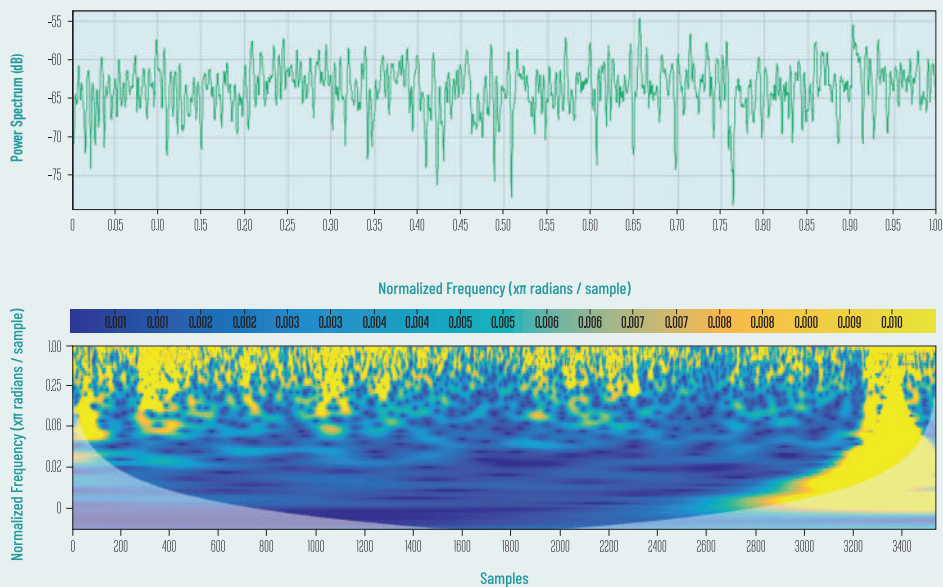


A COMPARISON OF ISLAMIC VS CONVENTIONAL INDICES: A WAVELET BASED APPROACH

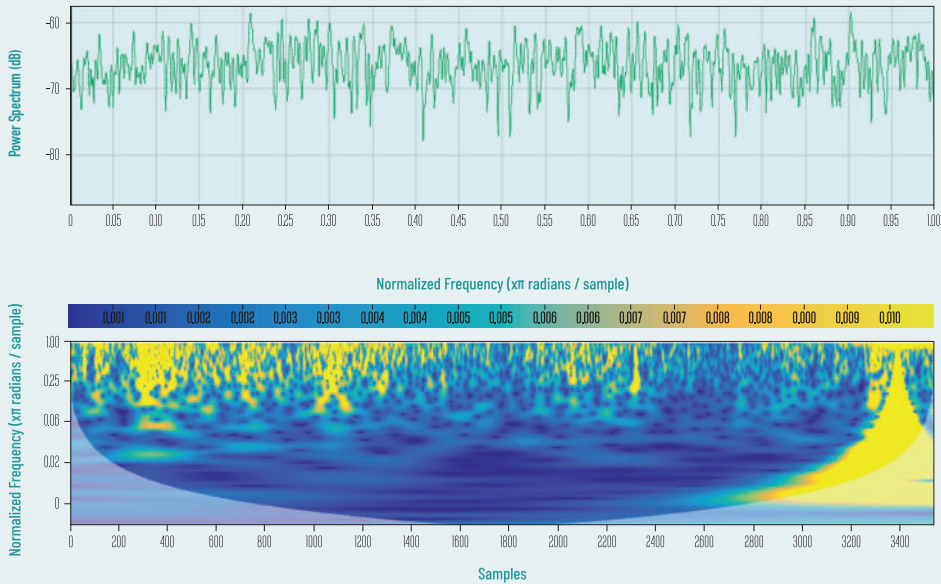
ITALY



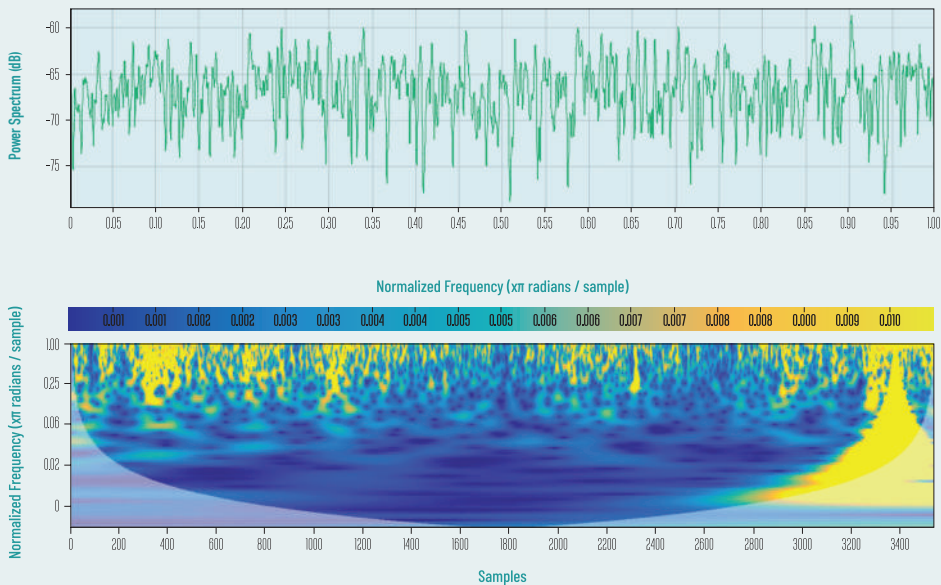
ITALY ISLAMIC



NETHERLANDS

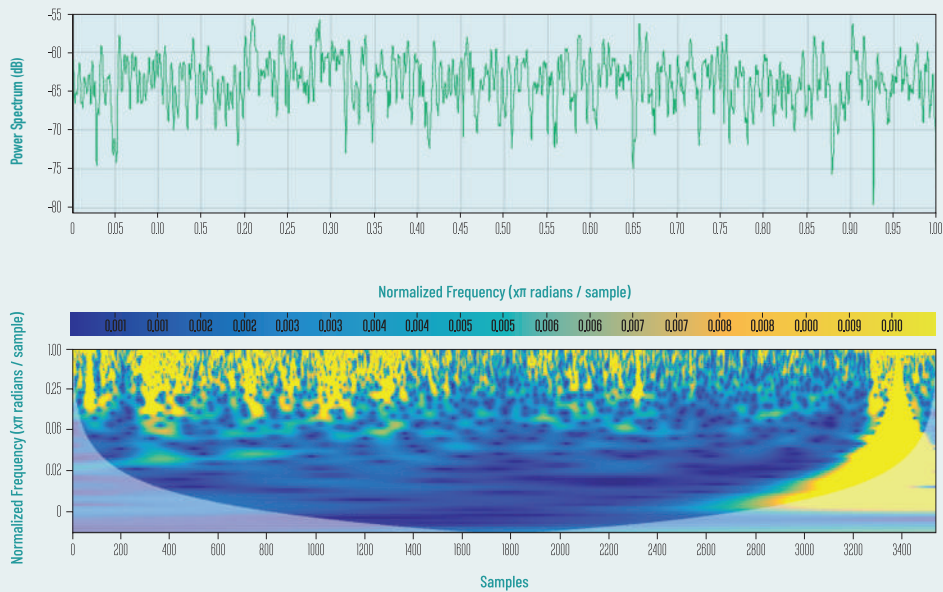


NETHERLANDS ISLAMIC

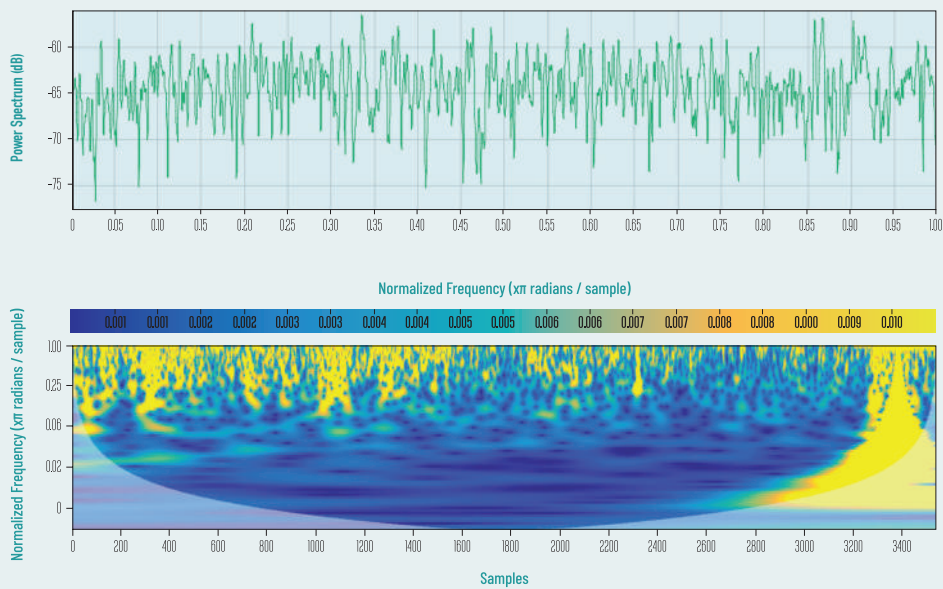


A COMPARISON OF ISLAMIC VS CONVENTIONAL INDICES: A WAVELET BASED APPROACH

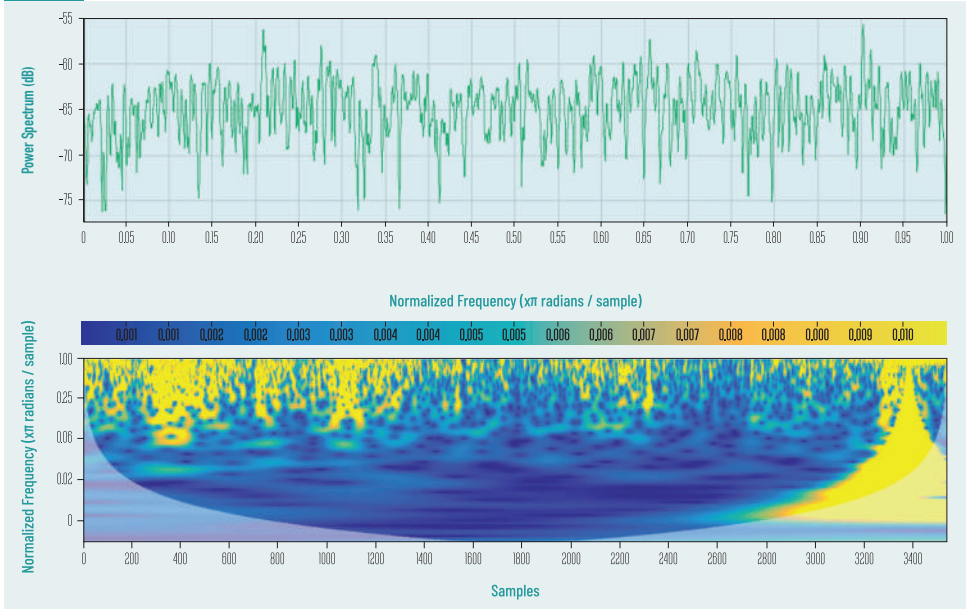
SPAIN



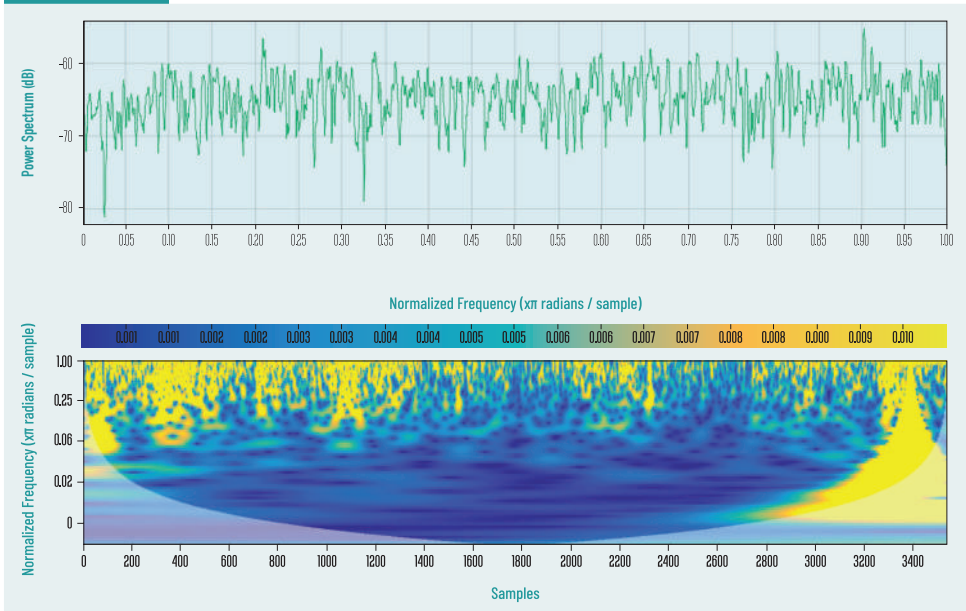
SPAIN ISLAMIC



SWEDEN

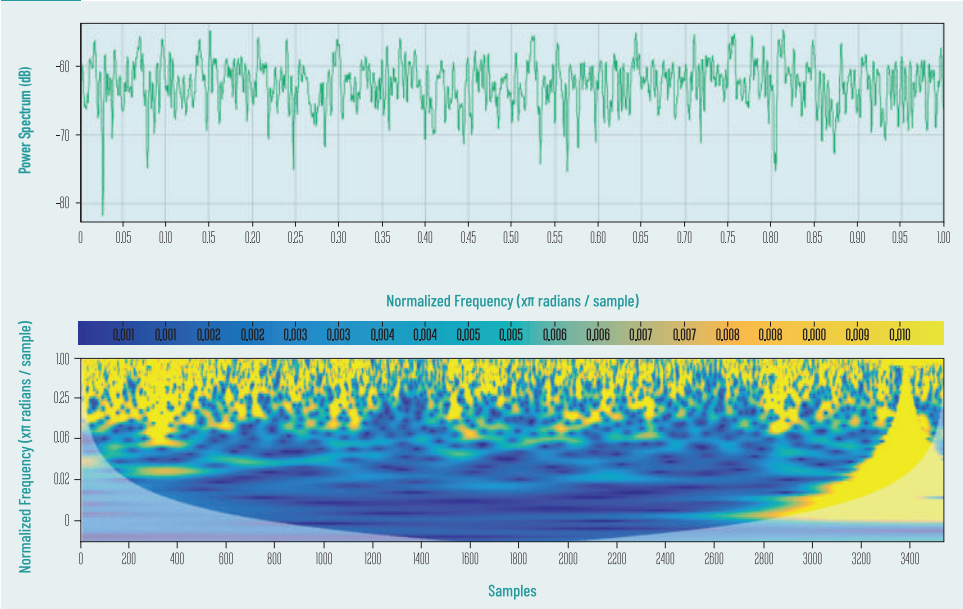


SWEDEN ISLAMIC

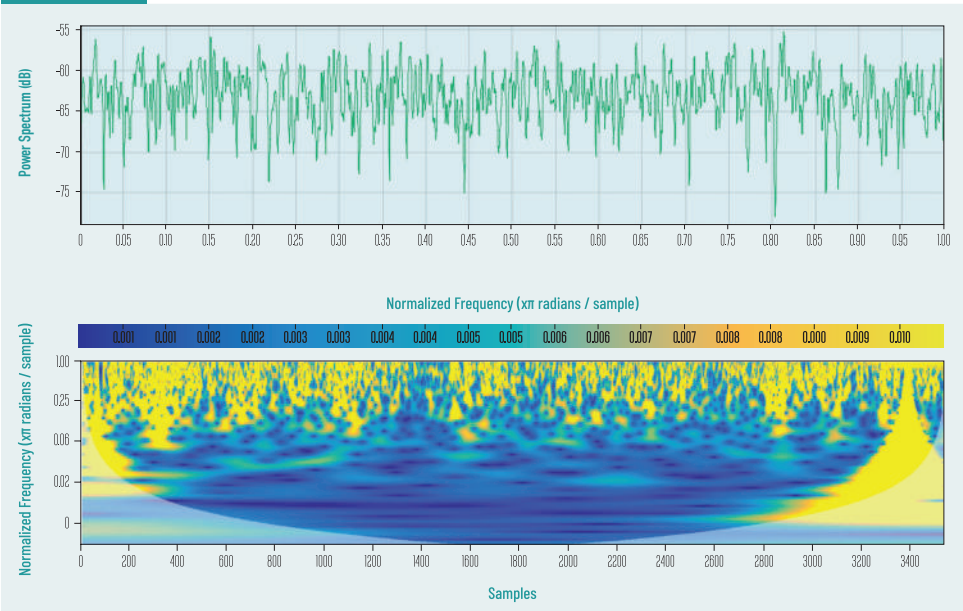


A COMPARISON OF ISLAMIC VS CONVENTIONAL INDICES: A WAVELET BASED APPROACH

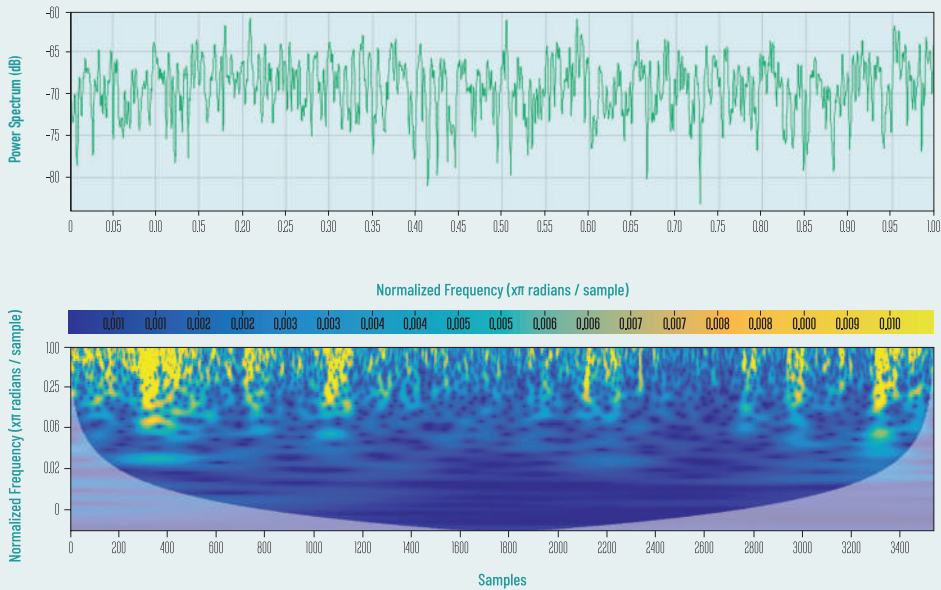
TURKEY



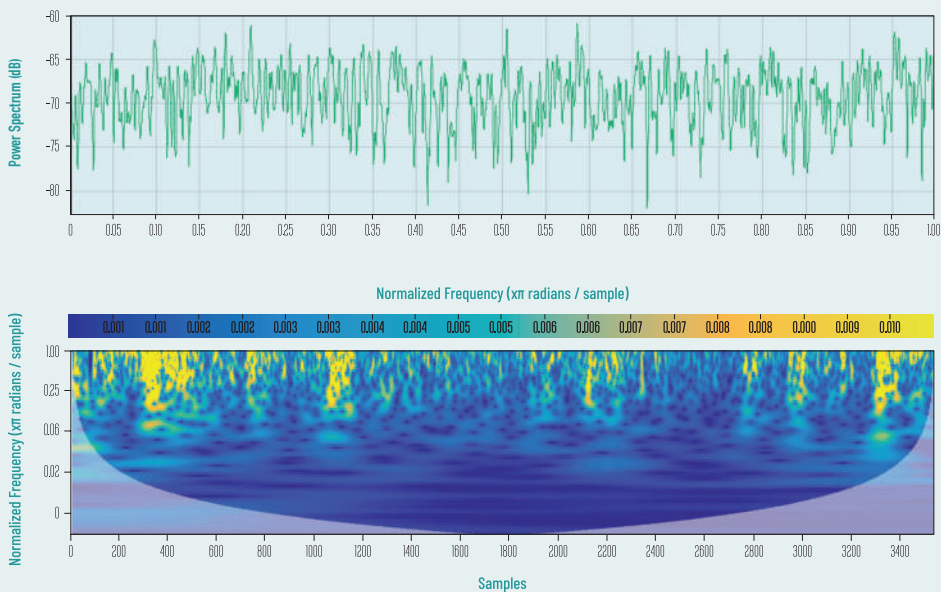
TURKEY ISLAMIC



US

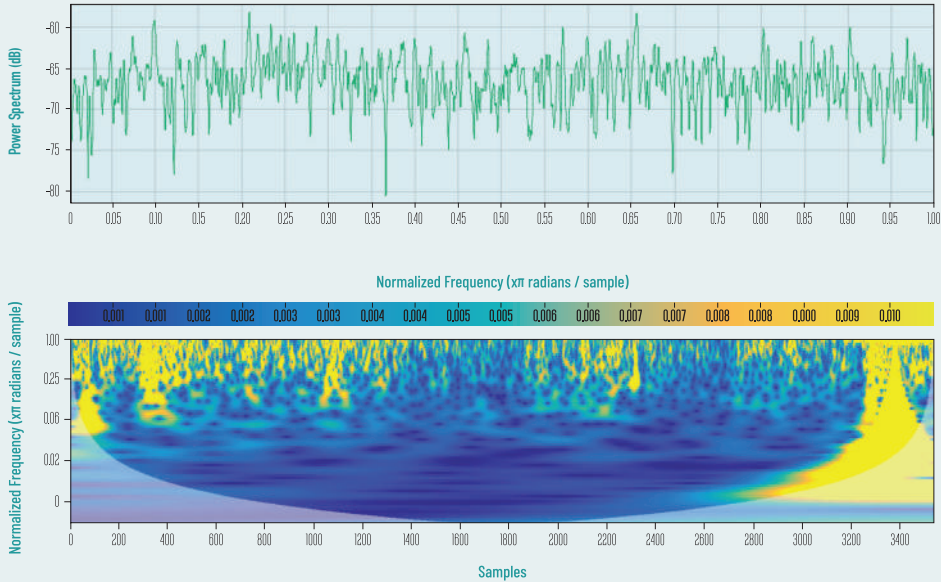


US ISLAMIC

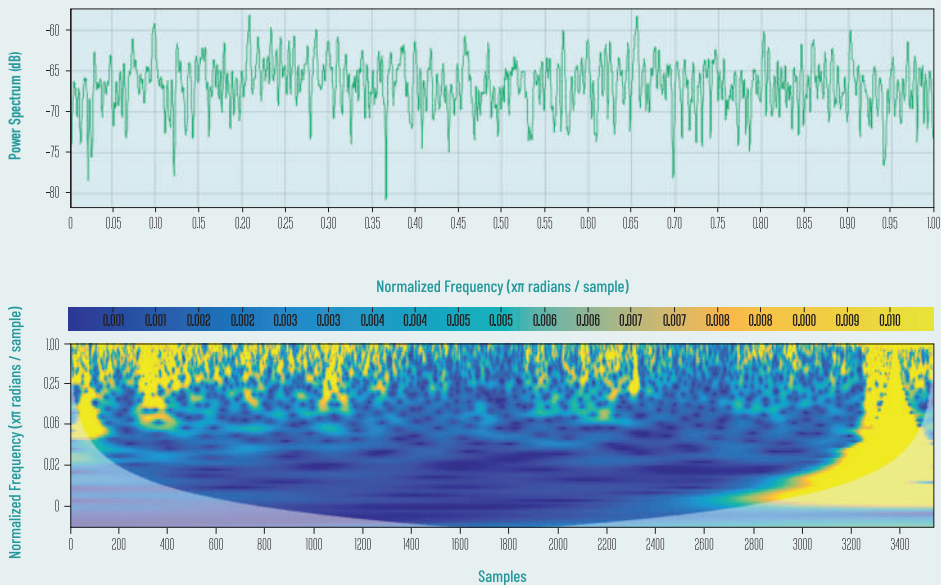


A COMPARISON OF ISLAMIC VS CONVENTIONAL INDICES: A WAVELET BASED APPROACH

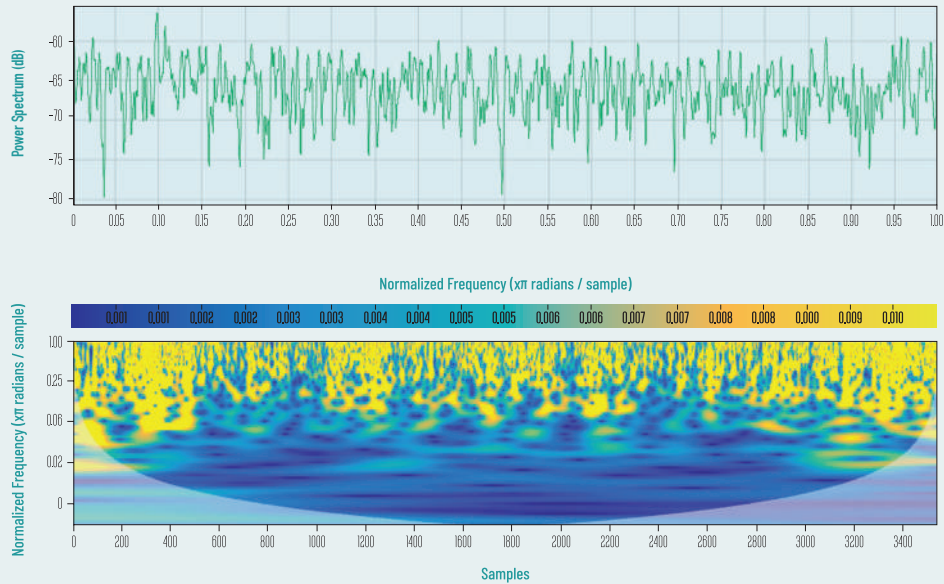
UK



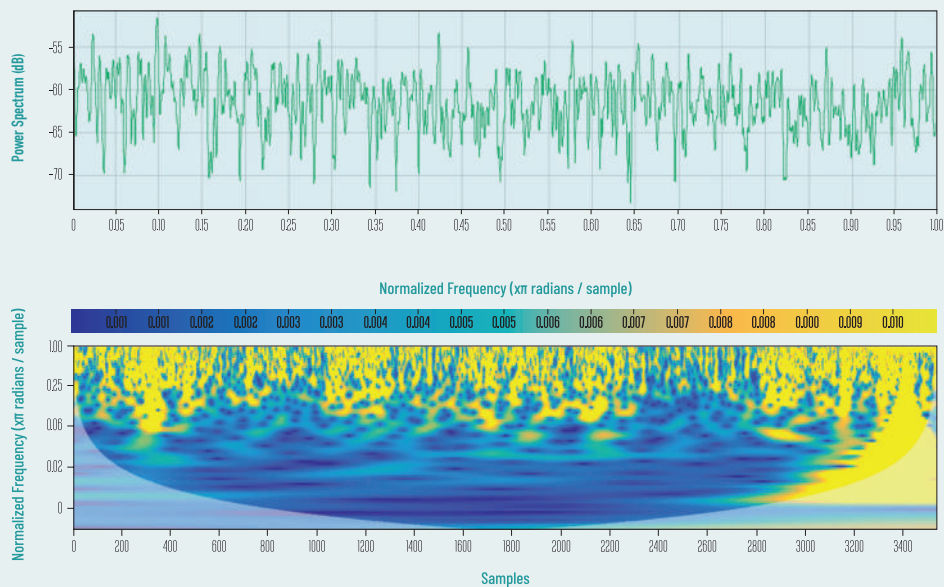
UK ISLAMIC



ARGENTINA

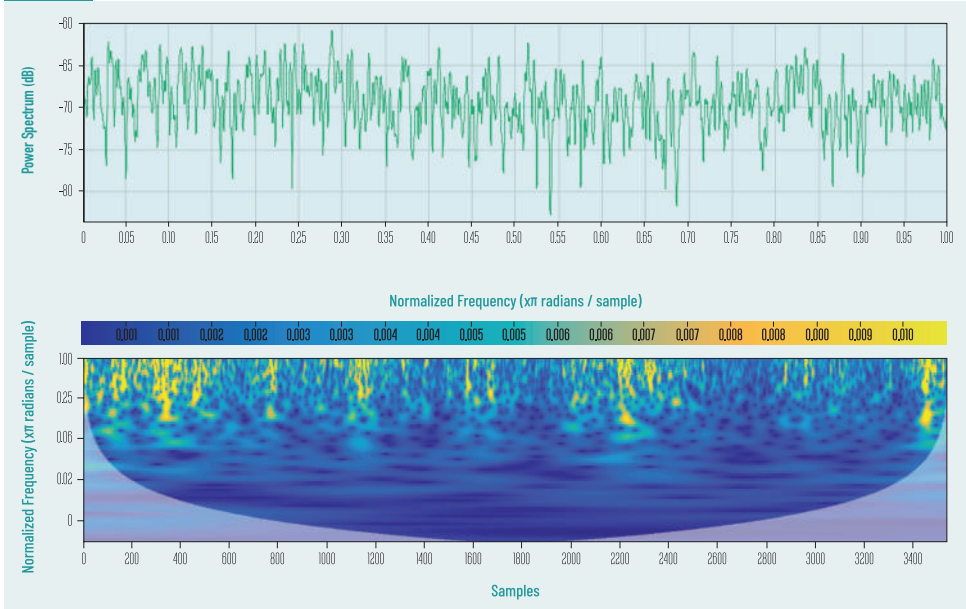


ARGENTINA ISLAMIC

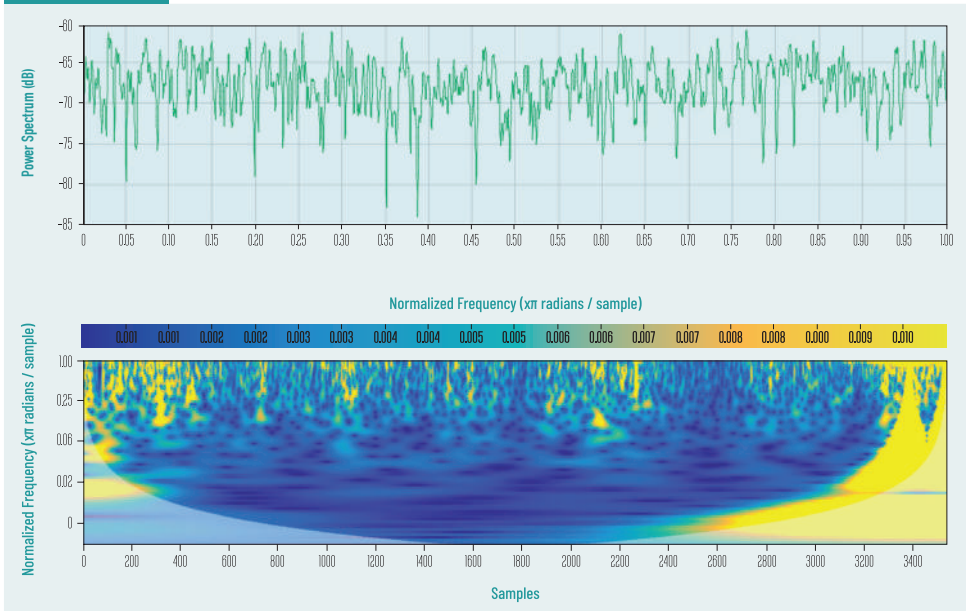


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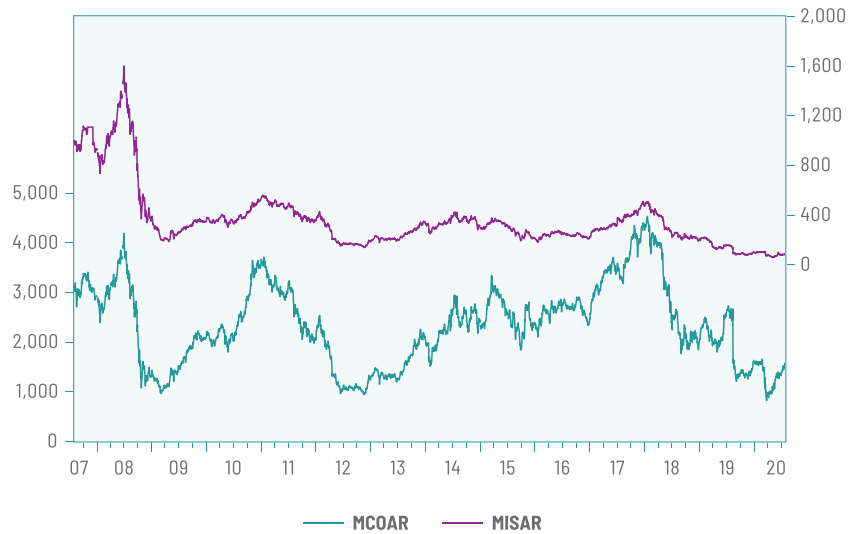
MALAYSIA



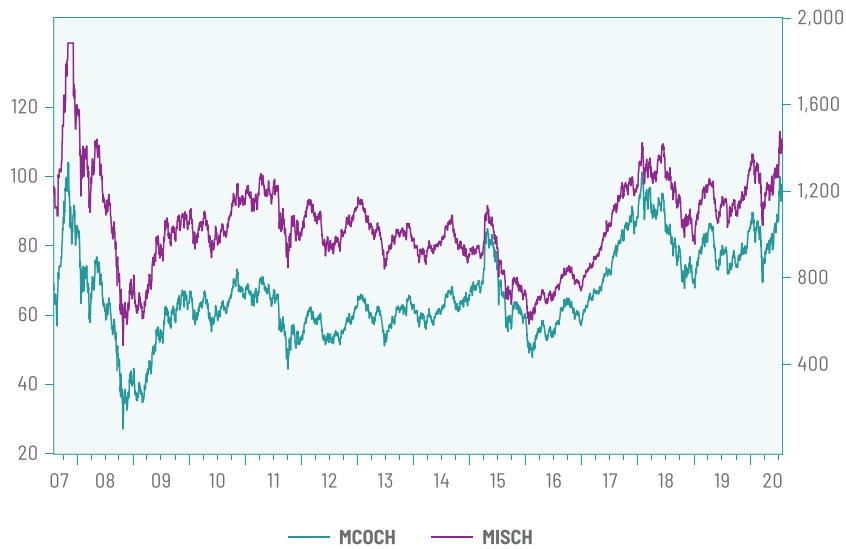
MALAYSIA ISLAMIC



Index Price Graphs-Paired Series

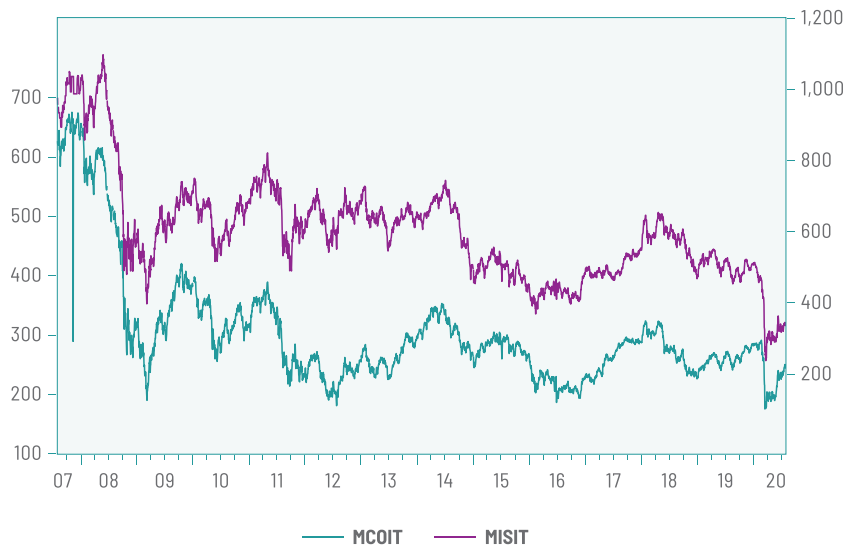


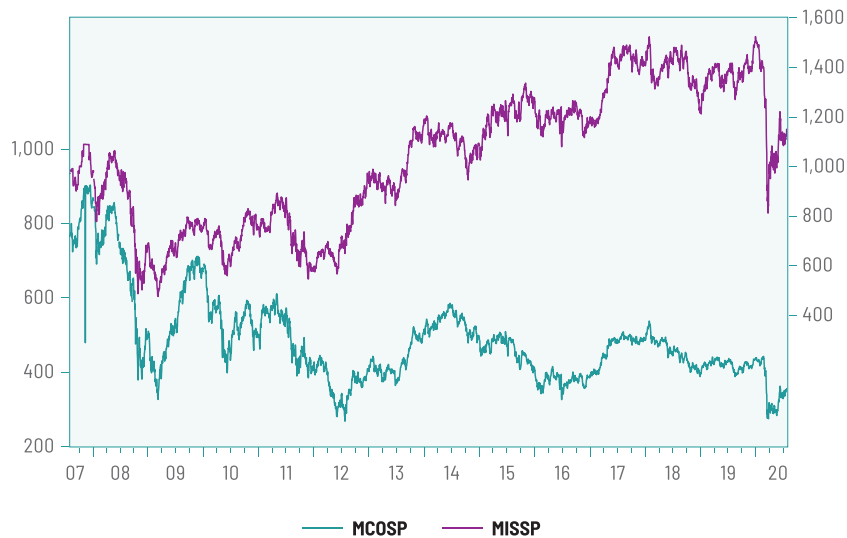
A COMPARISON OF ISLAMIC VS CONVENTIONAL INDICES: A WAVELET BASED APPROACH



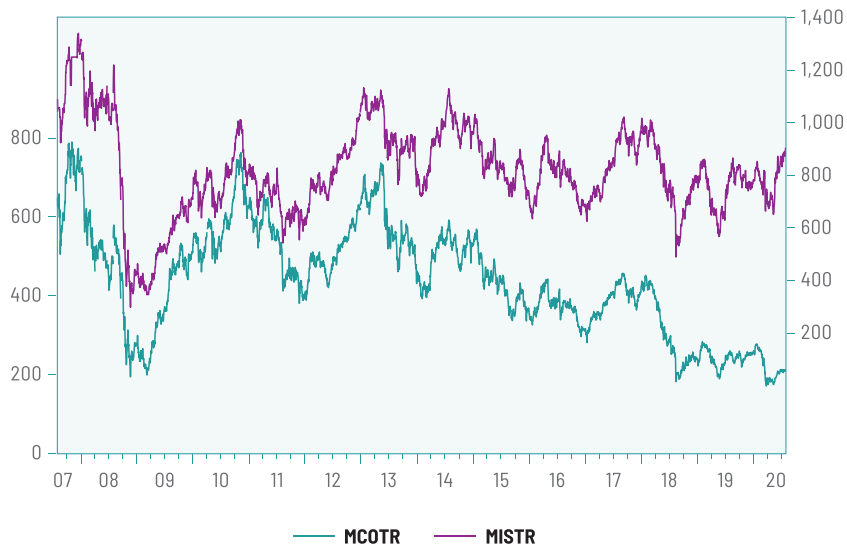
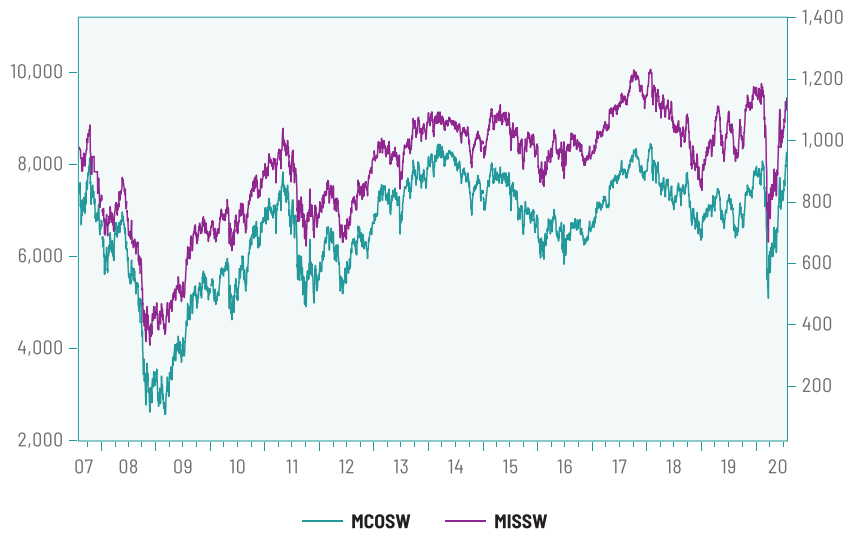


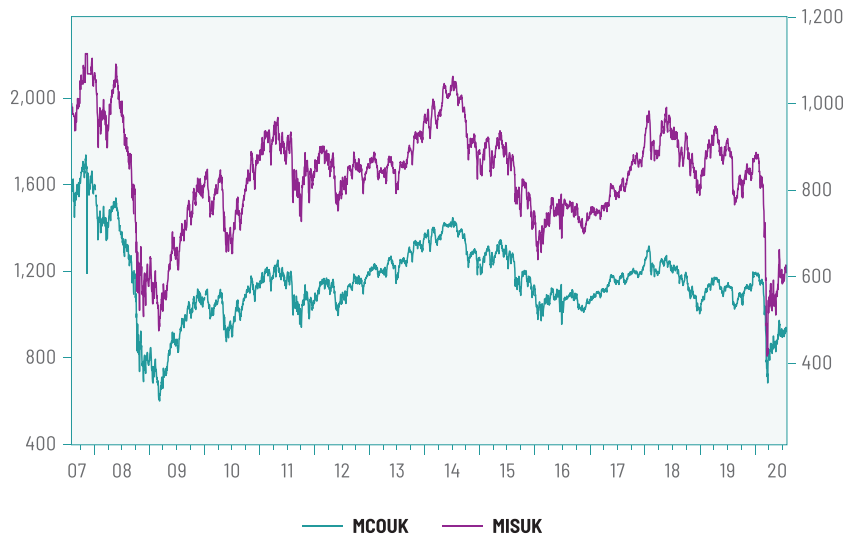
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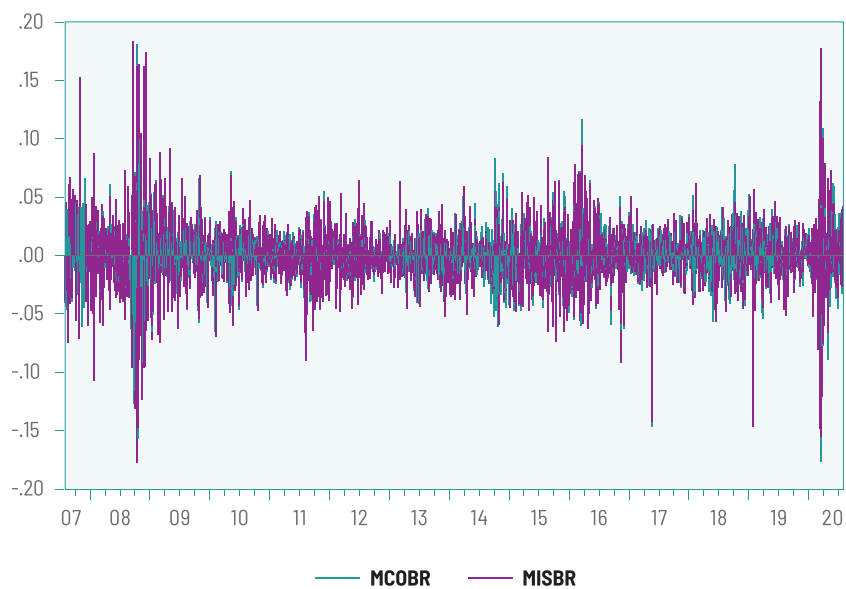
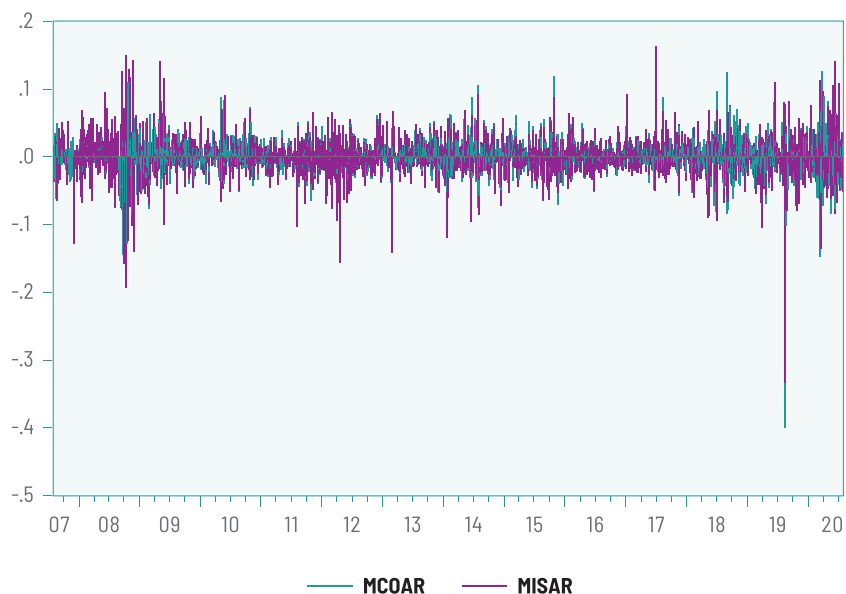


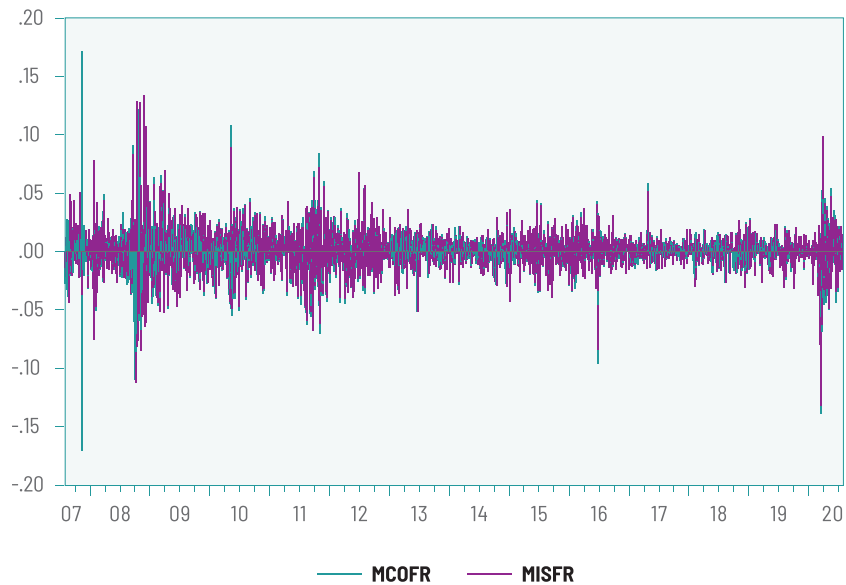
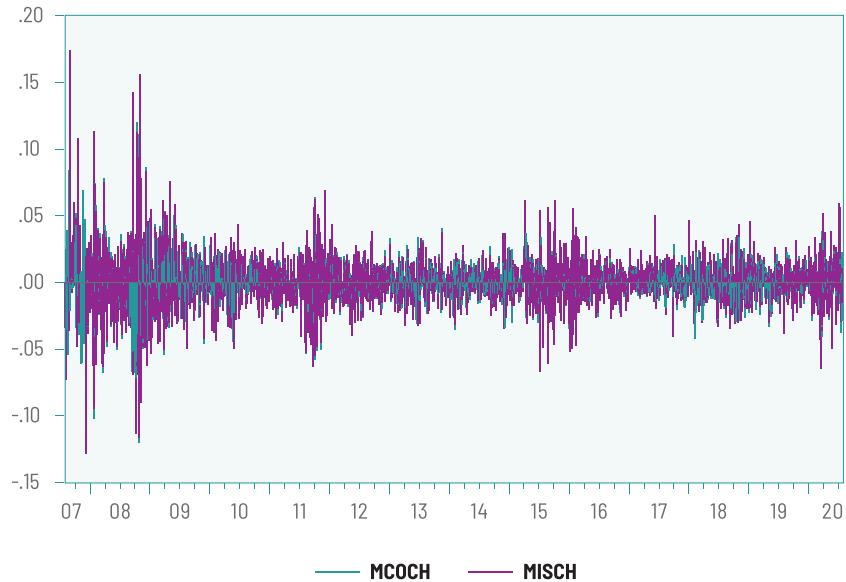
A COMPARISON OF ISLAMIC VS CONVENTIONAL INDICES: A WAVELET BASED APPROACH



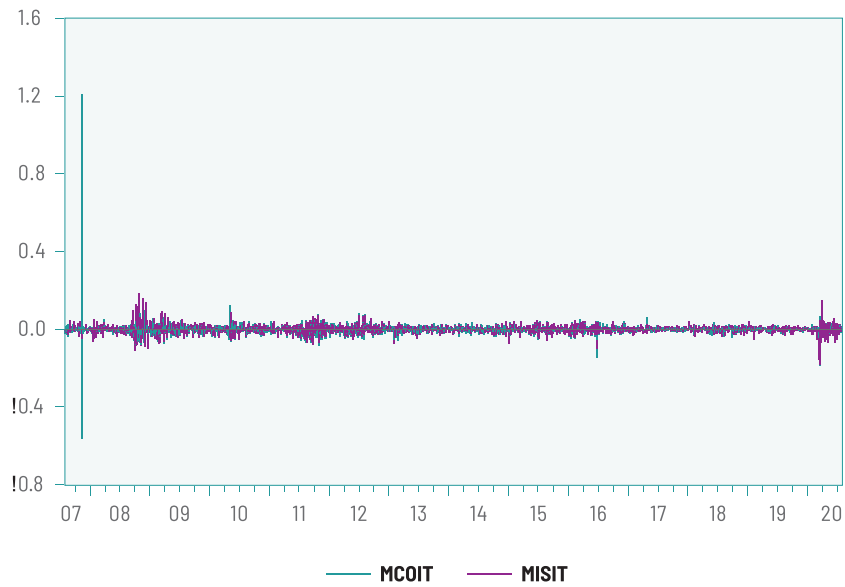
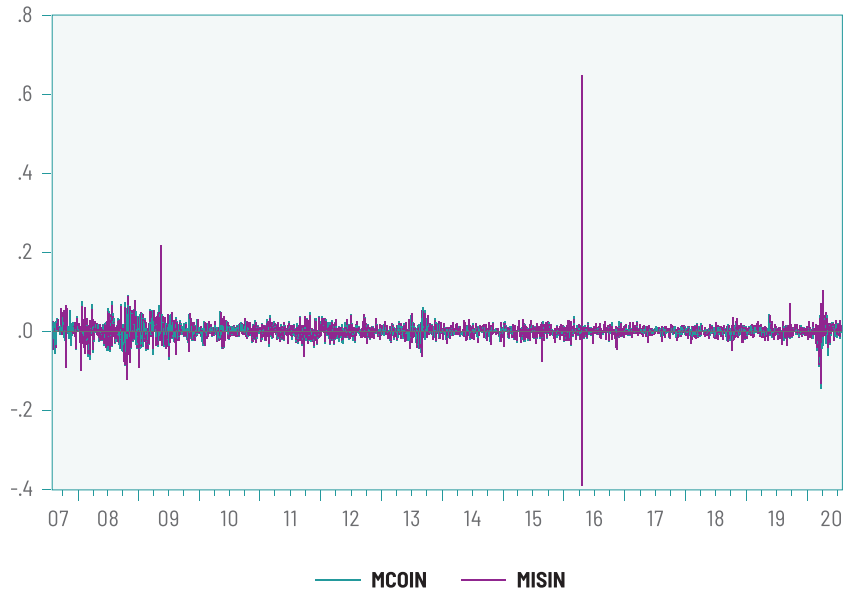


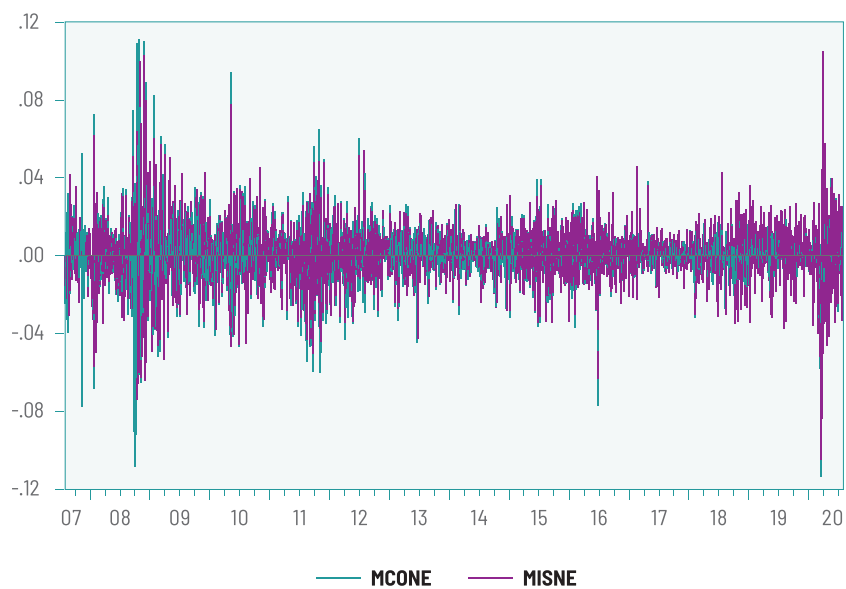
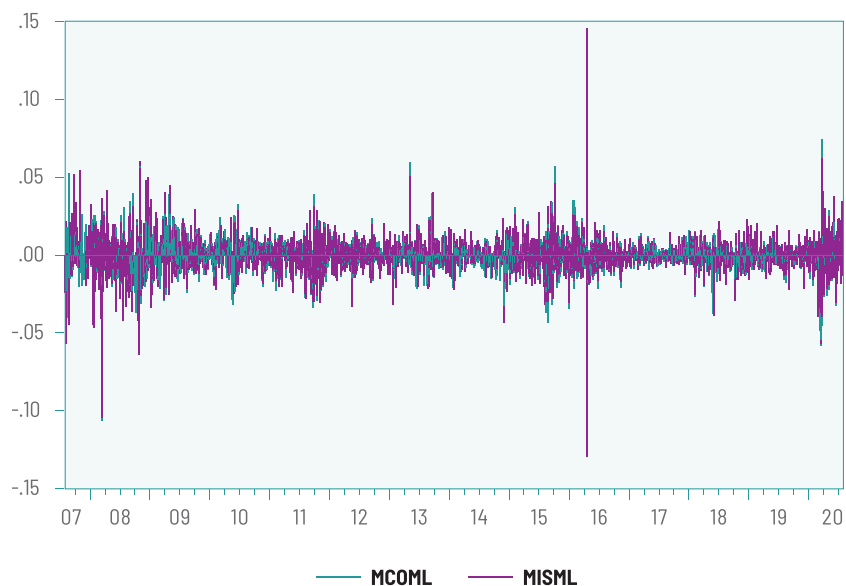
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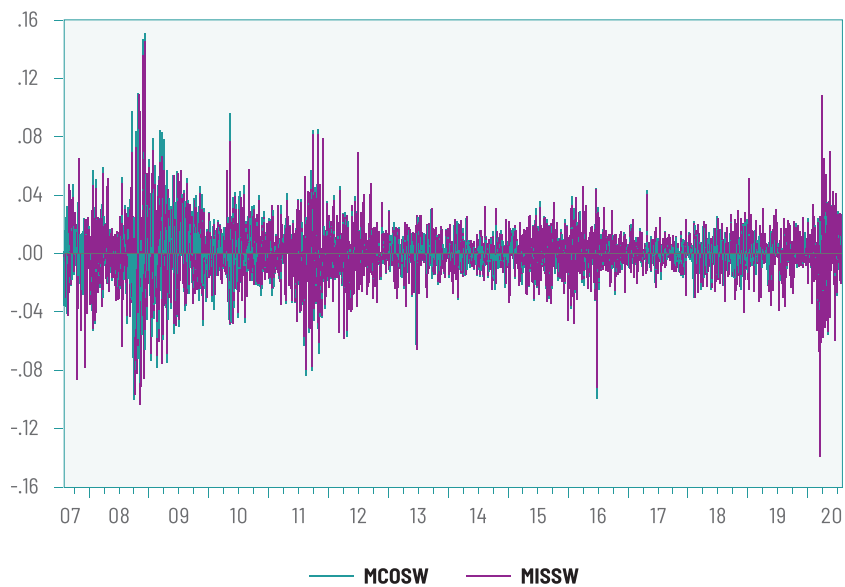
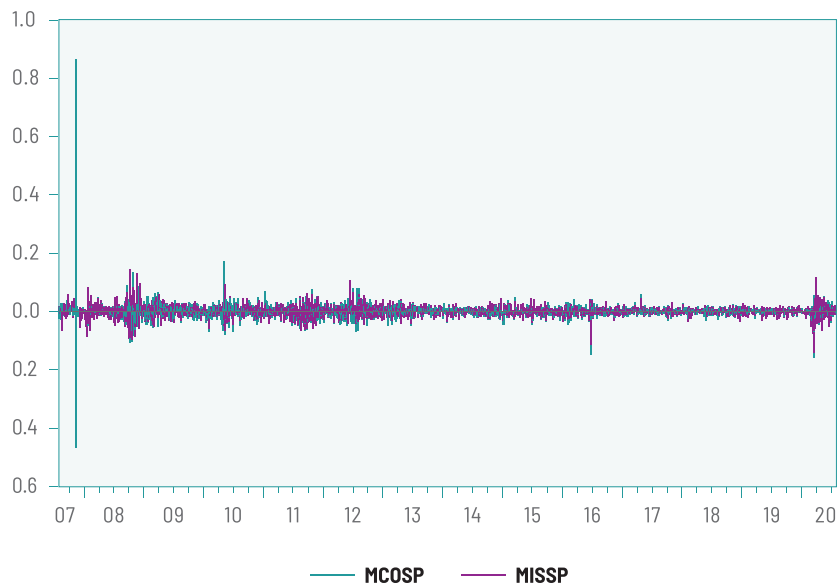


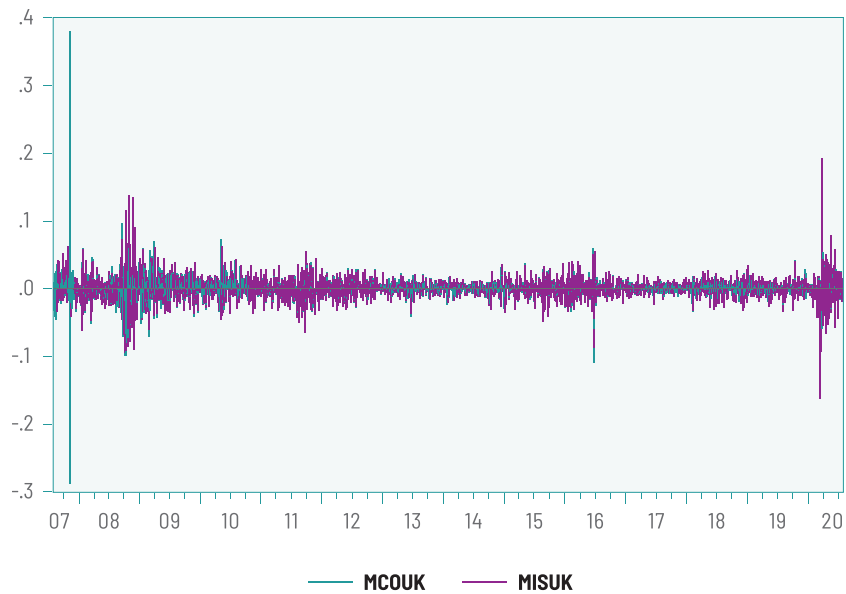
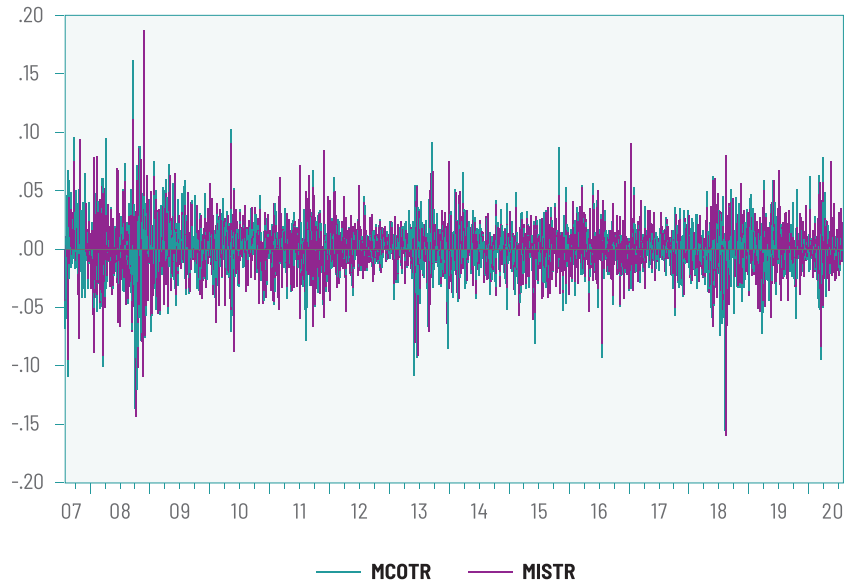
A COMPARISON OF ISLAMIC VS CONVENTIONAL INDICES: A WAVELET BASED APPROACH



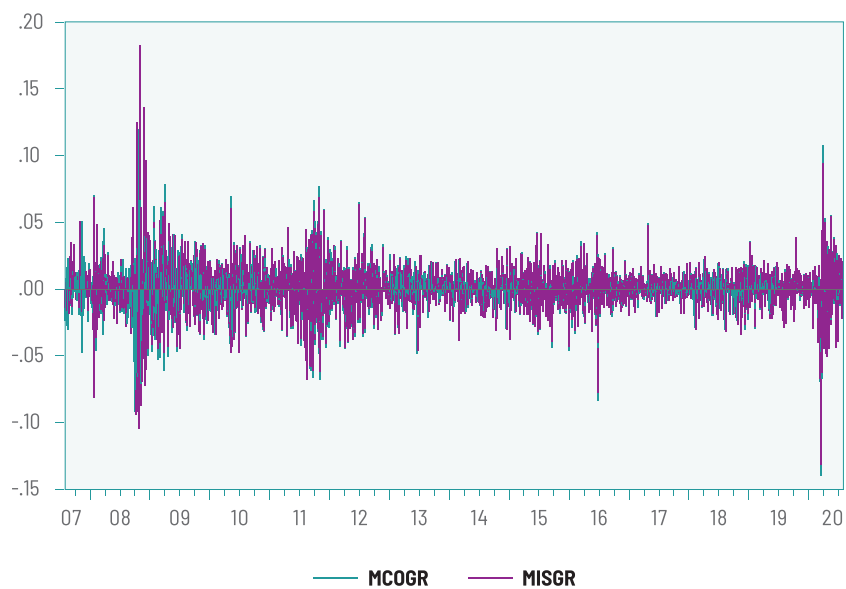
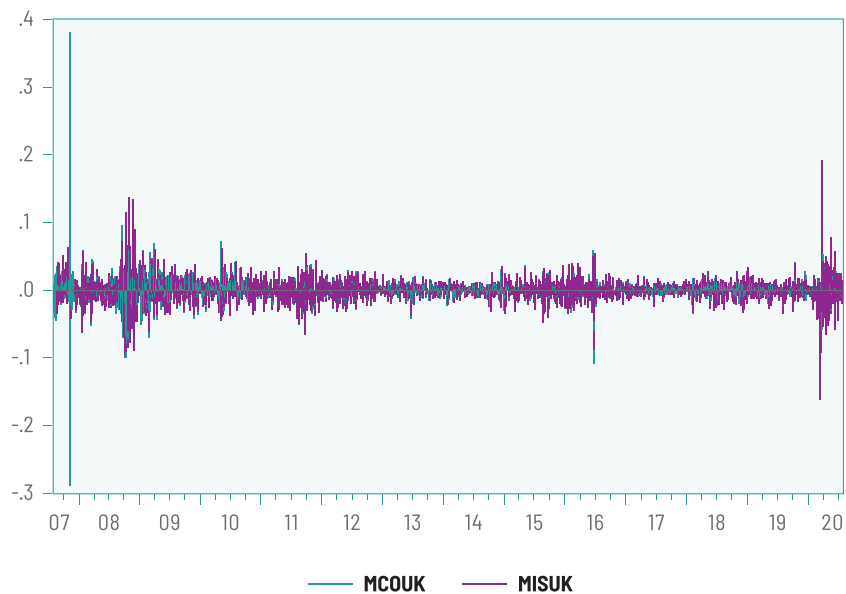


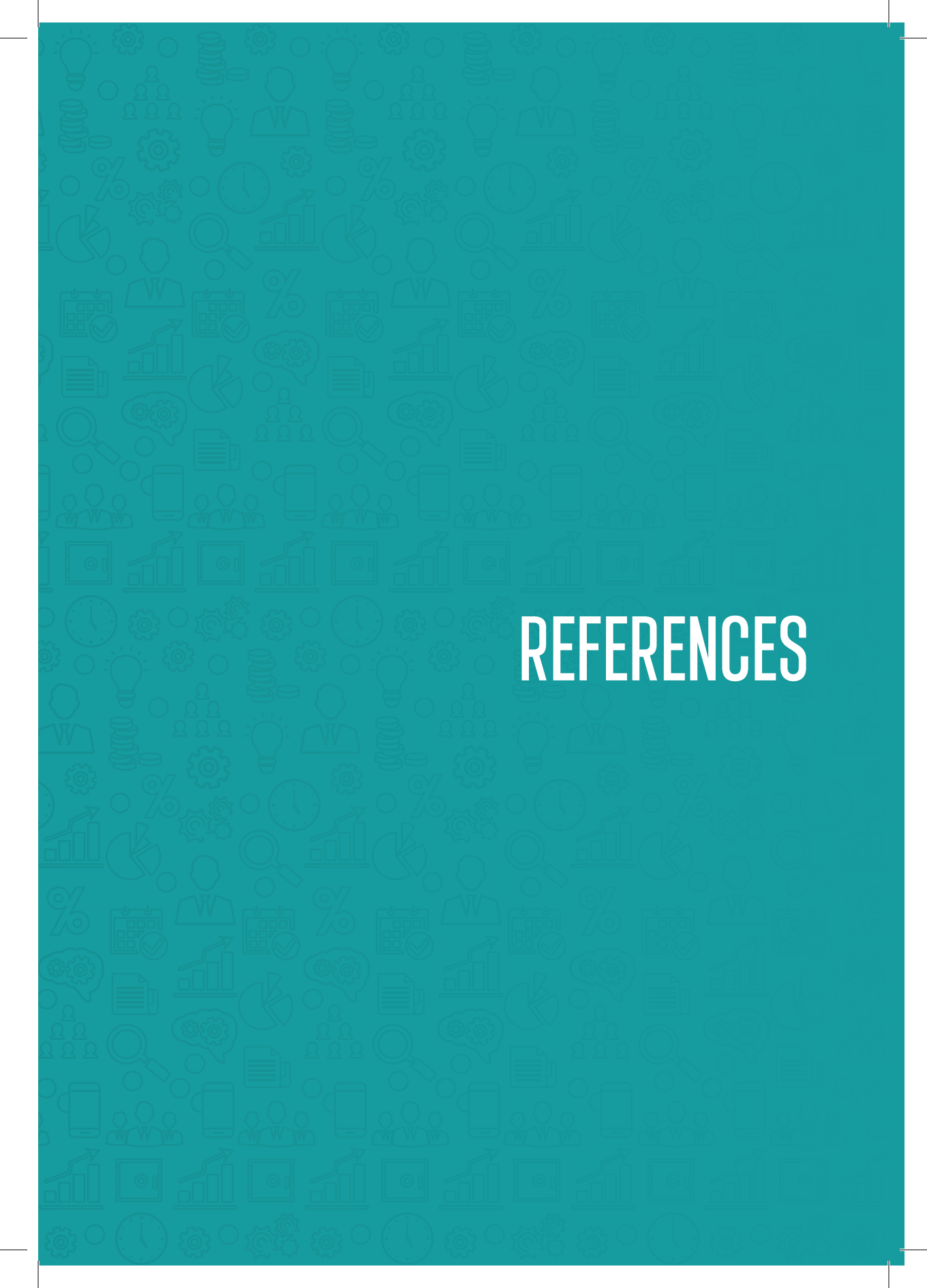
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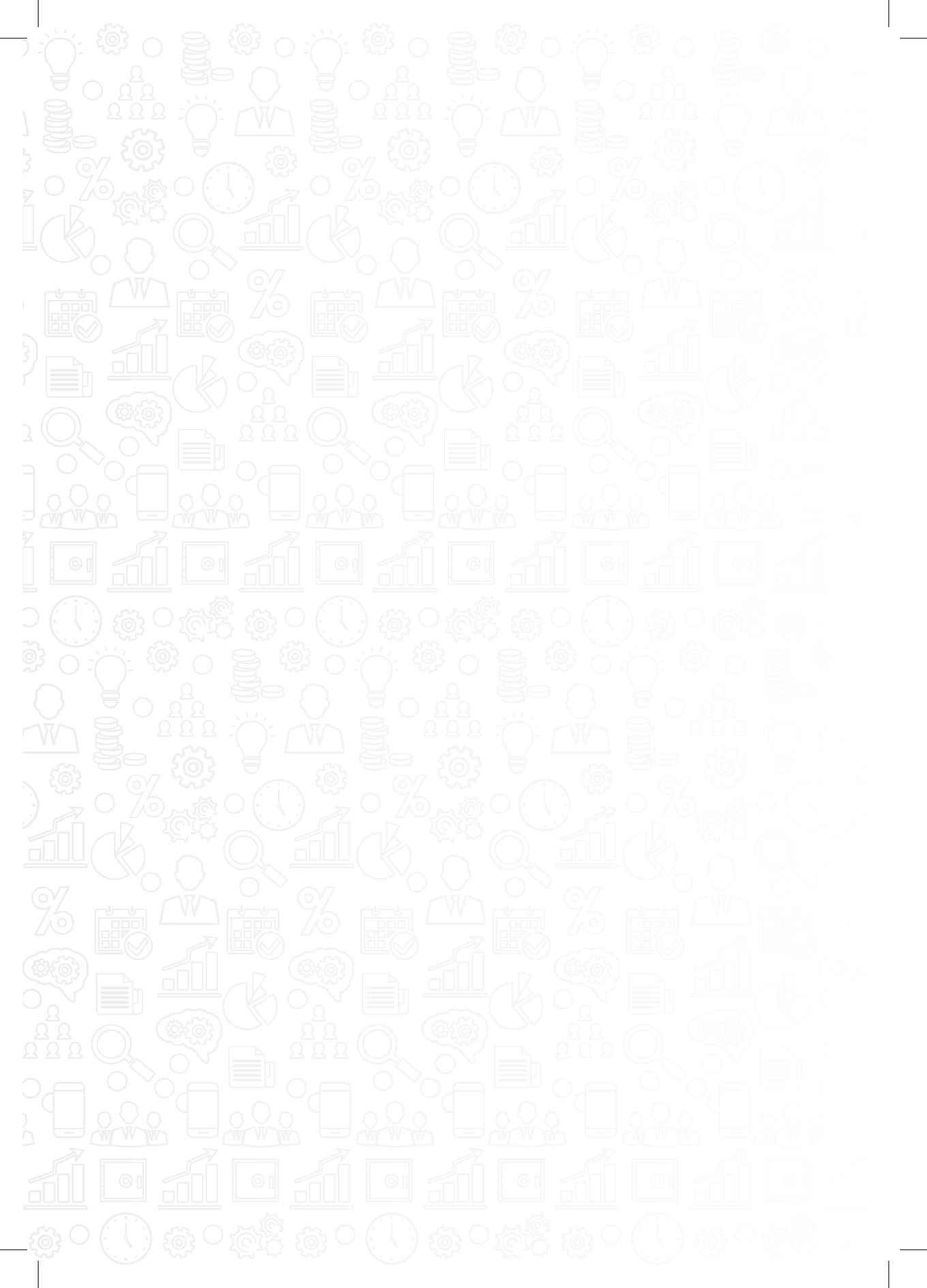


A COMPARISON OF ISLAMIC VS CONVENTIONAL INDICES: A WAVELET BASED APPROACH





REFERENCES



REFERENCES

- Abedifar P., Molyneux P., Tarazi A., (2012) “ Risk Taking in Islamic Banking <https://hal-unilim.archives-ouvertes.fr/hal-00915115>
- Abid F., Kaffel B., (2018) Time–frequency wavelet analysis of the interrelationship between the global macro assets and the fear indexes *Physica A* 490 1028–1045
- Abramovich F., Bailey T.C., Sapatinas T., (2000) Wavelet Analysis and its statistical Applications. *Journal of the Royal Statistical Society. Series D (The Statistician)*, Vol. 49, No. 11-29
- Ahmed H., Khan T., (2005) Risk management in Islamic banking. *Handbook of Islamic Banking* 144-157
- Ajmi A. N., Hammoudeh S., Nguyen D.K, Srafrazi S. (2014) How strong are the causal relationships between Islamic stock markets and conventional financial systems? Evidence from linear and nonlinear tests *Int. Fin. Markets, Inst. and Money* 28 213– 227
- Akhter W., Pappas V., Khan S.U, (2017) A comparison of Islamic and conventional insurance demand:Worldwide evidence during the Global Financial Crisis. *Research in International Business and Finance* 42 1401–1412
- Alam N., Arshad S., Rizvi S.A.R. (2016) Do Islamic stock indices perform better than conventional counterparts? An empirical investigation of sectoral efficiency. *Review of Financial Economics* 31 108–114
- Al-Khazali O, Lean H. H., Samet A, (2014) Do Islamic stock indexes outperform conventional stock indexes? A stochastic dominance approach. *Pacific-Basin Finance Journal* 28 29–46
- Al-Khazali O., Leduc G., Alsayed M.S, (2016) A Market Efficiency Comparison of Islamic and Non-Islamic Stock Indices. *Emerging Markets Finance & Trade*, Vol.52 1587-1605

- Al-Khazali O., Mirzaei A., (2017) Stock market anomalies, market efficiency and the adaptive market hypothesis: Evidence from Islamic stock indices. *J. Int. Financ. Markets Inst. Money* 51 190–208
- Anand B., Paul S., Ramachandran M. (2014) Volatility Spillover between Oil and Stock Market Returns. *Indian Economic Review*, Vol. 49, No. 1 37–56
- Ariss R.T (2010) Competitive conditions in Islamic and conventional banking: A global perspective. *Review of Financial Economics* 19 101–108
- Alaoui A., Diwandaru G., Masih M., Bacha I.O., Musa M. (2015) Wavelet Analysis of Stock Price Behaviour: Evidence from Dow Jones Islamic GCC Stock Index Returns. *Islamic Finance: Performance and Efficiency (Volume 3)* 131–150
- Alaoui C., Hkiri B., Marco Lau C.K., Yarovaya L., (2016) Investors' sentiment and US Islamic and conventional indexes nexus: A time–frequency Analysis. *Finance Research Letters* 19 54–59
- Alkheil Ahmed. A., Khan W.A, Parikh B., Mohanty S.K., (2017) Dynamic co-integration and portfolio diversification of Islamic and conventional indices: Global evidence *The Quarterly Review of Economics and Finance* 66 212–224
- Bahloul S., Mroua M., Naifar N., (2017) The impact of macroeconomic and conventional stock market variables on Islamic index returns under regime switching. *Borsa Istanbul Review* 17–1 62–74
- Bhuiyan A.R., Rahman M.P., Saiti B., Mat Ghani G., (2019) Does the Malaysian Sovereign sukuk market offer portfolio diversification opportunities for global fixed-income investors. Evidence from wavelet coherence and multivariate-GARCH analyses. *North American Journal of Economics and Finance* 47 675–687
- Bilen C., Huzurbazar S., (2002) Wavelet-Based Detection of Outliers in Time Series. *Journal of Computational and Graphical Statistics*, Vol. 11, No. 2 311–327
- Billah Dar A., Bhanja N., Tiwari A.K., (2014) Exchange Rate and Stock Price Relationship: A Wavelet Analysis for India *Indian Economic Review*, Vol. 49, No. 1 125–142
- Berger T., Czudaj R.L., (2019) Commodity futures and a wavelet-based risk assessment. *Physica A* 2–11

- Bouiri E., Shahzad H.J.S., Roubaud d., Kristoufek L., Lucey B., (2020) Bitcoin, gold, and commodities as safe havens for stocks: New insight through wavelet analysis. *The Quarterly Review of Economics and Finance*
- Chang S., Gupta R., Miller S.M., Wohar M.E., (2019) Growth volatility and inequality in the U.S.: A wavelet analysis. *Physica A* 521 48–73
- Charles A., Darne O, Pop A., (2015) Risk and ethical investment: Empirical evidence from Dow Jones Islamic indexes. *Research in International Business and Finance* 35 33–56
- Charles A., Darne O., Kim J.H (2017) Adaptive markets hypothesis for Islamic stock indices: Evidence From Dow Jones size and sector-indices. *International Economics* 151 100–112
- Chen H., Ngo T., (2017) Leverage-based index revisions: The case of Dow Jones Islamic Market World Index. *Global Finance Journal* 32 16–34
- Chen D., Chen W, Chuang C (2009) Multiscale hedge ratio between Taiwan stock and futures index: an application of wavelet analysis. *Investment Management and Financial Innovation Journal* Vol.6 Issue.1
- Çevik E.I., Bagan M.F, (2017) Regime-dependent relation between Islamic and conventional financial Markets. *Borsa Istanbul Review* 1-8
- Conlon T., Cotter J., (2012) An empirical Analysis of Dynamic Multiscale Hedging Using Wavelet Decomposition. *Journal of Futures Markets* Vol.32, No:3 272-299
- Doumpor M., Hasan I., Pasiouras F., (2017) Bank overall financial strength: Islamic versus conventional banks. *Economic Modelling* 64 513–523
- Demiralay S, Bayracı S, Gencer G, (2018) Stock Bond Co-Movements and flight to quality in G7 countries: A time/Frequency Analysis. *Bulletin of Economic Research* 70:1 0307-3378
- Elahi Y., Abd Aziz M.I, (2011) Islamic options (al-Khiyarat); Challenges and opportunities. *International Conference on Information and Finance IPEDR* vol.21 101-104
- El-Askhar A.B.F, (2010) Towards an Islamic Stock Exchange in a Transitional Age. *IDB Research Paper*

- Fun Ho C.S, Abd Rahman N.A, Muhamad Yusuf N.H, Zamzamin Z. (2014) Performance of global Islamic versus conventional share indices: International evidence. *Pacific-Basin Finance Journal* 28 110–121
- Gencay, R., F. Selcuk, and B. Whitcher. (2001) Differentiating intraday seasonalities through wavelet multi-scaling. *Physica A* 289 (3–4):543–56. doi: 10.1016/S0378-4371(00)00463-5.
- Gencay, R., F. Selcuk, and B. Whitcher. (2002) An introduction to wavelets and other filtering methods in finance and economics. San Diego, CA: Academic Press.
- Guyot A., (2011) Efficiency and Dynamics of Islamic Investment: Evidence of Geopolitical Effects on Dow Jones Islamic Market Indexes. *Emerging Markets Finance & Trade* Vol. 47, No. 6 24–45
- Haniff N., Masih A.M, (2018) Do Islamic Stock Returns Hedge Against Inflation? A Wavelet Approach *Emerging Markets Finance & Trade*, 54:2348–2366
- Hsu Ku Y, Chen H, Chen K. “On the application of the dynamic conditional correlation model in estimating optimal time varying hedge ratios” *Applied Economics Letters*, 2007, 14, 503–509
- Hakim S., Rashidian M., (2005) Risk & Return of Islamic Stock Market Indexes. Dept of Finance, Seaver College of Business, Pepperdine University, 2–13
- Hammoudeh S, Mensi W., Reberedo J.C, Nguyen D.K (2014) Dynamic dependence of the global Islamic equity index with global conventional equity market indices and risk factors. *Pacific-Basin Finance Journal* 30 189–206
- Hassan M.K., Aliyu S., (2018) A contemporary survey of islamic banking literature *Journal of Financial Stability* 34 12–43
- Hkiri B., Hammoudeh S., Aloui C., Yarovaya L., (2017) Are Islamic indexes a safe haven for investors. An analysis of total, directional and net volatility spillovers between conventional and Islamic indexes and importance of crisis periods. *Pacific-Basin Finance Journal* 43 124–150
- IFSB Financial Stability Report (2016) www.ifsb.org
- Ibrahim M. H. (2015) Issues in Islamic banking and finance: Islamic banks, Shari’ah-compliant investment and sukuk. *Pacific-Basin Finance Journal* 34 185–191

- In F., Kim S., (2006) Multiscale hedge ratio between the Australian stock and futures markets: Evidence from wavelet analysis. *Journal of Multi. Fin. Manag.* 16 411–423
- Jawadi F., Jawadi N., Louchi W. (2015) Conventional and Islamic stock price performance: An empirical investigation. *Applied Economics*, Vol. 47, No. 16, 1686–1697,
- Jawadi F., Jawadi N., Cheffou A.I (2014) Are Islamic stock markets efficient? A time-series analysis. *International Economics* 13773–87
- Johansen S. (1991) Estimation and Hypothesis Testing of Cointegration Vectors in Gaussian Vector Autoregressive Models. *Econometrica* Vol. 59, No. 6, pp. 1551-1580
- Kabir H.S., Masih M., Mansur A., Bacha I.O., (2017) Risk Return Profiles of Islamic Equities and Commodity Portfolios in Different Market Conditions. *Emerging Markets Finance and Trade* 1-50
- Karabiyik H., Narayan P.K., Phan D.H.B., Westerlund J., (2017) Islamic spot and index futures markets: Where is the price discovery Pacific-Basin Finance Journal <http://dx.doi.org/10.1016/j.pacfin.2017.04.003>
- Karim M.M, Masih M., (2019) Do the Islamic Stock Market Returns Respond Differently to the Realized and Implied Volatility of Oil Prices? Evidence from the Time–Frequency Analysis. *Emerging Markets Finance & Trade*, 1–16,
- Khalfoui R., Boutahar M., Boubaker H., (2015) Analyzing volatility spillovers and hedging between oil and stock markets: Evidence from Wavelet analysis. *Energy Economics* 49 540–549
- Kumar A.S., Anandarao S. (2019) Volatility spillover in crypto-currency markets: Some evidences from GARCH and wavelet analysis. *Physica A* 524 448–458
- Lien D., Shrestha K. (2007) An empirical analysis of the relationship between Hedge Ratio and Hedging Horizon Using Wavelet Analysis. *The Journal of Futures Markets* Vol.27 No:2
- Maharaj E.A, Dark J., Moosa I, Silvapulle P., (2008) Wavelet estimation of asymmetric hedge ratios: Does econometric sophistication boost hedging effectiveness? *International Journal of Business and Economics*, Vol. 7, No. 3, 213-230

- Martínez J.M.P., Macho J.F., Neumann M.B., Faria S.H, (2018) A pre-crisis vs. crisis analysis of peripheral EU stock markets by means of wavelet transform and a nonlinear causality test. *Physica A* 490 1211–1227
- Madjoub J., Mansour W., Jouini J. (2016) Market integration between conventional and Islamic stock prices. *North American Journal of Economics and Finance* 37 436–457
- Madjoub J., Sassi S.B., (2017) Volatility spillover and hedging effectiveness among China and Emerging Asian Islamic equity indexes. *Emerging Markets Review* 31 16–31
- Mc Nevin B.D., Nix J., (2018) The beta heuristic from a time/frequency perspective: A wavelet analysis of the market risk of sectors. *Economic Modelling* 68 570–585
- Mensi W., Tiwari A.K, Yoon S.M (2017) Global financial crisis and weak-form efficiency of Islamic sectoral stock markets: An MF-DFA analysis. *Physica A* 471 135–146
- Mensi W., Hammoudeh S., Sensoy A., Yoon S.M., (2016) Analysing dynamic linkages and hedging strategies between Islamic and conventional sector equity indexes. *Applied Economics*, 2-23
- Merry R.J.E, (2005) Wavelet Theory and Applications. Eindhoven University of Technology Department of Mechanical Engineering 2-40
- Meslier C., Risfandy T., Tarazi., (2017) Dual market competition and deposit rate setting in Islamic and conventional banks. *Economic Modelling* 63 318–333
- Mnasri A.,Nechi S., (2016) Impact of terrorist attacks on stock market volatility in emerging markets. *Emerging Markets Review* 28 184–202
- Muteba Mwamba J.W, Hammoudeh S, Gupta R. (2014) Financial tail risks in conventional and Islamic stock markets: A comparative analysis. *Pacific-Basin Finance Journal* 28 110–121
- Naifar N., (2016) Do global risk factors and macroeconomic conditions affect global Islamic index dynamics? A quantile regression approach. *The Quarterly Review of Economics and Finance* 61 29–39

- Najeeb S.F, Bacha O., Masih M. (2017) Does a held to maturity Strategy Impede Effective Portfolio Diversification for Islamic Bond Portfolios? A multi-scale Continuous Wavelet Correlation Analysis. *Journal of emerging Markets Finance & Trade* 53 2377-2393
- Narayan P.K, Phan D.H.B (2016) Momentum Strategies for Islamic Stocks. *Pacific Basin Finance Journal*,
- Narayan P.K, Phan D.H.B, Sharma S.S, Westerlund J. (2016) Are Islamic stock returns predictable? A global perspective. *Pacific-Basin Finance Journal* 40 210-223
- Nasr A.B., Lux T., Ajmi A.N., Gupta R. (2016) Forecasting the volatility of the Dow Jones Islamic Stock Market Index: Long memory vs. regime switching *International Review of Economics and Finance* 45 559-571
- Obaidullah M., (1999) Financial Options in Islamic Contracts: Potential Tools for Risk Management. *J.KAU: Islamic Econ.*, Vol. 11, 3-26
- Obaidullah M., (1998) Financial Engineering with Islamic Options. *Islamic Economic Studies* Vol. 6, No. 1, 73-103
- Osu B.O., Okonkwo C.U., Uzoma P.U., Akpanibah E.E., (2020) Wavelet analysis of the international markets: A look at the next eleven (N11) *Scientific African* 73-19
- Rizvi S.A.R., Arshad S., (2017) Understanding time-varying systematic risks in Islamic and conventional sectoral indices. *Economic Modelling* 1-10 <https://doi.org/10.1016/j.econmod.2017.10.011>
- Saiti B., Bacha I.O., Masih M., (2014) The diversification benefits from Islamic investment during the financial turmoil: The case for the US-based equity investor. *Borsa Istanbul Review* 14-4 196-211
- Sensoy A., Aras G., Hacihasanoğlu E., (2015) Predictability dynamics of Islamic and conventional equity markets. *North American Journal of Economics and Finance* 31 222-248
- Shahzad S.J.H., Ferrer R., Ballester L., Umar Z., (2017) Risk transmission between Islamic and conventional stock markets: A return and volatility spillover analysis. *International Review of Financial Analysis* 52 9-26
- Shamsuddin A, (2014) Are Dow Jones Islamic equity indices exposed to interest rate risk?. *Economic Modelling* 39 273-281

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A WAVELET BASED APPROACH

- Svensson M., Krüger N.A (2012) Mortality and economic fluctuations: Evidence from wavelet analysis for Sweden 1800–2000. *Journal of Population Economics*, Vol. 25, No. 4 1215–1235
- Taş O., Gürsoy Ö.Z., (2016) Fuzzy Logic Based Technical Indicator for BIST 30 Index and Islamic Index *Procedia Economics and Finance* 38 203 – 212
- Trabelsi N., Naifar N. (2017) Are Islamic stock indexes exposed to systemic risk? Multivariate GARCH estimation of CoVaR. *Research in International Business and Finance* 42 727–744
- Yee Ling Boo, Mong Shan Ee, Bob Li, Mamunur Rashid (2016) Islamic or conventional mutual funds: Who has the upper hand? Evidence from Malaysia” *Pacific Basin Finance Journal*,
- Zarembo A., Umar Z., Mikutowski M., (2019) Inflation hedging with commodities: A wavelet analysis of seven centuries worth of data. *Economics Letters* 181

