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The Relative Risk Performance of the Islamic Sukuks over the Conventional Bonds: New Evidence from Value at Risk Approach

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Declaration of Original Work

I, Mariam Hareb Humaid Belhaymah Aldhaheri, the undersigned, a graduate student at the United Arab Emirates University (UAEU), and the author of this dissertation entitled "*The Relative Risk Performance of the Islamic Sukuks over the Conventional Bonds: New Evidence from Value at Risk Approach*", hereby, solemnly declare that this dissertation is my own original research work that has been done and prepared by me under the supervision of Professor Aktham AlMaghaireh, in the College of Business and Economics at UAEU. This work has not previously been presented or published, or formed the basis for the award of any academic degree, diploma or a similar title at this or any other university. Any materials borrowed from other sources (whether published or unpublished) and relied upon or included in my dissertation have been properly cited and acknowledged in accordance with appropriate academic conventions. I further declare that there is no potential conflict of interest with respect to the research, data collection, authorship, presentation and/or publication of this dissertation.

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Abstract

Sukuk are financial instruments similar to bonds that are compliant with Shari'ah (Islamic law). Since their inception in 2002, sukuk markets have experienced dramatic growth rates, attracting the attention of investors, analysts, and researchers alike. Despite Islamic bonds (thereafter termed sukuk) successfully holding their place in the international bond markets, this dissertation's literature survey reveals that few empirical studies have undertaken a risk analysis of sukuk markets from the investors' perspectives. Conventional bonds and sukuk as financial instruments are both exposed to various types of financial and market risks. This dissertation's purpose is to engage in a risk analysis of sukuk markets compared with conventional bonds. Using a value at risk (VaR) approach, we examine whether sukuk are exposed to higher market risks than conventional bonds. In addition, we investigate whether the inclusion of sukuk in investment portfolios provides a diversification benefit to individual investors. We find that, for a given issuer, a conventional bonds' VaR is significantly higher than that of sukuk, indicating that sukuk are less risky. We also find evidence of persistent sukuk illiquidity. We further show that introducing a sukuk allocation to a bond portfolio improves the risk–return trade-off. This dissertation's findings have important policy implications for investors and Islamic bond issuers. Moreover, they are of particular importance to policy makers.

Keywords: Islamic finance, conventional bonds, Islamic bonds, sukuk, VaR, hedging analysis.

Title and Abstract (in Arabic)

أداء الصُّكُوك الإسلامية مقارنة بالسندات التقليدية: أدلَّة جديدة؛ باستخدام طريقة القيمة المعرضة للخطر

الملخص

الصُّكُوك هي أدوات ماليَّة، مماثلة للسندات، التي تتوافق و أحكام الشريعة الإسلامية. فمنذ تأسيسها في عام 2002، شهدت أسواقُ الصُّكُوك معدَّلات نموٍّ كبيرة جذبت انتباه المستثمرين، والمحللين، والباحثين على حدٍّ سواء. وعلى الرغم من السندات الإسلامية التي حافظت بنجاح على مكانتها، في أسواق السندات الدوليَّة التي سُمِّيَتْ ـ فيما بعد ـ بالصُّكُوك إلا أنَّ هناك دراساتٍ تجريبية محدودة، اقتصرت على تحليل مخاطر سُوق الصُّكُوك ؛ من وجهة نظر المستثمرين. إن السندات التقليدية، والصُّكُوك الإسلامية ـ كأدوات ماليَّة ـ معرضة لأنواع مختلفة من المخاطر المالية، والسوقية. والغرض من هذه الرسالة، هو استكشاف تحليل مخاطر سُوق الصُّكُوك الإسلامية، مقارنة بالسندات التقليدية. وباستخدام طريقة القيمة المعرضة للخطر، نقوم بدراسة ما إذا كانت الصُّكُوك تتعرض لمخاطر سوق أعلى من السندات التقليدية. وبالإضافة إلى ذلك، فإننا نحقق فيما إذا كان إدراج الصُّكُوك في محفظة الاستثمار سوف يوفِّر منافع التنويع للمستثمرين الأفراد. ونجد أنه بالنسبة لمصدر معين، فإن القيمة المعرضة للخطر للمخاطر التقليدية أعلى بكثير من القيمة المعرضة للخطر في الصُّكُوك ، الأمر الذي يشير إلى أن الصُّكُوك أقلُّ خُطُورة. كما نجد أدلة على استمرار عدم السيولة في الصُّكُوك . كما نوضح أن إدخال مخصصات صكوك لمحفظة السندات يُحسِّن من العلاقة بين المخاطر، والعائد. والنتائج التي تسعى إليها هذه الأُطروحة لها تأثير مهم في السِّياسة العامة، بالنسبة للمستثمرين، ومصدري السندات الإسلامية. وعلاوة على ذلك، فهي ذات أهميَّة خاصَّة لصانعي السياسات الاقتصادية.

مفاهيم البحث الرئيسية: التمويل الإسلامي، سندات تقليدية، سندات إسلامية، صكوك، القيمة المعرضة للخطر.

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Special thanks go to my parents, brothers, and sisters who helped me along the way. I am sure they suspected it was endless.

Dedication

To my beloved parents and family

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Chapter 1: Introduction

1.1 Orientation of the Thesis

An analysis of markets worldwide shows that the financial markets of Islamic countries have been growing rapidly, by 15% annually, compared with the global financial market.[1] This growth is believed to represent the fastest growing section of the global financial market; moreover, nothing indicates that the trend will slow down in the near future (Chong & Liu, 2009). Such growth may simply be because the region is an "emerging market" that has been developing slowly for the last five to six decades and is now able to catch up with more matured countries such as China, India, and Brazil. Further, over the last decade, investors have seen an unparalleled increase in financial institutions supporting Islamic markets and the widespread issuing of Islamic bonds called sukuk (Christophe, Turk-Ariss, & Weill, 2013). Sukuk are Islamic investment debt. Defining them in this way is vital since sukuk should not be seen merely as a substitute for conventional securities that are interest-based. Sukuk investments generally aim to introduce a new brand of monetary products that mimic fixed-rate debts, floating rate notes, and bonds that are similar to those used by traditional monetary markets worldwide (Cakir & Raei, 2007; Godlewski & Weill, 2010). However, sukuk are firmly linked with Shari'ah (Islamic law) (Ayman & Christopher, 2007).

The sukuk market has been growing tremendously since its inception. However, debate is continuing among scholars regarding the distinction between

[1] The Global University of Islamic Finance (INCEIF) reports that the global Islamic finance industry was worth approximately US$2.1 trillion in 2014. The industry is predicted to reach US$6.5 trillion by 2020 (http://www.inceif.org/industry-growth/).

sukuk and its conventional counterpart. This thesis aims to assess the difference between sukuk and conventional bonds by capturing any additional diversification benefits that can be gained by adding sukuk to conventional fixed income portfolios. Further, it evaluates the risks associated with sukuk and compares these with the risks of conventional bonds issued by the same issuer. I employed the value at risk (VaR) approach to achieve this goal. This study's findings suggest that sukuk and conventional bond prices display different behaviors in the secondary market. They also confirm, in accordance with prior literature, the diversification gains achievable by adding sukuk to conventional bond portfolios.

Fixed-income Islamic securities are potentially as useful to investors as conventional bonds. Moreover, for non-Muslim investors and who already own conventional bonds, the acquisition of sukuk presents an "applauded" new brand asset that gives them greater economic diversity and conceivably reduces their risks (Hesse, Jobst, & Sole, 2008). However, it is clear that investing in sukuk conveys numerous kinds of risks, including the risk of default, which affects interest rates that could change as reflected in the debit mechanism, and a risk to the investor's credit rating. These risks could help investors to assess their future prospects of payments with regard to specific sukuk issues (Zakaria, Isa, & Abidin, 2012). Nevertheless, there are additional risks that could arise because of interest rate changes and the debt instrument being represented in a currency other than the investor's own. These risks are collectively called market risk. They may occur with all kinds of commodities, ranging from oil to precious metals, or to equities and debt tools (Tariq & Dar, 2007).

Recent literature on Islamic finance has focused mainly on the characteristics of these markets and on the relative performance of the Islamic finance industry

(banks) compared with the conventional counterpart (e.g., Abdullah, Hassan, & Mohamad, 2007; Beck, Demirguc-Kunt, & Merrouche, 2013; Hayat & Kraussl, 2011; Hussein & Omran, 2005; Jawadi, Jawadi, & Louhichi, 2014; Karim, Lee, Karim, & Jais, 2012). However, very few studies have empirically focused on analyzing relative performance in terms of the market risk associated with sukuk compared with the conventional counterpart. For example, Cakir and Raei (2007) investigate sukuk price behavior and found a genuine difference. Using the case of sovereign sukuk and Eurobonds from a similar issuer, they estimated and compared the VaR for a portfolio that included both instruments with a portfolio that contained only Eurobonds. The results indicated a lower VaR when sukuk were added to the portfolio, demonstrating sukuk's diversification benefits. Similarly, Ramasamy, Yan, and Schmidt (2011) find that sukuk are less risky than conventional bonds. Godlewski, Turk-Ariss, and Weill (2011), however, suggest no significant market reaction to conventional bond issues but a significantly negative stock market reaction to sukuk.

This thesis seeks to extend the current literature on market risk in general and contribute to the literature on Islamic investments in particular. It examines the market risk associated with sukuk and compares it with the risk of the conventional counterpart. Specifically, the objectives of this research are to provide a broad, theoretical description of the risks and their characteristics, and estimate the market risk of sukuk. The thesis also assesses whether including sukuk in a bond portfolio investment provides diversification advantages for investors.

1.2 Motivation for the Thesis

This study was undertaken mainly because of the limited availability of empirical literature on Islamic sukuk. Research in this area has become essential

because of the recent attention received by this financial instrument. Investors are looking for safe, reliable, and Shari'ah-compliant investment vehicles, especially in Asia and the Gulf region. Additionally, sukuk have now become a preferred source of financing for many countries as opposed to conventional bonds (Ab Majid, Shahimi, Hafizuddin, & Hafizuddin-Syah, 2010; Al-Ajmi, Al-Saleh, & Hussain, 2011). Given such attention, sukuk transactions have shown solid growth from US$8 billion to more than US$251 billion over the last decade (DinarStandard, 2013). Further, various institutions, advisors, and experts have become interested in providing sukuk investment services to conventional investors as well as corporations and governments (Cakir & Raei, 2007). In the following chapters, we first compare sukuk to conventional bonds, then discuss in detail the risks associated with them.

1.3 Research Significance and Contributions

This research adds to the literature in the area of Islamic finance. It is perhaps the first comprehensive empirical research on the risks of Islamic sukuk. The research goes to the core of the controversy regarding the market risk associated with sukuk as a distinctive financing tool compared with other traditional tools. While there have been several empirical studies comparing the risk and profitability of Islamic and conventional bonds, the market risk performance of sukuk has remained largely unexplored. This study seeks to expand knowledge, clarify misconceptions, and provide guidance related to sukuk's potential market risk compared with the risk associated with conventional bonds. In sum, this research delivers an abstract work that can be used as a benchmark for further research.

This dissertation includes comprehensive theoretical definitions and aspects of sukuk-associated risks. Moreover, it uses the VaR approach to evaluate and measure

the market risk of sukuk. This study's outcome has important policy implications for investors and Islamic bond issuers. With regard to investors, it provides evidence about whether sukuk offer less risk than conventional equivalents, whether adding sukuk to their portfolios provides diversification benefits, and whether they should invest in sukuk funds to improve their portfolios' performance.

Sukuk issuance is encouraged by governments in Muslim countries for at least two reasons. First, there is widespread evidence that efficient capital markets foster economic growth. A well-organized and liquid sukuk market can therefore boost economic growth while being consistent with Shari'ah. Although the link between capital markets and economic growth can apply to all instruments (sukuk as well as conventional bonds), sukuk have added features that make them particularly attractive from a public policy perspective: Shari'ah compliance, economic system stability, reduced moral hazard and adverse selection problems, and an economic system more conducive to poverty alleviation. Second, this study shows that sukuk carry less market risk than conventional bonds.

International investors who do not specifically pursue Shari'ah-compliant investment objectives can also benefit from allocating part of their resources to sukuk. This study shows that sukuk are proving to be an excellent diversifier for a bond portfolio and improve significantly the risk–return tradeoff, as measured by the Sharpe ratio.

1.4 Research Objectives

This study's overall objective is to analyze and compare the market risk of sukuk and compare it to the risk of conventional bonds. The key objectives are as follows:

1. To examine whether including Islamic sukuk in a bond portfolio will reduce market risk.
2. To evaluate whether Value at Risk approach (VaR) is an appropriate method to measure the market risk of sukuk and conventional bonds.

1.5 Research Questions

This research aims to answer the following questions along with any other secondary questions that may arise throughout the study.

1. Do sukuk expose investors to higher market risk than conventional bonds?
2. Is the VaR approach a good method to measure and evaluate the market risk of sukuk and conventional bonds?
3. Does investing in sukuk provide viable diversification benefits for investors?

1.6 Research Hypotheses

This dissertation empirically examines the following null hypotheses.

H1: The market risk of sukuk is less than that of conventional bonds.

H2: VaR is a proper measure for calculating the market risk of sukuk.

H3: Including sukuk in investment portfolios provides additional diversification benefit to investors.

Because risk is a core concern in this study, a comparative analysis is carried out to investigate the risks of conventional bonds compared with sukuk. Thus, because of the nature of the study, a quadratic (econometric) paradigm will be followed. The empirical findings are compared with existing theories and the limited empirical studies available on this topic. Theoretically, we can argue that Islamic sukuk may be less risky than conventional bonds for the following reasons.

1. Islamic sukuk offer investors cash flow products, often not closely related to the market's interest rate, which tend toward a sustainable average; thus, they are less sensitive to the fluctuations in market's interest rate.
2. The sukuk market remains relatively isolated from most other financial markets and, thus, is less risky when compared with bonds.
3. Shari'ah principles require certain ethical business practices, underlying productive assets, equitable risk sharing, and the avoidance of speculative trading, all of which may make sukuk subject to less market risk when compared with stock markets.
4. Foreign exchange principles applicable to sukuk with an underlying asset are denominated in one currency and sukuk certificates issued in another currency. As suggested by Tariq & Dar (2007), exchange-rate fluctuations in this case can lead to losses for the investor or issuer.
5. Sukuk may be exposed to a price risk of their underlying assets in a secondary market, which may result in decreased risk.

1.7 Data and Research Methodology

The management and evaluation of risks is a major issue for financial institutions. The total capital requirement for a financial institution in the context of

market risk is described as the total of the requirement for positions in foreign exchange, equities, interest rates, commodities, and gold. The most popular and traditional measure of risk is variance or the standard deviation (volatility) of a distribution. The main problem with this measure, however, is that it does not consider the direction of an investment's movement; a financial asset can be volatile because it suddenly jumps higher. Further, for investors, risk is about the odds of loss rather than gains. A much better approach is risk's focus on the tail of distribution of portfolio returns; namely, Value at Risk approach (VaR). Value at risk approach is the degree of loss on a portfolio that the investor expects to be maintained at the same level or beyond, while keeping a margin of small probability. Thus, this risk measure could be regarded as a forecast of a given percentile, mostly in the lower tail, of the probability distribution of portfolio returns. The significance of VaR as a measurement of financial market risk is highlighted by the fact that financial institutions have been obligated by the Basel Committee on Banking Supervision at the Bank for International Settlements to meet capital requirements in accordance with this risk measure (Dowd, 1999). This method is used to analyze data and measure risks to achieve the study's objectives. The analyzed sample of sukuk and conventional bonds came from Datastream. Despite the increasing interest in sukuk issuance globally, there is a lack of authentic data on various markets. The sample size was determined by the information available on all requested variables. The goal was to select data that had similar characteristics, such as the same issuer, duration, price, structure, coupon, and yields of Islamic Sukuk, with the conventional bonds focusing on corporate bonds and trade bonds that were already issued. We selected only the bonds (Islamic and conventional) on which we have complete data. With the selected data, we applied the methodology described earlier.

Moreover, Datastream was used to extract daily data from the Dow Jones Corporate Bond Index and the Dow Jones Sukuk Index.

1.8 Thesis Organization

The thesis is organized as follows. Chapter 2 discusses the background of Islamic finance. Chapter 3 reviews the literature on conventional and Islamic bonds. Chapter 4 describes the methodology. Chapter 5 focuses on descriptive statistics. Chapters 6 and 7 present the results and findings. A summary of the results, implications, contributions, recommendations for further research, limitations, and suggestions are presented in Chapter 8.

Chapter 2: Islamic Finance/ Background

2.1 Introduction

Islamic finance has been growing rapidly in recent years. Motivated by a heightened interest in financial instruments emphasizing risk sharing, it is attracting greater attention in the wake of the recent global financial crisis. This class of instrument appears to have avoided many of the most severe consequences of the crisis. Several features underpin the expansion and performance of Islamic finance. For instance, Islamic finance is rapidly evolving and expanding, with banking assets estimated to exceed US$920 billion in 2015 (EYGM, 2015). Since the first experiment of the Mit Ghamr Bank (MGB) in Egypt in 1963, Islamic financial services have become increasingly attractive to over 1.6 billion Muslims across the world. Such dramatic growth has stretched well beyond Muslim countries in a way that suggests Islamic finance is becoming a global financial force that cannot be ignored(Jung,Yong-Cheo,&Stulz,1996). The importance of Islamic finance stems from its ultimate objective of achieving socioeconomic development and social justice among different groups in society. However, the rise of Islamic finance has posed a dilemma for Muslim governments to either accept or restrain this new phenomenon. Despite the awareness that Islamic finance "could potentially contribute to capital formation and economic development" (Wilson, 2008), the dilemma has led to the slowdown of such finance in some Muslim countries. This slowdown has been accompanied by the emergence of arguments that perceive the state as the sole responsible agent of such a drawback because of retrogressive policies.

Islamic finance is based on Shari'ah, which in essence requires that gains be derived from ethical and socially responsible investments and discourages interest-

based banking and investments. Islamic finance is fundamentally different from conventional banking models because it is based on profit and loss sharing (PLS) and the prohibition of riba (interest). This structure requires that a financial institution invests with a client to finance the client's transaction rather than lend money to the client. Because of the inherent risk involved in any investment, the financial institution is entitled to profit from the financial transaction. This is in stark contrast to modern finance in which interest is one of the key methods by which banks make money through their products, such as mortgages and personal loans. Another fundamental distinction of Islamic banking is the absence of insurance that protects clients' deposits, which is found in conventional banks.

While PLS permits the receipt of money by depositors when invested deposits have earned a profit, depositors must incur losses when deposit investments incur losses in order to comply with Shari'ah mandates. Deposit insurance, such as the protection provided by the Federal Deposit Insurance Corporation, defeats the very purpose of the PLS model, because the depositor does not incur any risk. Deposit insurance is an integral part of Western banking regulations but is in direct conflict with the basic concepts of Islamic banking. The issue of deposit insurance has proven to be a major hurdle for Western, primarily European, banks that wanted and have chosen to provide Shari'ah-compliant products. European banks have overcome this hurdle of deposit insurance by informing clients that the insurance is not Shari'ah-compliant.

Because of a lack of uniformity in the application of Islamic principles, specific banking procedures may be accepted by some Muslims and rejected by others. Modern Islamic finance products generally address two major issues: riba and gharar. Riba is

the payment of charges for the use of money, including interest and usury, and is forbidden in the Qur'an in a number of places. An uncertain rate of return (a profit) is permissible, but a fixed rate of return (interest) is prohibited. Purely financial agreements that are Shari'ah-compliant do not exist because there must always be an asset underlying a contract.

Gharar is the idea of risk or uncertainty, but can also imply deceit. Gharar in a form of "normal" risk or hazard is not forbidden; however, any deceit, fraud, or undue advantage that results in injustice to either party is prohibited. In addition to the Shari'ah principles pertaining to riba and gharar, any financial relationship following Islamic principles must also consider activities that may be impermissible (haram) under the Qur'an. For example, it is unacceptable for a bank to fund a business that is involved in the production of alcoholic beverages or a restaurant that serves alcohol, or for a mutual fund to invest in a casino or in a business that makes or sells either pork or pornography.

Among the Islamic concepts commonly used in Islamic banking are profit sharing (mudharabah), safekeeping (wadiah), joint venture (musharakah), cost-plus (murabahah), and leasing (ijarah). There is a consensus among Muslim scholars that the Qur'an prohibits usury, which is the payment and/or collection of any type of interest. The payment and collection of interest is referred to as riba. In addition, Islamic law prohibits investing in businesses that are haram. In addition to prohibiting riba and investing in haram industries, the Qur'an clearly admonishes gharar, which can be interpreted to mean "contractual uncertainty and/or ambiguity," and maisir, which is gambling. Despite differences from its Western counterparts, Islamic finance has the same purpose as conventional banking except that it operates in accordance

with the rules of Shari'ah, known as fiqh al-muamalat (Islamic rules on transactions). Unlike ordinary commercial banks whose operations are based on interest, Islamic banks operate an interest-free system and are guided by the common principle that depositors, instead of receiving a fixed return in the form of interest, share the risk of investment and take part of the resulting profits or bear part of the losses.

Such an investment is a contractual agreement between a bank, financial institution, or capital investor and an entrepreneur. This agreement can be viewed as venture capital funding. Essentially, it is a contract that provides for profit sharing between a bank and an entrepreneur. In such a contract, the entrepreneur can mobilize the funds of the former for a business activity. While the bank provides the funding for the business venture, the entrepreneur provides expertise, labor, and management.

Profits are shared between the bank and the entrepreneur in accordance with a predetermined ratio. In the event of a loss, the bank loses the capital, while the entrepreneur loses the provision of labor. It is this financial risk, according to Shari'ah, that justifies the bank's claim to part of the profit. The profit sharing continues until the loan is repaid. Such participatory arrangements between capital and labor reflect the Islamic view that the borrower must not take on all the risk/cost of a failure, resulting in a balanced distribution of income and not allowing the lender to monopolize the economy.

In this arrangement, the depositor and the bank enter into an agreement whereby the bank acts essentially as the keeper and trustee of the funds deposited. However, while serving as a trustee, the bank is entitled to use the funds on deposit for its business endeavors. The bank, however, guarantees a refund of the entire deposit or whatever balance remains when the depositor demands it. The bank at its discretion

may periodically reward the depositor with hibah (a gift) in appreciation for allowing it to use the depositor's funds. Hibah, in most instances, is a cash payment equivalent to an interest payment. However, it is not considered riba because there is no guarantee of such payments and the amount is generally not fixed. The amount, frequency, and duration of hibah are entirely at the bank's discretion.

Musharakah can be likened to what is commonly known as joint ventures. In this scheme, two or more persons or entities combine either their capital or labor to share the profits, while enjoying similar rights and liabilities. This method of financing is often used in investment projects, letters of credit, and the purchase of real estate or property. While the investment by each partner may be unequal, each partner retains an equal right to manage and participate in the business. In essence, every partner is an agent for the other because all the partners benefit from the musharakah business. When a contract of musharakah is made, the condition of agency is automatically presumed to be in existence in the contract. Although each partner enjoys equal rights in all respects, any condition regarding participation in the administration of the musharakah and any variation in the share of profits is considered valid. Further, although every partner has the right to participate actively in the affairs of musharakah should they desire, they can choose to relinquish and waive that right without any repercussions. For example, when a bank enters a fast-food venture with an individual, it will most likely waive any and all rights regarding the day-to-day management of the enterprise.

The basis for entitlement to the profits of musharakah is capital, active participation, the nature of the business, and responsibility. Profits are to be distributed among the partners in the business based on the proportions settled by them in advance. The share of every party in the profits must be determined as a proportion or

percentage. No fixed amount can be settled for any party. However, Muslim scholars are in unanimous agreement that, with this method of financing, losses shall be allocated to each partner in proportion to the capital invested.

The foregoing concept refers to the sale of goods at a price that includes a profit margin agreed by both parties. The purchase and selling price, other costs, and the profit margin must be clearly stated at the time of the sales agreement. The bank is compensated for the time value of its money in the form of the profit margin. This is equivalent to a fixed-income loan for the purchase of a real asset (such as real estate or a vehicle), with a fixed rate of interest determined by the profit margin. The bank is not compensated for the time value of money outside the contracted term. Such a concept is widely used in Islamic mortgage transactions. In these transactions, instead of loaning the buyer money to purchase a property, the bank may buy the item itself from the seller and resell it to the buyer at a profit, while allowing the buyer to pay the bank in installments. However, because profit cannot be made explicit, there are no additional penalties for late payment. In order to protect itself against default, the bank requires strict collateral. However, the goods or land are registered in the name of the buyer from the start of the transaction; as such, the buyer is in fact able to benefit and receive tax credits, et cetera.

Ijarah simply refers to leasing, renting, or wages. However, under the purview of Islamic finance, ijarah means selling the benefit or use of a service for a fixed price or wage. Under this concept, a bank makes available to the customer the use of a service of assets or equipment, such as plant, office automation, or a motor vehicle, for a fixed period and price. The benefits derived and the reasons behind this form of financing are very similar to those that drive major corporations to lease rather than

purchase equipment, tools, offices, and automobiles. Islamic banks provide a variation to the leasing model that is used by corporations. This method of financing is known as ijarah-wal-iqtina and involves a contract under which a bank provides equipment, a building, or other assets to the client against an agreed rental with a unilateral undertaking by the bank or the client that at the end of the lease period, ownership of the asset is transferred to the lessee. The undertaking or the promise does not become an integral part of the lease contract to make it conditional. The lease and the purchase price are fixed in such a manner that the bank receives back its principal sum together with a profit over the period of the lease.

2.2 Islamic Banking and Economic Development

The epistemology of Islamic finance and economics goes back to Shari'ah principles, which are deduced from the guidance of the Qur'an, Sunna, Ijma, and Qiyas (Maghrebi, Mirakhor, & Iqbal, 2016). In the particular context of Islamic finance, the primary sources of Shari'ah permit transactional exchange and prohibit dealings with interest, ambiguity, and gambling, among others. Thus, all forms of transactions are bound with inherent risk; however, deferred contracts involve a time interval that is liable to other risks and requires the parties involved to record the transaction (Aliyu, Hassan, Mohd Yusuf, & Naiimi, 2017). The risk element of financial transactions emerges because of the probability of outcomes in the contractual relations, which necessitate risk and profit sharing under the Islamic concept of financial transactions. Although Islamic finance is asset-backed, sharing risk and profit is one of the major tools used to achieve the targeted enhancement in social well-being. Thus, the empirical literature of Islamic financial activities has encompassed the practical

direction of Islamic financial transactions regarding convergence to or divergence from the risk and profit sharing principles (Hassan & Sirajo, 2017).

An Islamic bank is an institution where the main activity, similar to a conventional bank, is the mobilization of funds from the savers to the agents with a deficit (companies and business owners). Moreover, all banking activities are conducted without invoking an interest rate. Thus, the role and the functions of Islamic banks, like all other banks, are extremely useful and socially desirable. Unfortunately, the role of conventional banks is tarnished by the practice of charging interest that limits their activities to operations of money trading. Conventional banks often finance these operations in terms of short-term and personal loans. This approach does not answer the need for venture capital; consequently, their effect on economic development is less than their real potential suggests.

Islamic banks represent an improvement in two ways. Firstly, Islamic banks frequently offer capital lending to the process of production and, through the instruments of the process, aim to contribute to companies' capital. The disbursement of financial resources in accordance with the requirements of production is more efficient than allocation in accordance with pure lending principles. It is suggested that in this regard, Islamic banks' impact on economic development is more important. Secondly, Islamic banks guarantee to Muslim people that their contracts will not include elements of interest, which are forbidden in Islam. Financial development is an important component of any overall development strategy. Seeing the success of Islamic banks, which is characterized by an annual growth rate of 16% as participation banking continues despite political and economic volatility in major regions, several international banking institutions have started to establish their own Islamic units,

windows, or branches to capture the opportunity. Some economists believe that this modern generation of banking will lead to better financial development and growth than conventional banking.

The relationship between financial development and economic growth has remained one of the most debated issues in terms of whether the financial sector actually contributes to the process of economic development. Some authors consider finance an important element of growth (Goldsmith, 1969; King and Levine, 1993; McKinnon, 1973; Schumpeter, 1934; Shaw, 1973), while for others it is only a minor growth factor (Lucas, 1988; Robinson, 1952). Schumpeter (1934) sees the banking sector as an engine of economic growth through its funding of productive investment. In contrast, Lucas (1988) argues that the role of finance has been overstressed. Patrick (1966) also contributes to this literature by identifying two possible patterns in the causal relationship between financial development and economic growth.

The first pattern is called "demand-following," which means that the creation of modern financial institutions, with their financial assets and liabilities, and related financial services, is in response to the demand for these services by investors and savers in the real economy. This implies that the financial system can support and sustain leading sectors in the process of growth. Here, an expansion of the financial system is considered to be a consequence of real economic growth.

The second pattern is "supply-leading," which means that the creation of financial institutions and the supply of their financial assets, liabilities, and related financial services are in demand, especially from entrepreneurs in modern, growth-inducing sectors. Supply-leading has two functions: to transfer resources from

traditional (non-growth) sectors to modern sectors and to promote and stimulate an entrepreneurial response in modern sectors.

In addition, Goldsmith (1969) and Gurley and Shaw (1955) argue that more developed financial markets promote economic growth by mobilizing savings and facilitating investment. Explicitly or implicitly, it is notable from all studies that an efficient financial system accelerates economic development. The main contribution of a financial system to the materialization of growth is that it ensures the functioning of an efficient and evolutionary payment system, mobilizes saving, and improves growth's impact on investment. Thus, the existence of a reliable and sound financial exchange system is a prerequisite for growth. The financial sector plays a growth-promoting role if it demonstrates the capacity to direct financial resources toward sectors that demand these the most. When a financial sector is more developed, greater financial resources can be allocated to productive use; hence, more physical capital is formed, which in turn leads to economic growth.

However, Odedokun (1992) favors bidirectional causality between finance and growth. Both financial and economic developments are causally related: financial development causes an economy to grow; economic growth triggers the financial sector to develop the economy further. Masih and Masih (1996) support the demand-following hypothesis whereby economic growth causes financial sectors to develop. The more rapid the growth of real national income, the greater will be the demand by enterprises for external funds (the savings of others). Thus, financial intermediation, as in most situations, will be less able to finance expansion from internally generated depreciation allowance and retained profits. Consequently, the financial system can support and sustain the leading sectors in the process of growth. In this case, an

expansion of the financial system is induced as a result of real economic growth or demand-following.

Levine and Zervos (1998) study the empirical relationship between stock market development, banking development, and long-term economic growth. They show that stock market liquidity and banking development are both positively and robustly correlated with contemporaneous and future rates of economic growth, capital accumulation, and productivity growth. Fase and Abma (2003) argue that an expansion of the financial system could have a positive repercussion on economic growth. The financial sectors in this case act as supply-leading institutions to transfer resources from traditional, low-growth sectors to modern high-growth sectors and to promote and stimulate an entrepreneurial response in these modern sectors.

Abu-Bader and Abu-Qarn (2005) examine the causal relationship between financial development and economic growth in Egypt from 1960 to 2001. They use Granger causality tests and conclude that financial development promotes economic growth either through increased investment efficiency or capital accumulation. Romeo (2007) also confirms the positive impact of finance on growth. He investigates the relationship between finance and growth with an emphasis on the effect of financial deregulation and banking law harmonization on economic growth in the European Union. The study establishes that financial intermediation positively impacts economic growth through three different channels. Kenourgios and Samitas (2007) examine the long-term relationship between finance and economic growth in Poland and conclude that credit to the private sector has been one of the main driving forces of such growth. Huang and Lin (2009) reexamine the dynamic relationship between financial development and economic growth using the data set employed in Levine,

Loayza, and Beck (2000). Using a novel threshold regression with the instrumental variables approach, they support a positive link between financial development and economic growth. They also find that financial development has an important effect on growth in low-income countries.

Despite the availability of many studies investigating the relationship between financial development and economic growth, studies that examine the role of Islamic financial development in economic growth are scarce. Some limited articles have been written by scholars from countries in Southeast Asia. Furqani and Mulyany (2009) examine the dynamic interactions between Islamic banking and the economic growth of Malaysia by employing the co-integration test and vector error correction model (VECM) to assess whether the financial system influences growth and whether growth transforms the financial system's operation in the long term. They find that, in the short term, only fixed investment caused Islamic banks to develop in the period 1997–2005. In the long term, there is evidence of a bidirectional relationship between Islamic banking and fixed investment; further, there is evidence to support the demand-following hypothesis of gross domestic product (GDP) and Islamic banks, whereby an increase in GDP causes Islamic banking to develop and not vice versa. Abduh and Chowdhury (2012) investigate the long-term and dynamic relationship between the development of Islamic banking and economic growth in Bangladesh. The quarterly time-series data of economic growth, total financing, and total deposits of Islamic banking from Q1 2004 to Q2 2011 are used in their study. Through co-integration and Granger's causality method, Islamic banks' financing is found to have a positive and significant relationship with economic growth both in the long and short term. This finding implies that the development of Islamic banking is one of the policies that should be considered by governments to improve their nations' incomes.

The studies cited above have demonstrated that the development of the Islamic financial system has played a viable role in the economic growth of each country that is considered. However, the direction of the relationship between the flow of Islamic finance and economic growth has differed from one country to another, particularly in relation to the monetary policies of each country. Moreover, there have been some drawbacks in the studies showing the relationship between Islamic financial development and economic growth; for example, most studies have used short time periods and an analysis of just one Islamic bank in each country. Further, all the studies were conducted in Southeast Asian countries.

Goaied and Sassi (2011) investigate total Islamic banks' financing at all fully fledged Islamic banks in selected countries from the Middle East over a reasonable time so that adequate data can be collected. The study selects the most important countries from the Middle East in which Islamic finance has a footprint. Tabash and Dhankar (2014) examine the relationship between the development of the Islamic financial system and economic growth in the long term in selected countries of the Middle East. They empirically analyze the relationship between Islamic banks' financing and economic growth using econometric analysis. Because the variables in their analysis are stationary, Johansen's co-integration technique is applied. The co-integration results provide evidence of a unique co-integrating vector. In other words, a long-term stable relationship between Islamic banks' financing and economic growth is found in the three countries that are studied. This finding suggests that in the long term, Islamic banks' financing and economic growth move forward together, at least for selected countries of the Middle East.

It has been shown that the Middle East has benefited from a strong banking system. Goaied and Sassi (2011) find a causal, bidirectional relationship between Islamic banks' financing and economic growth for Bahrain and Qatar. They also discover that in the United Arab Emirates (UAE), a causal relationship exists, from the development of the financial system to economic growth, but not in the opposite direction. Their results indicate that improvement of the Islamic financial institutions in the Middle East has contributed to economic development and has been critical in the long term for economic welfare and poverty reduction. The study's results are quite significant; indeed, the study is one of the pioneering works on Islamic finance.

2.3 Advantages of Islamic Banking

Islamic banks provide the same contributions to the financial system and the economy as conventional banks. However, they present some relative advantages that can be summarized as follows: efficiency, economic system stability, the reduction of moral hazard and adverse selection problems, and greater conduciveness to poverty alleviation.

Islamic banks are more efficient since they are not based on the volatile principle of interest rates. Friedman (1969) demonstrates that a zero nominal interest rate is a necessary condition for the optimal allowance of resources. With a zero interest rate, traders will have no reason to substitute real resources for money; thus, more resources will be channeled into investments. Consequently, when fixing a positive price for money, traders will economize money for a fixed return and reduce their transaction costs. It has been demonstrated empirically that a zero interest rate is both necessary and sufficient for efficient allocation in general equilibrium models (Cole & Kocherlakota, 1998; Wilson, 1979).

By excluding the principle of interest from its mechanism, Islamic banks exclude all speculative activities related to interest rate expectations. Changes in money flow directly reflect the real sphere by changes in the demand and supply of goods and services. Islamic banks adapt to the real economic sphere by using other rates where the time-money value is maintained: the rate of profit sharing in mousharaka, the markup rate in moudaraba, and the rental rate in leasing. Thus, Islamic banks operate more efficiently. In their 2008 report, the International Monetary Fund (IMF) considered that the Islamic financial system is steadier and less inflationary than the conventional system based on interest rates. Further, applying the "z-scores" analysis, Cihák and Hesse (2008) prove that the Islamic financial system is financially stronger and less risky than conventional banking. In the conventional system, a depreciation of assets due to an exogenous shock downgrades the banks' equity capital. Since depositors have fixed value securities (the deposits), there are no risks provoking bankruptcy. In an Islamic system, the possessors of investment accounts do not have fixed value securities; thus, in macroeconomic or bank-specific crises, investment depositors automatically share the risk, which allows an adjustment of the liability in the case of asset reduction.

In the same way, when borrowers cannot repay their debts on time, they are obliged to pay penalty rates of interest, which are higher than regular rates. In Islamic banks, the debt value and the profit rate, or the markup, are fixed in advance. As such, Islamic banks are more reliable than the conventional system, which is another argument supporting the stability of inflation. Thus, Islamic banking is relatively more stable. Since banks operate in an environment characterized by asymmetry of information, Islamic banks benefit from the risk reduction of moral hazard and adverse selection by simultaneously providing equity and debt finance.

In addition, by sitting on companies' boards of directors, banks can influence corporate governance and are able to control the companies' performance, financing them at a cost that is less than usually possible with conventional banking. Thus, Islamic banks are likely to be more efficient in terms of monitoring and surveillance by reducing the risks of adverse selection and moral hazard. Further, since the most important criteria for financing projects in the conventional system is the ability to repay loans, collateral, and guarantees, only the rich have the broadest access to the financial market. In contrast, Islamic finance provides funds based on the sharing profit and loss principle, which accords importance only to profitability and the rate of return. Thus, those who are not rich but have essential skills to succeed in projects, such as scientists, engineers, and craftsmen, have a better chance to acquire finance.

2.4 The Main Developmental Characteristics of Islamic Modes of Financing

The essential characteristic of Islamic modes of financing is their direct and undetachable links with the real economy or physical transactions. Mousharaka and moudharaba are possible only for productive companies, which contribute to real-life businesses that increase production and improve quality. A company must generate a profit and distribute it between the entrepreneur and the bank. Mourabaha and other sale-based modes must involve a physical transaction of commodities or provision of services. The same also applies to leasing, where the leased assets are the pivotal issues around which financing is built. As such, all Islamic financing must relate to production and/or the exchange of real goods and services. In contrast with conventional banks that focus only on the ability of the entrepreneur to repay loans, Islamic banks concentrate on the profitability of the project, which is the essential

condition. Consequently, Islamic banks lead to economic growth by promoting productive projects and supporting the trading of commodities and services.

Another advantage for this foremost characteristic of Islamic modes of financing is that such financing is incompatible and unsuitable for debt rescheduling, debt swaps, speculative transfers, and other purely monetary-oriented activities that constitute a substantial part of the contemporary activities of conventional banks.

The second developmental characteristic of Islamic banking is the incorporation of ethical and moral values in their modes of financing; for example, one cannot ignore ethical/moral considerations in the project selection process. Regardless of legality in a given country, Islamic banks do not finance harmful goods, such as alcoholic beverages and tobacco, or morally unacceptable services, such as casinos and pornography. Such products and activities are indeed profitable but they have high social and economic costs and harmful long-term effects on productivity in the economy. The ethical and moral loyalty of Islamic banks is also manifested in another form: Islamic banks grant zero-interest credits from social funds in cases of dire need or unexpected circumstances for the poor and needy. These funds are principally financed by yearly zakah, a form of alms-giving paid by Muslim people, and also by interest accumulated from deposits in conventional banks and money from other transactions judged to be suspicious by Shari'ah boards from the Islamic point of view.

Donations from the public or countries are also an important source for the charitable funds of Islamic banks. An example is the Islamic Development Bank in Jeddah, which has US$100 million in its waqf account. The bank spends this money on research, training, developmental studies, research scholarships, technical assistance programs, and disaster relief services for Muslim countries. In other words,

although profit maximization is as essential to Islamic banks as to other businesses, the underlying philosophy of these institutions is conducive to promoting social commitment and activities that usually cannot be assured by the profit motive.

The third developmental characteristic of Islamic banks is found in the nature of their relationship with depositors and employees. Since Islamic banks deal with their depositors on investment grounds, competition is higher among Islamic banks than among conventional banks, which receive current and timed deposits against fixed interest. Such competition among Islamic banks drives profitability to its maximum in both the short term, which concerns depositors, and the long term, which concerns shareholders. This situation makes all the banks more aware of, and attached to, the real market. Nevertheless, a bank's financial performance is not the only criteria of competition; the ability of Islamic banks to keep, and to raise, deposits depends upon a good reputation.

2.5 Financial Performance of Islamic Banks

In addition to the theoretical arguments, there is empirical evidence that confirms the benefits of the Islamic system compared with the conventional system. Hassan and Bachir (2003) highlight the individual performance of the Islamic banking sector and show that Islamic banks, as a group, are much better than conventional banks. Iqbal, Ausaf, and Tariqullah (1998) test the performance of Islamic banks using a panel consisting of the 10 foremost banks in the world, the 10 foremost banks in Asia, the 10 foremost banks in the Middle East, and the 10 foremost Islamic banks. They prove that the performance of Islamic banks in a capitalistic environment, where the conventional system dominates, is higher.

Kader, Asaporta, and Al-Maghaireh (2007) examine the performance of Islamic banks in terms of profitability, liquidity, risk, solvency, and efficiency from 2000 to 2004 in the UAE, where Islamic funds are highly concentrated. The study finds that UAE Islamic banks are relatively more profitable, less liquid, less risky, and more efficient compared with the UAE's conventional banks. The authors associate this performance to the PLS paradigm. The success of Islamic banks, as shown by a high growth rate, may be attributed to the productive characteristic of Islamic products more than borrowing based on the PLS principle.

Jordan's statistics, however, show that the emergence of Islamic banks in the country did not decrease the deposits that were already in conventional banks. Thus, the Islamic banks attracted reserve funds that led to growth. Indeed, economists have favored the emergence of Islamic banking such banks help to vary the financial product range and improve the institutional quality of the financial sector. A result is that this new banking alternative offers better fund distribution.

2.6 Conventional Financing Compared with Islamic Financing

The concept of Islamic or Shari'ah-compliant finance is based on the core tenets of Islam concerning property rights, social and economic justice, wealth distribution, and governance. One of the key features of the system is the prohibition of riba and gharar (El-Gamal, 2009; Kabir & Mahlkrecht, 2011). There is consensus among scholars that the prohibition of interest is not limited to usury but refers to interest on debt in any form (Iqbal & Mirakhor, 2011). The prohibition of gharar[1] is to discourage excessive uncertainty in contracts, enhance disclosure, and proscribe all forms of deception. In addition to the prohibition of riba and gharar, Islamic finance has seven key precepts. Thus, implemented fully, Islamic finance does the following.

1. Eliminates pure debt securities from the financial system, replacing interest by the rate of return earned ex post on contracts of exchange or risk sharing.
2. Calls for bank deposits to be collected on a profit and loss basis rather than fixed predetermined liabilities. All profits and/or losses on the asset side are to be passed through to the investors (depositors) on the liability side (Ayub, 2007; Dar & Presley, 2000).
3. Promotes the financing of trade and the exchange of goods and services to ensure a close link between the real economy and the financial sector, because all financial contracts should be backed by assets or transactions/activities in the real economic sector.
4. Upholds the property rights of the individual and society, and clarifies the sources of individual ownership.[2]
5. Mandates the fulfillment and sanctity of contracts that deal with trade in goods and services, and the transfer of ownership and honoring of debt obligations (Ayub, 2007, Chapter 5).
6. Emphasizes principles of morality and ethics in business conduct, proscribing illicit activities according to Shari'ah (El-Ghazali, 2002) and mandating that all economic activities be governed by rules of fair dealing and justice.
7. Advocates the sharing of risk and reward between the rich and the poor through specific instruments of re-distribution.

The difference between the two banking systems also lies in the governance structures. Islamic banks must comply with the rules of the Holy Qur'an and meet the expectations of the Muslim community by providing acceptable financing modes to Islam. Islamic finance is a financial system that operates according to Shari'ah

principles. Shari'ah, which is an Arabic term, means, "The way to the source of life." Islamic finance has all the features of a conventional financial system such as capital markets, fund managers, investment companies, and insurance companies; however, these systems are governed by Islamic laws. A core concept of Islam is that Allah is the owner of all wealth in the world, and humans are only the trustees of the wealth. Thus, humans need to manage wealth according to Allah's commands, which promote justice and prohibit certain activities. The law does not forbid Muslims from enjoying wealth: They have the right to enjoy whatever wealth they acquire and spend it in Shari'ah-compliant ways. They need not feel apologetic about being wealthy as long as their behavior aligns with Islam.

Conventional banking, however, is based on the debtor–creditor relationship between a bank and a customer's interest. This relationship is just a consideration between the borrower and the banker, reflecting the opportunity cost of money.

Table 2.1: Differences between Islamic banking and conventional banking

Business Framework	Islamic Banking System	Conventional Banking System
Banking Practice	Based on Shari'ah; Shari'ah scholars ensure adherence to Islamic laws and provide guidance.	Based on secular banking laws and the financial practices of respective countries.
Equity Financing with Capital Risk	Islamic banks provide equity capital to a project or venture. Losses are shared in accordance with equity participation while profits are shared in accordance with a pre-agreed ratio. Management of the enterprise depends upon the type of financing provided. Examples: mudarabah and musharkah.	Although venture capital companies and investment banks take equity stakes and management control of an enterprise in return for providing start-up finance, commercial banks, which are the primary lenders, do not have this facility.
Prohibition of Gharar	Transactions deemed gharar are prohibited; they denote varying degrees of deception regarding the price and quality of goods, for example derivatives, which are prohibited in Islamic Finance.	Trading in all financial instruments, including derivatives, is allowed in conventional banking.
Profit and Loss Sharing	All transactions are based on this principle: Returns are variable depending upon bank performance, and consumers can participate in profit upsides in a more equitable way than receiving a predetermined return.	Returns to customers are irrespective of bank performance and profitability. Customers are treated only as depositors and do not receive any other compensation other than interest.

Islamic finance does not restrict economic activity; instead, it directs it toward responsible activities that benefit other people and honor Allah. It allows a free market economy where supply and demand are decided in the market and not in accordance with governmental rules and regulations.

2.7 Challenges to Islamic Banking

While Islamic banking may provide a more conservative and stable approach to conventional banking models, it is not immune to the current economic crisis. Experts predict that, because of its heavy reliance on property investments and private equity, the booming US$1 trillion global industry could be hit if the turmoil worsens and real assets start to crumble. The key challenges that have been partly considered by some researchers are described in the following paragraphs.

Recent regulatory changes concerning the structure of sukuk warrant careful consideration and may dampen some of the recent enthusiasm for Islamic capital market products. In February 2008, the Shari'ah committee of the Accounting and Auditing Organization for Islamic Financial Institutions (AAOIFI) issued new recommendations regarding the role of asset ownership, investment guarantees, and the Shari'ah advisory and approval process for sukuk origination and trading. The proposed rules attracted significant attention prior to their release, following a statement by the chairman of the Shari'ah committee in November 2007 indicating that 85% of sukuk issues in the Gulf Cooperation Council (GCC) do not concur with Shari'ah principles. Most sukuk issued in the GCC have explicit repurchase agreements that guarantee the repayment of the principal but violate the PLS features of Shari'ah.

Currently, there are discussions underway between the various stakeholders and some market participants to gauge the potential of these recommendations to cause permanent damage to the sukuk market. The sukuk market is also still plagued by illiquidity due to limited depth and breadth, mainly because Middle Eastern banks, which are the most likely securitizers/sellers of risk, are flush with liquidity and capital; thus, there is no strong funding or balance sheet rationale for sukuk. Although the commoditization of illiquid asset exposures through securitization facilitates the disciplining effect of capital markets, there is a lack of information from private sources about securitized assets in many sukuk and the prevalence of "buy-and-hold" investments that inhibit efficient price discovery and information dissemination. Moreover, sukuk are available at maturities of 3, 5, and 10 years but not for short-term maturities, which significantly limits their application in money markets.

Although Islamic banks are currently one of the largest buyers of Shari'ah-compliant products (at long maturities), they would benefit most from issues with shorter tenors. There is some hope that the launch of different sukuk funds in the near future may potentially unlock liquidity constraints; however, this may only create new demand without sufficiently alleviating supply constraints. It is also difficult to establish sukuk funds with sufficient diversification. Notwithstanding the compelling value proposition of sukuk, without efficient and transparent capital markets and appropriate legal frameworks to operate within, Islamic capital markets will not continue to grow meaningfully in the near future.

The liquidity risk management of Islamic banking is an important challenge and is constrained because of the limited availability of tradable Islamic money market instruments and a weak systemic liquidity infrastructure. At the moment, there is no

Shari'ah-compliant short-term Islamic money market (with less than one week's maturity) in local currency or in US dollars, and Islamic repo markets have not yet developed. Islamic money markets with longer maturities, which are based on commodity murabaha transactions (markup financing), sometimes suffer from unreliable brokers with low creditworthiness. Islamic banks also have a competitive disadvantage over conventional banks because they deposit their overnight money with their domestic interest-free central bank. The lack of liquidity and viable alternatives, combined with competitive disadvantage, hamper local Islamic banks and can even create a liquidity crisis. Many investment banks are currently designing new complex products, compliant with Shari'ah, that attempt to overcome the shortcomings of the Islamic money market. It remains to be seen whether these new solutions will demonstrate widespread Shari'ah compliance in the Islamic finance community and generate enough demand for a functional Islamic money market to develop.

Business models and products of Islamic banks are still rather homogenous, while Shari'ah compliance amplifies risks stemming from product configuration and process implementation. The success of Islamic banking in recent years has produced too many Islamic banks with the same business models. There is a lack of "bread-and-butter" lending, and the current excess liquidity has led to too much complacency among the Islamic banks. In addition, there is a large and diverse set of accounting standard differences across the different jurisdictions. The development and setting of simple standard legal contracts is necessary in order to overcome the complexity and heterogeneity of current contracts.

Further, the deployment of IT systems that help monitor the fulfillment and visibility of processes on an end-to-end basis are crucial in facilitating the continuous monitoring of activities by Shari'ah scholars while eliminating the possibilities of non-compliance, which in some cases may render transactions invalid. Financial innovation in Islamic finance is still hampered by the need for harmonized financial regulation.

Governance issues, especially regarding the Shari'ah compliance of products and activities, constitute a major challenge for the Islamic finance industry. Although Shari'ah rulings (fatwas) by legal scholars are disclosed, there are currently no unified principles by which Shari'ah scholars decide on the Shari'ah compliance of new products. Fatwas are not consolidated, which inhibits the dissemination, adoption, and cross-fertilization of jurisprudence across different countries and schools of thought. Moreover, there is still considerable heterogeneity of scholarly opinion about Shari'ah compliance, which undermines the creation of a consistent regulatory framework and corporate governance principles. The fragmented opinions of Shari'ah boards, which act as quasi-regulatory bodies, remain a source of continued divergence of legal opinion.

Since Islamic law itself is divided between different juristic schools of thought (madhahib), which provide guidance on the analytical reasoning (ijtihaad) or interpretative analogy (Qiyas) of the general principles of Shari'ah, there is no consensus (Ijma) on the religious compliance of certain products and transactional structures. Given the rising global integration of the Islamic financial services industry, greater supervisory harmonization across national boundaries is essential. There is also regulatory disparity among national supervisors, with each regulator working independently and refusing to recognize the validity of judgments made by foreign

counterparts. A greater role for the AAOIFI, the General Council for Islamic Banking and Finance Institutions (GCIBFI), and the Islamic International Rating Agency (IIRA) in this regard has added consistency to Shari'ah rulings, while the retention of conventional financial market practice and the supremacy of a governing law as a matter of form remain essential to maintain investor confidence in the rapidly growing Islamic banking system and capital markets. Moreover, national solutions are gaining traction. Various Islamic countries have teamed up in a bid to create more liquidity and enhance market transparency with a view to becoming a center of Islamic finance, while more specific regional initiatives have provided a valuable platform for drawing further attention to structured finance as an important element of local capital market development.

Additionally, institutions wanting to provide Shari'ah-compliant products face the challenge of increased and added costs that stem from the research, implementation, and development of such products. The costs associated with the implementation and development of such products is passed on by the institutions to clients seeking such products. This results in increased costs to the customers, often making the products unattractive. Regardless of the increased costs, institutions will probably have to examine and consider Shari'ah-compliant banking as a viable alternative in the current economic situation worldwide. Consumers who have suffered tremendous losses are now looking for a more conservative and stable banking system. Shari'ah-compliant products may provide them with such stability.

2.8 Development of Islamic Finance and Islamic Capital Markets

As modern Islamic finance moves through the second decade of the period of "transformation and innovation," we are witnessing the first stages of the realization

of the long-articulated admonition to develop capital markets, including secondary markets, for securities and investments that comply with the principles and precepts of Shari'ah. Before considering these factors, and by way of background, this section first considers the nature of Islamic finance. In other words: What is Islamic finance? The answer requires more than definitional recitation; it needs an examination (at least in summary) of the nature, composition, and role of Shari'ah supervisory boards that oversee the explication of Shari'ah as it applies to the field of Islamic finance, including the issuance of fatwas or authoritative opinions as to the permissibility, under Shari'ah, of structures and products. The final background discussion is a survey of a few rudimentary principles of Shari'ah that are of particular importance when considering Islamic capital markets.

A fundamental function of a capital market is to provide medium- to long-term funds to finance capital-intensive projects. In order to attract funds into the market to carry out this important function, innovative financial products that meet the specific needs of investors and fund-seekers are introduced (Alam, Hassan, & Haque, 2013; Etudaiye-Muhtar, Bashir, & Abdulkadir, 2012). The Islamic capital market serves as an alternative to the conventional capital market, where corporate and sovereign entities seek access to long-term funds (Kusuma & Silva, 2014). One such product in the Islamic capital market that enables the market to fulfill this function is the sukuk financial debt instrument.

This section now turns to the consideration of the primary factors influencing the development and growth of Islamic capital markets. Historical trends in the development of modern Islamic finance provide context, in terms of constraints and opportunities, based upon existing knowledge, available resources, and methodology. Next, this section summarizes some of the major multilateral organizations that have

focused on the development of the Islamic capital markets, including their initiatives and capabilities. Then, it provides an overview of the expectations of transactional participants in order to increase sensitivity to issues that will need to be addressed to effectuate capital market products in the Islamic finance field.

Turning to more specific factors, this section examines a range of factors that affect risk assessment by transactional participants, particularly those pertaining to the certainty, predictability, and transparency of risk factors. The first such factors considered are systemic legal matters: the role of legal opinions and governing law choices. Special attention is paid to the variations in the nature and composition of legal systems in which necessary legal opinions must be rendered. Some jurisdictions, particularly those within the Organization of the Islamic Conference (OIC), incorporate Shari'ah to a greater or lesser extent in the secular law of their jurisdictions (these are referred to as "incorporated jurisdictions," which are jurisdictions that desire to use Shari'ah-compliant financing techniques as their primary economic form and are referred to as the "Islamic economic sphere"; jurisdictions that use primarily interest-based financing techniques are referred to as the "Western economic sphere"). Other jurisdictions do not incorporate Shari'ah to any extent in their secular law (these are referred to as "secular jurisdictions").

Financial transactions conducted in Islamic capital markets worldwide have grown from relatively small-sized to large-sized transactions. The driving force behind this growth may be traced to the issuance of sukuk financial debt instruments by both sovereign and corporate entities (Alam et al., 2013). For instance, the financial report of the International Islamic Financial Market (IIFM) for 2014 reports that global sukuk issuance grew from US$1,172 billion in January 2001 to US$68,197 billion as of July

2014. The total value of sukuk issued over the same period was reported as US$668,058 billion. Similarly, Kusuma and Silva (2014) report the size of worldwide Shari'ah financial assets as $1.8 trillion as of 2014. These assets consist of banking assets, sukuk and other funds, with sukuk representing 15% of the total value.

Capital market transactions involve both types of jurisdictions. Further, the legal opinions and choice of governing law for transactional documentation in each type of jurisdiction are critical factors in effectuating these transactions and the growth of the markets.

These factors, in turn, are dependent upon whether contractual arrangements, which embody risk allocations as agreed by the transactional participants, will be enforced in secular and incorporated jurisdictions. Case law and contractual drafting in secular jurisdictions will be summarized first. Systemic issues and transactional practices in incorporated jurisdictions will then be examined. Sukuk issuance transactions, and related enforceability issues, will be considered as a capital markets case study.

As previously explained, Islamic finance is the conduct of commercial and financial activities in accordance with Shari'ah. For present purposes, Shari'ah is Islamic religious law as applied to commercial and financial activities.[2] It is a combination of theology, religion, and law. Shari'ah is a guide to how a Muslim leads life (it means, literally, "the way" or "the right path"). Thus, it is considered the perfect, immutable, divine law as revealed in the Qur'an and the Sunna.

Fiqh, literally "understanding," is the sum of human comprehension of divine law and forms the practical rules of Shari'ah as determined by Shari'ah scholars. The

primary methodology used in this determinative and interpretive endeavor is ijtihad (literally, "effort'"), or legal reasoning, using the "roots of the law" (usul al-fiqh). The roots (usul) upon which Islamic jurisprudence is based are: (i) the Qur'an, being the holy book of Islam and the revealed word of Allah (notably, less than 3 percent of the Qur'an is legal in nature); (ii) the Sunna of the Prophet Mohammed, which are the binding authority of his dicta and decisions; (iii) the Ijma or "consensus" of the community of scholars; and (iv) the Qiyas or analogical deductions and reasoning.

Shari'ah is comprised of principles and precepts. In its explication and application, it is largely oral (there is a limited number of written compilations, such as the 1839 compilation for the Ottoman empire, the *Majelle* or *Majalat al-Ahkam al-Adliyah*).[4] Further, there exist several schools of Islamic jurisprudence (the four main Sunni schools, which have the greatest impact on modern Islamic finance: Hanafi, Hanbali, Maliki, and Shafi). Historically, the different schools are frequently in conflict regarding the application of Shari'ah to different factual or structural situations. Even within a school, there are varying interpretations with respect to any given matter. There is also considerable divergence between Southeast Asia (particularly Malaysia, Indonesia, and Brunei) and the Middle East and Western Asia (particularly Pakistan).

As explicated by Shari'ah scholars over the last 1400 years, and as applied to Islamic finance, Shari'ah is a fulsome body of law. It covers virtually most aspects of commerce and finance that are addressed by a mature body of secular law. Thus, for example, it addresses contracts, concepts of consideration, legal capacity, mutuality, sales, leasing, construction activities, partnerships and joint ventures of various types,

guarantees, estates, equity and trust, litigation, and many other activities and legal structures.

2.8.1 Forces influencing the development of Islamic capital markets

The development of Shari'ah-compliant capital market instruments, in their modern incarnation, began in approximately 2002 and has continuously accelerated since. This process is the result of a confluence of factors, some of which are as follows:

1. The evolution of modern Islamic finance, particularly since the mid-1990s;
2. The efforts of multilateral institutions, such as the AAOIFI, the Islamic Development Bank (IDB), and the Islamic Financial Services Board (IFSB); and
3. Transactional developments since the mid-1990s.

2.9 Conclusion

Among the common Islamic concepts used in Islamic banking are profit sharing, safekeeping, joint venture, cost-plus, and leasing. The epistemology of Islamic finance and economics goes back to Shari'ah principles, which are deduced from the guidance of the Qur'an, Sunna, Ijma, and Qiyas.

Empirical literature on Islamic financial activities encompasses the practical direction of Islamic financial transactions regarding convergence to or divergence from the risk and profit-sharing principle.

The main activity of an Islamic bank, as with a conventional bank, is the mobilization of funds from savers and the offer of these funds to agents that have a deficit; moreover all banking activities must be undertaken without the use of interest

rates. Over the long term, there is evidence of a bidirectional relationship between Islamic banks and fixed investments; further, there is evidence supporting the demand-following hypothesis of GDP and Islamic banks, whereby an increase in GDP causes Islamic banking to develop and not vice versa.

Islamic banks provide the same contributions to the financial system and the economy as conventional banks and also present some relative advantages: efficiency, economic system stability, the reduction of moral hazard and adverse selection problems, and greater conduciveness to poverty alleviation. Another argument favoring the stability of the Islamic system is that Islamic banking does create money; thus, it is not inflationary.

In addition to the theoretical arguments, there is empirical evidence confirming the good done by the Islamic system relative to the conventional system. Islamic banking may provide a more conservative and stable approach to conventional banking models, even though Islamic banking is not immune from the current economic crisis.

Chapter 3: Theoretical and Literature Review of Sukuk and Bonds

3.1 Introduction

Sukuk have a unique structure and features that differ from one type to another. However, the structure of sukuk as a security is based on the main fundamentals of Islamic finance. In order to accurately interpret a risk–return analysis of sukuk, it is necessary to understand the concept of Islamic finance and its contracts and the different types and structures of sukuk.

Sukuk has emerged as an alternative financial instrument over the last decade to fill the need for secure and bond-like investments (Alam et al., 2013). Both conventional bonds and sukuk carry fixed maturity terms, can bear losses or benefits, and are tradable in qualified markets with a standard yield rate. However, Al-Bashir and Al-Amine (2008) state that, unlike traditional bonds, sukuk represent undivided full or partial ownership of other tangible assets such as properties, ventures, or even services. They are, as such, secured against real assets (SARA) and support entitlement to actual ownership of the underlying assets. Thus, SARA bonds are more secure than conventional bonds. In contrast, Islamic joint venture (IJV) bonds have more similarities with equity than debt (Vishwanath & Azmi, 2009). Sukuk also have legal partnership contracts binding the issuers to the investors. In contrast, traditional bonds are essentially forms of debt contracts that may be secured with specific assets or can even remain unsecured through the obligation of payment promises.

Investors residing in Islamic countries or those who want to invest in Islamic financial markets prompted the need for the creation of bond-like instruments; hence, the introduction of sukuk. As such, investing in sukuk gives investors the opportunity

to balance their portfolios with investments in asset-based securities, not debt instruments, since sukuk equate to tangible assets, usufruct of assets, services, projects, businesses, or joint ventures (Vishwanath & Azmi, 2009).

Notwithstanding the growth in sukuk financial transactions, several authors have questioned whether sukuk is another variation of the conventional bond (Afshar, 2013; Alam et al., 2013; Ariff, Safari, & Mohamed, 2013; Godlewski et al., 2011; Hassan, 2012). This question arises because of the similarities observed in the two debt instruments, although different approaches are used in examining the similarities/differences between them.

3.2 Global Sukuk Issuances

Total international sukuk issuances stood at US$31.56 billion in 2016, which translates into an increase of US$10.68 billion from the 2015 level of US$20.88 billion. This increase is the highest value of issuance recorded since the inception of the sukuk market. Total sukuk market size has now reached US$856M globally (IIFM, 2016).

3.3 Securitization of Sukuk

The processes and procedures applied for sukuk issuance are similar to those for securitization with conventional bonds, except for dissuading attempts to avoid the basic prohibitions of Islamic finance. Various factors are involved in sukuk transactions. The most important are listed below.

1. The originator or issuer of sukuk sells assets to special purpose vehicles (SPVs) and uses the realized funds. Although the originators are mostly governments

or large corporations, they could also be banking or nonbanking Islamic institutions. The user may delegate the process of arranging the issue for a consideration or a commission.

2. An SPV is an entity established specifically for the securitization process and for managing the issue. It purchases assets from the originator and funds the purchase price with the sukuk. Sometimes the SPV also refers to the issuer.
3. Investment banks act like issuing agents in term of underwriting, lead managing, and book-making services for sukuk. These services are provided by syndicates of Islamic banks or conventional banks that are operating Islamic finance windows.
4. Sukuk subscribers are mostly central banks, Islamic banks, and individuals who subscribe to securities issued by SPVs.
5. The obligator can be a contractual debtor to the originator who pays cash flows that are securitized.
6. The lead manager oversees the design and execution of the transaction and acts as an arranger for the securities. A company/trust/mutual fund could provide services for managing the sukuk issues.
7. The cash administrator, or receiving and paying agent, is the banker for the deal who manages inflows and outflows and invests interim funds and accesses cash collateral.
8. The credit enhancement provider provides credit enhancements by either guarantees or takaful (Islamic Insurance).
9. The credit rating agency provides a rating for the deal based on the structure and rates of the parties involved, and legal and tax aspects.

3.4 Main Types of Sukuk

3.4.1 Pure Ijarah Sukuk

The authorities issue pure ijarah certificates on stand-alone assets that can be seen from the balance sheet. Examples of such assets include real estate fixed assets, aircraft, and ships that a company intends to lease. The rental charges and rates of return vary depending upon the originator and could be either floating or fixed.

3.4.2 Variable Rate Redeemable Sukuk

Musharakah finance certificates (MTFCs) are viewed as an alternative to sukuk because of the MTFCs' seniority in terms of their redeemable nature, issuers' equity, and relative stability compared with their dividend payouts. The certificates are superior and advantageous because the jurists prefer employing musharakah returns on the basis that such a move strengthens the principles of PLS, which are considered core ideals and embodied in the paradigm of Islamic banking. Besides, the floating rates are contingent on a company's balance actualities, a situation that is contrary to others that depend upon benchmarking references; for instance, the London Interbank Offered Rate (LIBOR).

3.4.3 Fixed-rate Zero-coupon Sukuk

Organizations use fixed-rate zero coupon sukuk only when assets that need to be mobilized are not yet available. As a result, fund mobilization attains the objective of increasing a company's assets through istisna'a contracts. Nonetheless, the certificates are not immediately ready for trading because of the restrictions of Shari'ah. Thus, by nature, istina'a contracts and installment sales and purchases that fulfill debt obligations warrant the primary pools that the certificates generate.

3.4.4 Hybrid/Pooled Sukuk

These sukuk enable greater mobilization of funds because they work in a way that, in their structure, combines multiple Islamic finance contracts such as Mudarabah and Ijarah.

3.5 Main Structures of Sukuk

3.5.1 Pure Sukuk al-Ijarah

These sukuk are ideal when mobilizing funds for funding long-term projects, especially infrastructure projects. Thus, the sukuk are extended to a large number of individual and institutional investors to ensure that the objective is satisfied. In order to achieve this, the sukuk securitize physical and tangible assets such as airports, buildings, roads, and land. Importantly, these sukuk involve three parties, who are (i) the issuer, who doubles up as issuer and as trustee; (ii) the originator, who also acts as seller, obligator, and lessee (both in a sales undertaking and a purchase commitment); and (iii) the servicing agent, who is the investors in the sukuk.

3.5.2 Sukuk al-Mudarabah

These sukuk are certificates that represent all the activities and projects whose management is by the principles of a mudarabah contract. Such an approach is achieved by choosing any of the partners in the deal to take responsibility to act as the mudarib in managing the business. Thus, the mudarabah has three factors involved, which are (i) the mudarib, who is also the issuer; (ii) investors of the Sukuk, who are subscribers; and (iii) mudarabah capital, which is the amount of money mobilized. Importantly, the mudarabah sukuk holders are the owners of mudarab assets; further,

the owners of the capital share profits and suffer losses that occur in accordance with the agreed terms and agreement.

3.5.3 Sukuk al-Musharakah

These are certificated sukuk issued to each of the members of a partnership. They represent the equal value that the individuals issued as they mobilized funds for the partnership. Notably, the partners or the owners become owners of the project or the asset in equal shares to the value of the amount indicated in the certificate. The sukuk may be redeemable, meaning that the holder can give them to individuals and corporations, for general purchasing, obtaining commercial vehicles, starting factories and hospitals, and rehabilitating the owner whenever necessary. Organizations can also use musharakah sukuk to secure assets for large projects that require significant finance as capital. Notably, several parties take part in a sukuk al-musharakah. The first party is the issuer, who is the initiator of the project or activity and who invites others to fund the project. The second party is the subscribers, who are the investors who contribute their funds to the musharakah contract and are known as sukuk partners. Finally, the total amount mobilized consists of a summation of each member's contribution or share, whereby a certificate is issued to represent the proportion that each member contributed when they became subscribers. Subscribers or the owners of such certificates own the project or the asset. Each subscriber is entitled to a share of the profit that the project or asset realizes.

3.5.4 Sukuk al-Salam

This sukuk works on the basis that goods paid for will be delivered at a later date. As such, the sukuk work on a salam principle whereby the purchaser makes an advance payment to a property that will be given later. Thus, the purchaser will receive

a certificate representing the amount issued for the sale of the capital mobilized. Notably, the salam can afterward enter into another contractual relationship and forward the sale to someone else, using a contract that is parallel to the initial contract. Importantly, the sukuk al-salam has several factors: the issuer, who is the seller of the asset under salam; the subscriber, or certificate holder, who is the person buying the asset; and the funds collected, or salam capital, which represent the asset purchase price. The salam holder and the salam capital can also claim the salam asset because they are entitled to do so. The final factor is the salam price, or the price the salam is sold as part of a parallel agreement, if any occurs.

3.6 Differences between Sukuk and Bonds

Differences between sukuk and conventional bonds in Islamic finance empirical literature are usually examined in terms of issuance structure, regulatory/legal requirements, diversification/alternative investment opportunities, and the effect on returns. For example, while some studies such as Cakir and Raei (2007) and Godlewski et al. (2011) show that sukuk are alternative investment outlets, Ariff et al. (2013) and Fathurahman and Fitriati (2013) demonstrate that sukuk have significantly higher risks than conventional bonds and hence higher returns. Nonetheless, Alam et al. (2013) report a negative relationship between sukuk issuance and returns.

Arguing for the similarity between the two debt instruments, Nagano (2017) contends that sukuk issuance follows conventional corporate finance theory. This was observed in the reduction of information gathering costs between issuers and investors following an increase in the number of sukuk issuers due to sukuk market development. Likewise, Mohamed, Masih, and Bacha (2015) utilize a partial

adjustment model of debt and conclude that sukuk issuance follows conventional corporate finance theory. Specifically, the authors argue that sukuk issuance follows trade-off theory through optimization of company behavior. They also observe support for the pecking order theory of capital structure in some partnership-based sukuk when companies are faced with higher costs arising from information asymmetry. Further evidence supporting the assertion that sukuk follow corporate finance theory is observed in Godlewski, Turk-Ariss, and Weill (2013) and Klein and Weill (2016), where information asymmetries via moral hazard and adverse selection are found to enhance companies' choice to issue sukuk.

Other empirical research highlighting similarities between sukuk and conventional bonds includes examinations of the execution of contracts under sukuk that are structured in a similar way to conventional bonds (Cakir & Raei, 2007) and sukuk returns that mirror conventional bond returns (Miller, Challoner, & Atta, 2007).

In terms of issuance and regulatory structure, Zulkhibri (2015) argues that in order to integrate Islamic finance into the global financial market and harness the advantages of sukuk issuance, there is a need for Shari'ah-compliant transactions in secular Western economies. This integration may be achieved by incorporating Shari'ah into the laws of the country concerned, such that Shari'ah governs Islamic financial transactions. This clearly marks another major difference, as observed in Table 2.1, since the laws applicable in a secular country already cover bondholders. Zulkhibri (2015) further notes that the existence of sound accounting and reporting standards ensures a well-regulated Islamic financial system. This is of particular importance since the main essence of Islamic finance is to ensure equity and fairness in financial transactions (maqasid al-shari'ah). Nonetheless, the problem of sukuk

default has been traced to sukuk structures that mirror conventional bond structures, especially in terms of mismatching relevant jurisdictions, ill-defined property rights, and the choice of legal rights (Majid, Shahimi, & Abdullah, 2010; Wijnbergen & Zaheer, 2013; Zulkhibri, 2015).

Empirical literature also suggests that macroeconomic factors influence Sukuk market development, as occurs in the conventional bond market. For example, GDP per capita, population, and trade-openness in Said and Grassa (2013) are observed to have a significant and positive economic impact on sukuk market development in a similar way to the effect on the conventional bond market. Nonetheless, the bond market in the same study is also noted to have a positive effect on sukuk market development, suggesting that the two financial debt instruments (conventional bonds and sukuk) complement each other and are not substitutes. In a similar study, Ahmad, Daud, and Kefelia (2012) employ a series of econometric techniques and find that a country's business cycle, inflation rate, and GDP are all important determinants of sukuk market development. Specifically, sukuk is found to Granger cause GDP, while GDP Granger causes both the business cycle and inflation; moreover, in the short term, the sukuk market is driven by its own dynamics. Sukuk, like most other assets, carry face values that are typically proportional or based on the assets' market values and can be bought at a discount or premium by investors (Usmani, 2008). However, conventional bonds are long-term debt instruments issued by companies or the government. Sukuk and traditional bonds generate two streams of cash flows for their holders as follows.

1. Face Value: The fixed amount of funds the bond issuer pays to bondholders at maturity.

2. Coupon/Interest: The fixed amount of funds the bond issuer pays bondholders periodically until maturity. Such a period can be semi-yearly or yearly, depending upon the contract.

Sukuk entitle the holder to the ownership of existing resources or a pool of diversified tangible assets (Jobst, Kunzel, Mills, & Sy, 2008). The risk and return associated with the related cash flow is proportional to that of the underlying assets. In the following, we highlight the key differences and similarities between sukuk and conventional bonds.

1. Sukuk owners claim the ownership of assets and their cash flows.
2. Sukuk returns can be estimated from the associated underlying resource as opposed to the traditional/debt regime that is often associated with predetermined returns.
3. By holding sukuk, it is possible that the value of an associated asset may appreciate or depreciate and hence influence Sukuk returns, unlike fixed conventional bond returns. This also means that the returns are not guaranteed at maturity.
4. A sukuk contract represents a seller–buyer relationship as opposed to bonds' customer–lender relationship.
5. The assets associated with sukuk can be tangible or intangible, existing or with deferred delivery, usufruct, etc., while bonds are only associated with non-existent resources.
6. Sukuk returns can be fixed or variable.
7. LIBOR is utilized in pricing and valuation, like many other conventional bonds and Eurobonds.

Even with the above-demonstrated similarities between sukuk and conventional bonds, some studies provide different views. For instance, Cakir and Raei (2007) assert that sukuk can be fundamentally different from conventional bonds. They suggest that sukuk are essentially less risky compared with conventional sovereign bonds. Examining a portfolio of various sukuk and Eurobond contracts from the same issuer, the authors compare the VaR for a hybrid portfolio to a portfolio that holds only Eurobonds. According to the authors' estimation, sukuk reduce the overall portfolio risks when added and can create diversity for investors. Tables 3.1, 3.2, 3.3 and 3.4 summarize the structural and other differences between conventional bonds and sukuk.

Table 3.1: Structural differences between conventional bond and sukuk

	Conventional Bonds	Sukuk
Asset ownership	Bonds do not give the investor a share of ownership in the asset, project, business, or joint venture they support. They are a debt obligation from the issuer to the bond holder.	Sukuk give the investor partial ownership in the asset on which the Sukuk are based.
Investment criteria	Generally, bonds can be used to finance any asset, project, business, or joint venture that complies with local legislation.	The asset on which Sukuk are based must be sharia-compliant.
Issue unit	Each bond represents a share of debt.	Each Sukuk represents a share of the underlying asset.
Issue price	The face value of a bond price is based on the issuer's credit worthiness (including its rating).	The face value of Sukuk is based on the market value of the underlying asset.
Investment rewards and risks	Bond holders receive regularly scheduled (and often fixed rate) interest payments for the life of the bond, and their principal is guaranteed to be returned at the bond's maturity date.	Sukuk holders receive a share of profits from the underlying asset (and accept a share of any loss incurred).
Effects of costs	Bond holders generally aren't affected by costs related to the asset, project, business, or joint venture they support. The performance of the underlying asset doesn't affect investor rewards.	Sukuk holders are affected by costs related to the underlying asset. Higher costs may translate to lower investor profits and vice versa.

Table 3.2: Sukuk versus conventional bonds in terms of return, issuers, and risk

Sukuk	**Conventional Bonds**
1. Income is generated from assets	1. Income is derived from debt instrument
2. Return is expected	2. Return is interest and pre-determined
3. Negotiability is restricted to specific types of Sukuk	3. Negotiable financial paper
4. Sukuk issue is a seller of assets	4. Bond issuer is a borrower
5. Sukuk holder is an owner of assets	5. Bond holder is a lender
6. Seller-Buyer relationship	6. Lender-borrower relationship
7. Business risk-return relationship	7. Issuer guarantees the payment of face value and periodic interest
8. Major risk lays with underlying assets	8. Major risk is with issuer – credit risk
9. Return is expected from the underlying assets	9. Interest payment is an obligation
10. Return of investor's capital cannot be guaranteed	10. Issuer is obligated to return investor's capital (face value)

Table 3.3: Structural differences between conventional bonds and sukuk

	Conventional Bonds	Sukuk
Asset ownership	Bonds do not give the investor a share of ownership in the asset, project, business, or joint venture they support. They are a debt obligation from the issuer to the bondholder.	Sukuk give the investor partial ownership in the asset on which the sukuk are based.
Investment criteria	Generally, bonds can be used to finance any asset, project, business, or joint venture that complies with local legislation.	The asset on which sukuk are based must be Shari'ah-compliant.
Issue unit	Each bond represents a share of debt.	Each sukuk represents a share of the underlying asset.
Issue price	The face value of a bond's price is based on the issuer's credit worthiness (including its rating).	The face value of sukuk is based on the market value of the underlying asset.
Investment rewards and risks	Bondholders receive regularly scheduled (and often fixed rate) interest payments for the life of the bond, and their principal is guaranteed to be returned at the bond's maturity date.	Sukuk holders receive a share of profits from the underlying asset (and accept a share of any loss incurred).
Effects of costs	Bondholders generally are not affected by costs related to the asset, project, business, or joint venture they support. The performance of the underlying asset does not affect investor rewards.	Sukuk holders are affected by costs related to the underlying asset. Higher costs may translate to lower investor profits and vice versa.

Table 3.4: Sukuk compared with conventional bonds in terms of returns, issuers, and risk

Sukuk	Conventional Bonds
1. Income is generated from assets	1. Income is derived from the debt instrument
2. Return is expected	2. The return is interest and is predetermined
3. Negotiability is restricted to specific types of sukuk	3. Negotiable financial paper
4. Sukuk issuer is a seller of assets	4. Bond issuer is a borrower
5. Sukuk holder is an owner of assets	5. Bondholder is a lender
6. Seller–buyer relationship	6. Lender–borrower relationship
7. Business risk–return relationship	7. Issuer guarantees the payment of face value and periodic interest
8. Major risk lies with underlying assets	8. Major risk is with issuer: credit risk
9. Return is expected from the underlying assets	9. Interest payment is an obligation
10. Return of investor's capital cannot be guaranteed	10. Issuer is obligated to return investor's capital (face value)

3.7 Risk Exposure

Assessing risk exposure is perhaps the most important element in any study aiming to investigate and contrast sukuk with other assets (Abdel-Khaleq & Richardson, 2006; Al-Zoubi & Maghyereh, 2007; Viceira, 2012). Although sukuk and conventional bonds have different structures, they may have similar risks; moreover, each also has its own risks. The following are the various risks associated with the holding of both assets.

1) Financial Risk. This is the risk when the issuer defaults on interest or face value or both. Although Sukuk and bonds both carry this risk, their remedial methods differ. Conventional bondholders have no choice but to chase the issuer for unpaid amounts through a lawsuit. Thus, there is uncertainty about how much can be retrieved from the original amount that is

due. However, in the case of a default, sukuk holders have recourse to the assets of the bankrupted individual.

2) Call Risk. This is the risk that a bondholder is obligated to sell the bonds back to the issuer. When market interest rates rise, conventional bonds are exposed to this risk. This situation may create significant cash flow problems to bondholders because they will not be receiving the higher market interest rates. In contrast, sukuk are not exposed to interest rate fluctuations (Bask, 2010; Tariq & Dar, 2007)

3) Liquidity Risk. This occurs when a bond cannot be sold in secondary markets because of a lack of interest. Such a situation can be equally applicable to corporate and municipal bonds in the US market, for instance, and to some sukuk. Sukuk can be entirely tradable, which means they also bear this risk (Hayat & Kraeussl, 2011).

4) Interest Rate Risk. When interest rates change, there is an inverse relationship between interest rates and bond prices. Thus, the overall return for bonds will change with the interest rate; however, such a risk is typically mitigated through holdings over long periods (Ahmad et al., 2012; Tariq & Dar, 2007).

5) Purchasing Power Risk. Rising inflation rates can reduce conventional bond yields while strengthening sukuk returns because the latter's underlying asset values increase with inflation (Usmani, 2008).

6) Foreign Exchange Risk. Fluctuations in market currency influence both sukuk and conventional bonds. However, sukuk, which are liquid, namely short term, have less exposure to this risk (El Shazly & Tripathy, 2013).

7) Price Risk or Collateral Risk. Sukuk are exposed to the risk of depreciation in the value of their corresponding assets upon maturity (Tariq, 2004; Usmani, 2008).

8) Shari'ah and Legal Risk. Risks resulting from the violation of Shari'ah fundamentals or changes in policies apply only to sukuk. Suck risks are more pronounced in countries that do not comply with Shari'ah (Hesse et al., 2008).

9) Operational Risk. The risk of delay in accruing the benefits of the underlying asset or cash flow for operational reasons (Tariq & Dar, 2007).

Of the foregoing, systemic market risks include interest rates, foreign exchange, price risks, and commodity risks. These are addressed in detail by a considerable amount of literature. The risks also include idiosyncratic risks such as credit, Shari'ah, and operational risks (Hayat & Kraeussl 2011). Interest rate risks are similar for sukuk with fixed rates and conventional bonds with fixed rates. When market rates rise above the coupon's value, the value of fixed rate sukuk falls. Foreign exchange and currency risks vary with time and influence both assets. There are also some specific risks associated with the operation and issuance of sukuk, in accordance with their structure. Additionally, coupon risks associated with the obligor failing to pay on time may also occur. Moreover, the associated asset may not be fully redeemed, thereby exposing the sukuk holder to redemption risks (Alhabshi, 1994).

Further, sukuk structures expose sukuk to liquidity risks because there is no up-to-date and well-structured secondary market for trading, and most of the certificates tend to be held until maturity. Assets associated with sukuk may also be

subject to the risk of asset loss or depreciation. Such risks are usually mitigated by the Islamic form of insurance (Tariq & Dar, 2007).

As is the case for all assets and securities, institutions and governments must evaluate and manage bonds' risks. The 1988 Basel Accord suggested regulations and guidelines for credit and market risks. The novel formation and structure of sukuk inherently mean that sukuk have greater exposure to certain markets, assets, and, hence, risks. Overall, the Islamic financial regime has its own structure and risks, as do sukuk (Tariq, 2004). However, because of Shari'ah fundamentals, Islamic banks do not allow the issuance of, or trading in, derivative instruments and other high risk-bearing instruments, unlike conventional financial institutions (Tariq, 2004).

Sukuk markets mainly operate in emerging nations where less sophisticated risk management expertise and mechanisms exist compared with the developed traditional bond markets. The marked-up pricing of debt at a higher rate is not permissible because of the Shari'ah prohibition of interest. Consequently, counterparties in the market are, accordingly, inclined to default on their commitments to other parties. In addition, institutional fees are higher in accordance with PLS arrangements. Recently, diversified sukuk issuances have mainly involved assets based on ijarah, istisna'a, salam, and murabaha contracts, which have credit risk considerations at various levels (Azmat, Skully, & Brown, 2013; Bask, 2010; Dusuki, 2010). Additionally, sukuk-issuing institutions may have a difficult time developing and executing effective risk management strategies congruent with Shari'ah fundamentals (Khan, 2010).

More importantly, market risk in well-defined markets includes systematic risks that occur because of monetary policy and idiosyncratic risks because of

instruments that may differ from predominant market instruments (Hakim & Rashidian, 2002). Market risk includes interest rate and foreign exchange risks. With regard to sukuk, interest rate risks can be considered rate of return risks. Maturity terms also affect risk considerations. The longer a term, the higher the risk. Sukuk contracts with fixed rates may be exposed to risks in almost the same way as fixed-rate conventional bonds have market interest rate risks. Essentially, sukuk are indirectly exposed to fluctuations in interest rates through widespread benchmarking with LIBOR (i.e., in their financing operations). Opposing fluctuations of market rates also affect the creditworthiness of issuers unfavorably; hence, such fluctuations result in a higher credit risk (Tariq, 2004; Tariq & Dar, 2007).

3.7.1 Market Risks/Rate of Return Risk

Any rise in market interest rates may result in a noticeable decline in the value of fixed-rate sukuk. This is because the exposure of fixed-rate sukuk to rates of return is similar to that of fixed-rate bonds to interest-rate risk (Abdel-Khaleq & Richardson, 2006). Additionally, when a traded asset is not liquid, a reinvestment risk occurs in addition to the opportunity cost of investing at the new rate, as is the case with zero-coupon non-tradable sukuk. Essentially, sukuk are indirectly exposed to fluctuations in interest rates through widespread benchmarking with LIBOR. For instance, markup, which is a defining characteristic of a murabahah contract, is the most popular Islamic financial instrument on the asset side of the balance sheet (Wilson, 2008). Every contract benchmarked with LIBOR inherits the risk that future LIBOR rates will rise and that the issuer, on the asset side, may not have earned as much.

The liability side of the issuer's balance sheet is also of interest. This has provisions dependent upon varying market conditions. Sukuk issuers have to counter

fluctuations in LIBOR because any increase in earnings will have to be shared with the investors in accordance with the sukuk structure. On the asset side, meanwhile, repricing of murabahah contracts is not permissible because debts are non-tradable according to the Islamic financial regime (Jin & Ziobrowski, 2011). Thus, a conflicting situation occurs whereby a murabahah contract exposes the issuer and buyer to a considerable interest rate risk, albeit indirectly. Some sukuk issuances, such as IDB trust certificates, have assets that include murabahah receivables; hence, they are exposed to an interest rate risk.

3.7.2 Foreign Exchange-Rate Risks

Currency risks arise from unfavorable fluctuations that influence holdings in foreign currencies. Sukuk investors can also be exposed to such risks when held in foreign currencies. For instance, according to the IDB, an Islamic dinar (ID) is equivalent to one special drawing right (SDR) of the IMF, composed of 45% US dollars, 29% euros, 15% Japanese yen, and 11% British pounds. However, sukuk are denominated by US dollars and are consequently exposed to currency risk.

Over the last few years, this currency mismatch has been favorable for the IDB because of the weakness in the US dollar relative to the ID. Thus, such IDB strength has served as a guarantor and bench market protection for investors in sukuk with foreign currencies. This, however, may not completely mitigate the exchange risk for sukuk originators. Generally speaking, with fast-growing and globalized market-based economics, currency exchange rates become more volatile and hence pose greater risk exposure to financial instruments. As such, issuing institutions and governments should implement effective exchange-risk management strategies that are compliant with Shari'ah principles (Grewal, 2007; Khan, 2010).

3.7.3 Credit and Counterparty Risk

This risk occurs when an asset or loan becomes irrecoverable because of default or a delay in settlement. Chapra and Khan (2000), Khan and Ahmed (2001), and El-Hawary, Grais, & Iqbal (2004) identify various credit risks that are unique to Islamic finance. Sukuk trade in emerging markets, where counterparties enjoy less sophisticated risk management mechanisms and the rescheduling of debt at higher rates is not permissible because of the prohibition of interest; thus, counterparties are more inclined to default on their commitments to other parties.

3.7.4 Default and Coupon Payment Risks

These risks can result in contract termination in the case of obligor default. When a sukuk obligor fails to pay the rental due on the ijarah, namely the coupon payment, the holder may exercise the right to nullify the contract and force the defaulting obligor to purchase the assets back, against the obligor's will and at a non-favorable value. Further, legal action can be taken against the obligor if they fail to return the principal amount. Delayed funds, due to obligor failure to pay on time, are subject to a specified penalty payment amount, typically accumulated with the SPV (Tariq, 2004; Viceira, 2012). Shari'ah boards recommend that such funds are donated to charity.

3.7.5 Asset Redemption Risk

Redemption risk is more likely to occur when the originator has to purchase an asset back because the originator may not be able to afford the purchase at that time (Tariq, 2004).

3.7.6 Liquidity Risk

Because of the lack of a well-structured and adequate secondary liquid market, sukuk are exposed to liquidity risk. Usually, sukuk are listed on several local markets that may be unable to provide the desired liquidity. Sukuk certificates are usually medium to long term in maturity; further, their long-term success largely depends upon their ability to provide higher liquidity with adequate risk management mechanisms. Moreover, fixed-rate sukuk bear this risk in a very similar way to fixed interest rate bonds. However, sukuk certificates are directly exposed to interest rate fluctuations because of benchmarking with LIBOR (Tariq, 2004). Opposing alterations in market rates may even unfavorably alter the credit history of issues. Further, sukuk are exposed to foreign currency-rate risks just like any negative exchange-rate fluctuations. With such, there is a school of thought that suggests sukuk as an ideal tool for liquidity management and the mobilization of fresh funds. The collateral assets eventually make them a safe form of asset. Indeed, existing asset-backed securities can be bundled together and transformed into new sukuk that can, in turn, generate fee income (Bask, 2010; Giot & Laurent, 2003).

Investors can choose between fixed or variable returns depending upon future market expectations and have the opportunity to finance infrastructure projects. In this regard, sukuk have become a vehicle for the equitable distribution of wealth because they allow investors to benefit from true economic profits in equal shares (Vishwanath & Azmi, 2009). Additionally, because sukuk are asset-backed, they provide asset security or corporate guarantees (referred to as special vehicles in sukuk contracts) to investors even in the case of default. Sukuk also undergo credit rating and auditing procedures similar to conventional bonds. Ab Majid et al. (2010) suggest that sukuk

default occurs primarily because of a breach of binding obligations in the agreement between the issuer and holder.

Cakir and Raei (2007) examine the considerable risk-reduction advantages of holding sovereign sukuk. Using the case of sovereign Sukuk and euro bonds from similar issuers, they estimate and compare the VaR for a portfolio that includes both instruments with one that only has Eurobonds. The results indicate lower VaR when sukuk are added to the portfolio, demonstrating the diversification benefits of sukuk. However, Godlewski et al. (2011) suggest no significant market reaction to conventional bond issues but a significant negative stock market reaction to sukuk. The researchers attribute the different markets' reactions to two factors. First, investors expect an adverse selection mechanism to encourage the less healthy entities to prefer sukuk over conventional bonds. Second, investors may think that if companies issuing sukuk are prevented from entering the conventional bond market, they can still take advantage of excess demand for sukuk from Islamic banks.

Tariq and Dar (2007) study how expanding sukuk markets have highlighted Islamic property-based securities in emerging economies. In this context, the authors consider the securities' fluidity, credit ability, and market risk. The ultimate goal is to evaluate sukuk structures and gauge the numerous risks associated with Islamic private and commercial structures. Such worthwhile examinations have been undertaken by investigators such as Elgari (1997), Kahf (1997), and Zarqa (1997) with regards to funding in Islamic economies.

Further, Al-Suwailem (1999) and El-Gamal (2001) inspect the consequences of doubt and uncertainty in Islamic economies that may develop into pivotal points regarding Islamic risk management instruments. Nevertheless, Godlewski et al. (2011)

suggest that there is no noteworthy reaction in the market to traditional bond issues and that there may be considerable negative reaction to the sukuk by the market. The literature contrasts the different stock market reactions to such assets; for example, the study by Hayat and Kraeussl (2011) indicates that Islamic equity funds (IEFs) can be typical investment vehicles that receive neutral reaction. However, IEFs must comply with numerous ethical and financial criteria before acceptance in accordance with Islamic law. Over the last decade, the IEF industry has exhibited solid growth; minimal academic literature has analyzed the funds, though.

In a prior investigation (Hayat & Kraeussl, 2013), the performance of IEFs is examined. The researchers utilize well-known techniques to develop estimated coefficients for systematic risk (beta), risk-adjusted return (alpha), market timing (gamma and theta), and downside risk (relative beta) using the excess returns of 145 open-ended IEFs over the decade following the year 2000. On average, IEFs have underperformed both Islamic and conventional benchmarks considerably prior to including management fees. The authors also find that globally invested IEFs, surprisingly, have the worst performance, while locally invested IEFs perform slightly better. Throughout the recent financial crisis of 2008–09, this underperformance has further increased.

Such a finding is surprising because it widely contrasts with the prior literature, which asserts that IEFs perform better during bear than bull markets (Hayat & Kraeussl, 2011). However, to thoroughly examine market timing, the investigators also employ parametric and non-parametric approaches, only to find that, based on numerous robustness tests, IEFs are poor market timers. The authors also explicitly analyze the downside risk as a potential explanation for inferior performance, but find

that IEFs do not possess any significant downside risk. Moreover, one should note that next to being relative underperformers, IEFs possess some unique and specific risks that cannot simply be modeled with existing conventional investments because they are dissimilar. Such risks include the changing Shari'ah rules, the evident lack of sufficient historical data, high exposure to companies that may be suboptimally leveraged, and considerable exposure to companies with low working capital. Indeed, such risks should be taken into account when assessing IEFs as an investment alternative in order to yield accurate judgment. Meanwhile, it seems that IEF managers still need further time and experience before offering Muslims an investment instrument that is attractive in terms of risk and return, although prior research indicates the competitiveness of Islamic indices compared with conventional indices (Albaity and Ahmad, 2008).

Additionally, Hakim and Rashidian (2002) conduct a study on the risk and return of Islamic stock market indices. Introduced in 1999, the Dow Jones Islamic Market Index (DJIMI) has rapidly gained traction from Muslim investors worldwide. The index caters to the needs of investors seeking Shari'ah-compliant assets and equities. Further, it gives investors a viable benchmark to gauge the performance of Islamic funds/portfolios, whereby better-performing fund managers are rewarded while underperforming managers are penalized. As such, this index is an indication of the maturity process of Islamic financial markets, which is estimated today as having a value of US$251 billion (DinarStandard, 2013). However, even with such attractiveness, the stochastic properties of the DJIMI remain unexplored, primarily because of the absence of academic research.

Rusgianto and Ahmad (2013) conduct a study about the volatility behavior of the sukuk market. The aim of the study is to examine such behavior in terms of structural breaks. The Dow Jones Citigroup Sukuk Index (DJCSI) for 2007–2011 is used as a proxy of the global sukuk market. In their results, the authors indicate that structural breaks significantly alter the volatility behavior of sukuk. In other words, volatility during the pre-crisis period and the contemporaneous period is more sensitive to market events compared with the post-crisis period. The findings imply that in order to realize a more rational and efficient sukuk market, a need exists for policies that are more transparent, impose information disclosure, and offer better incentives to attract investors. Such policies could, in turn, lead to higher trading activities in the secondary market. Future research may develop a risk-return forecasting model incorporating the volatility behavior of the sukuk market.

However, Ramasamy et al. (2011) urge that sukuk are less risky than conventional bonds. Sukuk differ from governmental and conventional bonds as far as rates and the calculations of delayed payments are concerned (Bacha, 1996). Thus, with conventional finance, interest rates accrue and add to the principal because borrowers fail to repay their dues on time. As such, interest earns interest based on the length of the time the funds are utilized by the borrowers (Lydon, 2009). Such charges are not permitted by Shari'ah and are considered as mere markup (profit) because of delays in payment (Al-Omar & Abdel Haq, 1996). That said, in an Islamic-compliant regime, this exposure by the lender to risk also yields a higher return while offering investors a steady income stream, which, although low, is less risky when compared with shares. As such, sukuk are unique in character and pricing mechanism. Indeed, as a financial instrument, they eventually cannot deviate much from conventional bonds because arbitrage opportunities will emerge between the two markets. However,

overpricing of one asset and not the other will deter investors from parking their funds in sukuk while underpricing will attract everyone in a chaotic pattern. This necessitates the development of an efficient fair pricing mechanism to avoid arbitrage between Islamic and conventional bonds (Al-Zoubi & Maghyereh, 2007)

We can also say, generally, that government bonds should always be considered as safe and highly liquid, while offering lower yield. Sukuk are growing fast, along with governmental and conventional bonds. Sukuk funds invest, as per Shari'ah principles, in halal (permissible) businesses; as such, they are safer when compared with conventional bonds. When empirically analyzed for riskiness, however, the results reveal that sukuk are moderately more risky than governmental bonds and less risky than conventional bonds, indicating a possible lower return. Nonetheless, such an asset can offer a great opportunity to investors to diversify, even for those who do not follow Islamic laws. Ultimately, investors who resort to parking their money in the bond market are usually risk averse (Ramasamy et al., 2011).

3.7.7 Shari'ah Compliance

When issuers breach their responsibility to comply with Shari'ah, this can possibly result in the loss of asset value. Dissolution clauses of Sukuk prospectuses outline events that make contracts void because of Shari'ah noncompliance. If sukuk, for instance, are based on a hybrid of ijarah and istisna assets, ijarah must always have greater precedence than istisna otherwise the contract will dissolve (Usmani, 2008). As such, there is a risk of the ability of such sukuk to compete and survive in the market as distinct Shari'ah-compliant assets. There are numerous conflicts concerning the applicability of Islamic financial instruments in accordance with different schools of thought; hence, sukuk issuance and structure are affected, thereby posing a further risk.

For example, the applicability of the murabahah varies among diverse schools of thought. For instance, bodies such as the Organization of Islamic Cooperation's (OIC) Fiqh Academy asserts that murabahah contracts are binding only on the seller and not the buyer, while other schools of thought say that such contracts are binding on both (Vogel & Hayes III, 1998).

With regard to liquidity facility, sukuk prospectuses stipulate that a facility must limit lags between payments to investors and returns on underlying asset pools. Some facilities are formed to permit a trustee to improve the facility for any liquidity deficit ensuing from default in sukuk asset pools. The imbursement of liquidity services has been provisional upon surplus funds after the distribution of coupon payments to sukuk holders. The sole purpose of such a facility is to reduce lags between investor payments and returns on the underlying asset pools. The importance of such a liquidity facility can most effectively be appreciated when the arrangement has floating-rate payments because fixed-rate returns would imply the nonexistence of interest-rate differentials (Zakaria et al., 2012).

It is important to note that sukuk prospectuses are subject to the same fiduciary risks as Islamic banks (El-Hawary et al., 2004). As such, if compliance is not proved, originator reputation can suffer because investors would lose their confidence in the issuer, who would hence lose potential investments. Thus, overall, the association of Shari'ah auditors with sukuk issuances ensures investor confidence and market flow. However, devising mechanisms that assure compliance with competitive market conditions remains a challenge for sukuk issuances.

3.8 Risk and Return

The novelty of sukuk inherently entails a higher exposure to certain market and financial risks. The credit and counterparty risks inherent in Islamic finance are unique owing to the nature of Islamic financial instruments that have become the foundation of the sukuk assets pool. Unlike conventional financial institutions, Islamic banks do not have access to derivative instruments and other credit risk management mechanisms because of Shari'ah considerations.

Sukuk issuers operate, for the large part, in emerging markets where counterparties possess less sophisticated risk management mechanisms. The rescheduling of debt at a higher markup rate does not occur because of the prohibition of interest. Consequently, counterparties are more inclined to default on their commitments to other parties. Agency costs are also higher with regard to PLS arrangements.

Recent major sukuk issuances have mainly involved assets based on ijarah, istisna'a, salam, and murabaha contracts. There are numerous credit risk considerations associated with these modes of finance. In addition, sukuk are exposed to a variety of systemic risks such as interest rate and exchange rate risks, and operational risks such as redemption and SPV-specific risks.

3.9 Literature Review of Sukuk Performance

OIC Fiqh legitimized sukuk in 1988; since then, sukuk have gained significant acceptance in the world's leading financial markets. This is because tangible assets back most Islamic financial transactions and a sukuk signifies asset ownership. In contrast, a bond is a real debt agreement between two parties, the investor and the

issuer (Omar, Abduh, & Sukmana 2013). Moreover, a sukuk is known as a method of mobilizing funds for supporting an investment but with an expectation of earning a future yield for settling obligations, thus enabling it to access financial markets (Nagano, 2017). However, Islamic bonds are designed in such a way that they adhere to the guidelines and regulations of Shari'ah, although they have the characteristics of both stocks and bonds (Klein & Weill, 2016). Sukuk are known for their low volatility, which makes them an even more stable option for investment (Alaoui, Diwandaru, Azhar, & Masih, 2014; Boumediene, 2015). Further, Nagano (2017) finds that large corporations with high demands for funding opt to use the sukuk market instead of the conventional debt market, especially when there is a significant need for financing in situations where information relating to the conventional debt market is not matched, meaning that accessing funds from banks may become difficult. Specifically, sukuk are a readily available option for large-scale funding that may be beyond the limits of the conventional debt market, especially from the banks.

Moreover, Azmat et al., (2014), upon further analysis, note essential characteristics that distinguish conventional bonds from Islamic bonds. For example, it is apparent that when choosing Islamic bonds, issuers do not have a similar approach as they would for a debt-deriving common bond. This is because they do not regard a debt-equity investment venture bond as an equity instrument. Besides, it is clear that the distance to the issuer, the type of sukuk, and the Shari'ah advisor's popularity determine the stock price (Godlewski, Turk-Ariss, & Weill, 2016). This means that the issuers must find ways to suit their preferential needs. They can achieve their aim by upholding Shari'ah principles consistently without considering fatwas.

Nevertheless, it is noted that Malaysian investors fail to react to the announcement of conventional bonds; however, they have an adverse reaction to sukuk in the stock market (Godlewski et al., 2013; Klein & Weill, 2016). This situation applies despite conventional bonds and sukuk being different before, during, and after the financial crisis that affected the whole world. In fact, when the two are compared in an empirical investigation, the announcement of conventional bonds and sukuk has caused a negative market reaction, although this reaction differed at specific times of the financial crisis period. For example, conventional bonds had negative effects only during and after the crisis, while sukuk had negative effects before and during the crisis (Alam et al., 2013).

Nevertheless, in the case of a single product, for instance sukuk only, there is a possibility of obtaining varying results during the crisis period from different international markets. For example, it is apparent that analyzing the sukuk market using wavelet technique during the crisis period shows that sukuk proved to be of high quality, while at the same time having less risk, with the Dubai Financial Market being the top index in the GCC region (El Alaoui et al., 2015). Moreover, when the analysis is conducted using the Markov switching technique, the results are impressive. For example, Aloui, Hammoudeh, and Hamida (2015) analyze the GCC sukuk market and Shari'ah-compliant stock. They find that when using two different regimes, the first shows that the bonds have higher means and a smaller variance, while in the second, the results are inverse. Moreover, the authors demonstrate that the regime determines the link between Shari'ah-compliant stock and sukuk. They also show that Shari'ah-compliant stock responds to the sukuk market's activities in an asymmetrical way. In addition, using dynamic conditional correlations for 1241 observations on a daily basis together with the multivariate integrated asymmetric power of an autoregressive

conditional heteroskedasticity (ARCH) model, Aloui, Hammoudeh, and Hamida (2015a) investigate the spillover of Shari'ah-compliant stock with sukuk in the GCC region. The researchers find that for corporate and financial services, sukuk and Shari'ah-compliant stock have a high correlation and an inverse interaction. In the second phase of their analysis, the researchers discover that in the GCC, there is behavior that exhibits itself as a dynamic conditional correlation, which is a spillover from the crisis period from the US. However, during the crisis, the Islamic indices showed detachment from conventional products, despite evidence of an adverse effect spreading from the crisis to conventional portfolios and Islamic bonds (Hkiri et al., 2017). In other words, Islamic finance is a safe option for investors who would like to diversify so that they can spread and minimize risks, especially during a financial crisis. In addition, when Aloui, Hammoudeh, and Hamida (2015b) use a wavelet squared coherency approach to determine the co-movement power between conventional bonds and sukuk in the GCC capital market, they realize that Shari'ah stock and sukuk have a dependent relationship that involves a kind of co-movement. This co-movement mostly depends upon time-frequency and the long-term effect.

Nonetheless, Arundina, Omar, and Kartiwi (2015) give neural networks priority over multinomial logit techniques when they conduct research to determine sukuk rating accuracy. They prove that sukuk ratings depend upon sukuk structure and share price. There is also a dissimilar transmission between the two, as revealed by a dynamic spillover index (Maghyereh & Awartani. 2016). Further, Maghyereh and Awartani (2016) discover that sukuk have high transmission mechanisms brought about by the availability of information relating to market equity, regardless of the slow integration of sukuk into other markets. Nevertheless, Kenourgios, Naifar, and Dimitriou (2016) note an advantage with Islamic portfolios, claiming that such

portfolios have the potential to protect investors against risks and economic instability, a benefit that was exhibited during financial crises. This is especially the case when sukuk are diversified and used in both developed and developing economies. Consequently, it is possible for investors to gain higher profits, provided that they can distinguish a domestic market from regional markets and have a strategy that enables proper resource allocation. Balcilar, Cerci, and Demirer (2016) unearth unmatched diversification options for sukuk that are unique in a way that conventional bonds are not. The authors base their argument on an examination of performance analysis. However, they discover that during financial crises, sukuk have a negative correlation with global stock markets. However, Nagano (2017) describes the importance of timing the market efficiently, especially when issuing sukuk. Notably, Nagano (2017) says that ordering should be in a sequence flow, starting from sukuk market accessibility, financial constraint, and undervaluation of the organization just before sukuk are issued. Similarly, Mohamed, Masih, and Bacha (2015) highlight two events. The first promotes trade-off theory for products in the process of achieving optimal behavior. The second indicates that the two product issuers mimic pecking order theory, whereas those who issue exchange-based sukuk and straight bonds use underlying growth opportunity theory. Consequently, each event is unique, although the uniqueness depends upon the preferred products and their target matches.

Regarding returns, Naifar (2016) discovers that sukuk returns depend upon the volatility of the stock market in Saudi Arabia. Further, with regard to the UAE, Malaysia, and Saudi Arabia, Islamic bond indices show that sukuk have a sensitive effect on the world's conventional stock markets compared with Islamic products in global, regional, and local markets (Naifar, Hammoudeh, & Al Dohaiman, 2016). Naifar and Hammoudeh (2016) decide to investigate the effect of economic policy, oil

uncertainties, and the global financial crisis on sukuk returns using quantile regression. Particularly in GCC countries, they discover that policy, uncertainty, and a crisis affect the lower quantile negatively; however, only a crisis affects the higher quantile negatively. The authors also note that gold uncertainty combined with bonds has no impact on sukuk returns in the GCC. Notably, according to Halim, How, and Verhoeven (2016), corporations suffering agency costs and still experiencing problems of underinvestment choose sukuk in most instances instead of deciding to issue bonds. This action suggests that sukuk can lessen the effects that underinvestment and agency costs cause to a corporation. Nonetheless, future studies should focus on cost and benefit analysis.

3.10 Conclusion

With such attention, sukuk transactions have shown solid growth over the last decade from US$8 billion to more than US$856 M globally (IIFM, 2016). By holding sukuk, it is possible that the value of associated assets may appreciate or depreciate and thereby influence sukuk returns, unlike fixed conventional bond returns. Sukuk are exposed to many types of risk such as liquidity and Shari'ah-compliance risks. More importantly, sukuk are exposed to market risk. In well-defined markets, the risks include systemic risks that occur because of monetary policy and idiosyncratic risks that occur because instruments may differ from predominant market instruments (Hakim & Rashidian, 2002). Sukuk are an ideal tool for liquidity management and the mobilization of fresh funds. They are a relatively safe form of investment because they are asset-backed. Existing asset-backed transitions can be bundled together and transformed into new sukuk. These instruments generate a significant amount of fees as income for Islamic financial institutions. However, investors may select fixed and

variable returns depending upon future market expectations. Investors also have the potential to finance infrastructure projects. Sukuk are a means to achieve the equitable distribution of wealth and enable investors to benefit from the true profits that result from enterprises in equal shares.

Chapter 4: Methodology

4.1 Introduction

The literature has identified some appropriate techniques for use in this thesis, namely the VaR approach and hedging analysis. The objective behind selecting these is as follows.

1. To measure and quantify the level of financial risk within a company over a specific time.
2. To determine the extent and occurrence ratio of potential losses in institutional portfolios.
3. To empirically explore the diversification benefits of sukuk in fixed income portfolios.

The rest of this chapter is organized as follows: section 4.2 describes the VaR approach used and section 4.3 describes hedging analysis.

4.2 Value at Risk Approach

The concept of value at risk was originally initiated as a substitute risk measure of variance by Bawa (1978). However, it was not until the early 1990s that the term "VaR" came into common use. According to Linsmeier and Pearson (1996), VaR provides a general and consistent measure of risk, taking into account a range of positions and risk factors. Through VaR, the risk linked with a fixed income asset can be measured in a way that is consistent with and comparable to the measure of risk linked with the equity position. Another feature of VaR is that it considers correlations among various risk factors. The methods by which VaR information could be utilized

for the provision of strategic risk assessments for managers, traders, and other employees have been discussed by Kuruc and Lee (1998). They suggest ways for dissuading the excess risk taking that takes place when traders are rewarded solely on the basis of profits. Such risk assessment could even be used in a portfolio context. The use of VaR for reporting and disclosing has been discussed by Jorion (1996), who observes that companies are progressively ensuring the reporting of VaR information in their annual reports. It has been suggested by Dowd (1999) that portfolio hedging approaches against the amount measured by VaR could be applied through VaR information.

The VaR model can perhaps be commonly regarded as a quantitative tool for the purpose of calculating the possible loss that could occur in a financial institution for a number of assets within a specific time period (Jin & Ziobrowski, 2011). The banking industry presently uses conditional VaR for the measurement of market risk since it is related to commodity, equity, interest rate, and currency risk. In financial institutions, VaR is acknowledged and regularly used because of its easy-to-comprehend definition: It sums up the possible inadequacy of a portfolio of assets into numbers stated as percentages or possibly nominal amounts in a selected currency (Jin & Ziobrowski, 2011). With regard to poor market risk, the market cost exposure from the financial instrument is measured through VaR, lest the next day could be statistically described as bad. Moreover, the risk–return profile of active market participants, for example resource managers or traders, could be measured through VaR (Jin & Ziobrowski, 2011). With regard to market risk, the market value exposure of a financial instrument can be measured through VaR if, for instance, the next day is a statistically defined bad day (Linsmeier & Pearson, 2000).

Even though there could be a single, strong, and distinct definition of VaR, the exact process of VaR application has not yet been confirmed. In accordance with its nature, the measurement of VaR relies strongly on good forecasts of catastrophic risk or unusual happenings. Thus, modeling the returns precisely is essential. It is because of its easily comprehensible definition that VaR is well-known and extensively used by financial institutions (Cakir & Raei, 2007). Such use is also because VaR totals the potential loss of a portfolio of assets into a nominal amount in a selected currency or in a number stated as a percentage. In addition, the risk–return profile of active market members such as asset managers or traders can be qualified through VaR (Jorion 1996; Pérignon & Smith, 2010).

With regard to modeling the returns distribution, the following traditional techniques are used: (1) stress testing (scenario analysis), (2) parametric techniques (analysis based), (3) Monte Carlo simulation, and (4) historical simulation (Al-Zoubi & Maghyereh, 2007).

However, there are certain Islamic finance indices such as the DJCSI in capital markets that could be utilized for calculating and measuring sukuk risks. The DJCSI was formulated to evaluate the performance of global Islamic fixed-earnings investments. The overall approach from the set of Citigroup fixed earnings indices and even the DJIMI approach for inspecting investments for Shari'ah compliance are followed by the DJCSI. This latter index could be benchmarked by sukuk traders in US dollar-denominated investment-grade sukuk issued within the international market. Those that have been verified for Shari'ah compliance in accordance with the index approach, are also included in the index. In the Islamic indices (from the

beginning), the usual return is an expected 83.94%. However, there is a more sensible 8.45% in the five-year return in the Islamic indices (Al-Zoubi & Maghyereh, 2007).

The worst possible loss of a portfolio within a particular holding period at a set confidence level under normal market conditions is measured through VaR (Jorion, 1996). The analysis of whether the initiation of sukuk bond portfolios leads to any diversification advantage is undertaken through a VaR approach. This projection of the distribution of future portfolio values and the measurement of potential losses by utilizing past data could be undertaken through different techniques such as simulation methods (Pérignon & Smith, 2010). Basically, VaR is a representation of a portfolio's market risk, signifying the maximum amount that could be lost during the holding period, in every case, except possibly 1%. For instance, through the VaR approach, it can be known with a confidence level between 0.99% and 1% that a given number of US dollars will be lost in a particular year, month, or day. Thus,

$$\sigma p = w \Sigma w \tag{4.1}$$

where Σ = the variance-covariance matrix of returns on securities in a portfolio, w = the vector of weights for the different securities in the portfolio, and w' = the transposed vector of weights in the portfolio.

A portfolio's VaR can be formed through a grouping of the risks of the main securities. It basically includes cover for the correlation and volatility within the different risk variables over time. With regard to the measurement of VaR, different approaches could be used. A commonly utilized approach is the variance-covariance method, also known as the delta-normal technique. Through this method, the worst 1% and 5% on the curve can be ascertained easily through the Gaussian normal

distribution curve, which is expressible in terms of the confidence interval, the standard deviation, and the mean. A key assumption here is that returns are jointly normally distributed. Through the following equation, a portfolio's VaR can be calculated:

$$VaRp = -(\mu p - \alpha \sigma pW) \quad (4.2)$$

where W = the initial portfolio value, μp = the average return of the portfolio, and α = the standard normal deviate (for the 99% confidence level).

It is evident through the above formula for VaR of an asset that a smaller VaR is implied through lower volatility, which is quite preferred. If the returns of the constituent assets have small or even negative correlations, a lower volatility is achieved in a portfolio of assets. Gains through diversification occur through diversification of a portfolio of assets whose outcomes are not extremely positively correlated (Cakir & Raei, 2007).

Even though there are certain shortcomings, the VaR calculation is made suitable through the normality assumption. As opposed to the symmetry represented in normal distribution, there are two common methods in which asset returns deviate from symmetry. By using suitable approaches, these sets of asset returns can be estimated by modeling volatility (this will be discussed later in the thesis). In calculating asset returns, fat tails are quite usual, indicating that extraordinary losses could occur more often than the times they have been forecast through normal distribution. In addition, asset returns are frequently negatively skewed, with more observations on the left side than the right (Dowd, 1999; Hayat & Kraeussl, 2011).

The Monte Carlo simulation method, as opposed to the delta-normal approach, requires less strong assumptions. However, it involves more calculations. At first, for the price paths, stochastic data-generating procedure is stated, and through the data, parameters such as correlations and risks are derived. Next, for all variables of interest, price paths are simulated through computer-generated random numbers. In order to create a distribution of returns, all these pseudo realizations are utilized. Through this approach, a VaR figure is calculated. As is the case with all other approximations, the projected VaR could have faults in approximation. Thus, these shortcomings should be taken into account before making any significant explanation, comparison, and implementation of the projected VaR (Linsmeier & Pearson, 1996; Linsmeier & Pearson, 2000).

In the Monte Carlo simulation approach, the precision of any projected parameter is proportional to 1/n where n is the total count of iterations. Monte Carlo simulation approaches rely on computer-generated random numbers. Since these are not completely random numbers, they result in certain faults that reduce as n increases. With regard to the estimation faults, there is no closed form representation, so they will not be discussed further in this study. However, closed-form formulas are available for the standard errors of estimation using the delta-normal approach. The numbers for these have already been determined (Cakir & Raei, 2007; Dias, 2013).

4.2.1 Expected Shortfalls

According to Acerbi and Tasche (2002), a risk measure is coherent if and only if it is monotonous, sub-additive, positively homogeneous, and translation invariant. Failure to comply with any one of these four requirements invalidates the risk measure.

From this perspective, VaR is not coherent since it is not sub-additive. Sub-additivity implies that a portfolio made of sub-portfolios will have a VaR smaller than or equal to the sum of the sub-portfolios' VaR; in other words, diversification will reduce risk. This axiom is violated by VaR. Chen (2013) illustrates the lack of sub-additivity of VaR by considering two stylized, independent, and identical projects with a 2% probability of a US$10m loss and 98% probability of a US$1m loss. The 97.5% VaR on each project is assumed to be US$1m. Looking at the combined VaR, the loss distribution is as follows: a 0.04% (2%*2%) probability of a $20m loss, a 3.92% (2*2%*98%) probability of a US$11m loss, and a 96.04% (98%*98%) probability of a US$2m loss. The 97.5% VaR is then US$11m, which is higher than the combined VaRs of the two projects (US$2m).

The VaR approach also ignores tail risk: The α% VaR tells us that loss is not expected in more than α% of occurrences but says nothing about the potential loss should VaR exceeds. This is particularly problematic since our data display much bigger tails than predicted by the Gaussian distribution. The expected shortfall is an alternative market risk measure, defined as the average loss beyond VaR. The expected shortfall is a sub-additive risk measure (it is monotonous, positively homogenous, and translation invariant) and is thus a coherent measure of risk. We apply expected shortfall to our data to check whether they validate or invalidate the VaR results presented earlier.

Following Acerbi and Tasche (2002), let us assume that for day t, X_t represents the profit and loss of a portfolio, the distribution of which can be forecast by the predictive distribution P_t. Thus,

$$VaR_{\alpha,t} = P^{-1}{}_t(\alpha) \qquad (4.3)$$

and

$$ES_{\alpha,t} = -\frac{1}{\alpha}\int_0^{\alpha} P_t^{-1}(q)dq \quad (4.4)$$

In a (second) consultative paper published in January 2014, the Basel Committee for Banking Supervision (BCBS) proposed to move away from 99% VaR as a measure on which to base banks' capital requirements and to replace it with 97.5% expected shortfall. The main rationale for the change is that VaR is not sub-additive and ignores tail risk. Should returns be Gaussian, the two measures would be equivalent. However, should returns exhibit fatter tails then 97.5% expected shortfall, the returns would drive a higher capital charge. When effective, the new regulatory environment makes expected shortfall the prime market risk measure.

4.2.1.1 Model Set Up

In a generalized autoregressive conditional heteroskedasticity (GARCH)(p,q) model, the volatility regresses on p against past squared returns and q past variances. Thus, in the GARCH(1,1) version we have

$$h_t = a + br_t^2 + c\sigma_{t-1}^2 \quad (4.5)$$

where h_t is the conditional variance at time t, a is a mean-reversion parameter, and b and c the lag-one squared returns and variance coefficients respectively.

We implemented GARCH(1,1) with our data. In GARCH(1,1), the unconditional variance of returns is obtained as follows:

$$\sigma^2 = a / (1- b -c) \quad (4.6)$$

With most of our data, the constraint b+c>1 is not met; thus, the unconditional variance is undefined. In such cases, exponentially weighted moving average

(EWMA) models are normally preferred. We chose to focus on the RiskMetrics model (a EWMA model with lambda=0.94).

EWMA is a special case of GARCH(1,1), where the mean reversion parameter is omitted and the condition b+c=1 is imposed. With EWMA, past data are given declining weights: (t-1) data is assigned weight 1, (t-2) data weight (1- λ)λ, (t-3) data weight (1- λ)λ)^2, … , (t-i) data weight (1- λ)λ) ^(i-1). The entire series conveniently reduces to the following recursive formula:

$$h_t = \lambda\sigma_{t-1}^2 + (1-\lambda)r_{t-1}^2 \tag{4.7}$$

where λ is the decay parameter (the higher the value of λ, the lower the decay). The RiskMetrics version of EWMA uses λ=0.94 for daily data. The sample mean of squared residuals is used to start recursion.

We next implemented and backtested the RiskMetrics model.

4.2.1.2 Backtesting

Backtesting is a statistical procedure that compares actual profit and loss numbers to VaR estimates with the aim of checking the VaR model's ability to capture actual risks. The simplest backtesting approach is to test whether the actual frequency of exceptions (losses higher than VaR) is statistically different from that suggested by the VaR confidence interval. Since such tests are called "unconditional coverage" tests, we will use the Kupiec likelihood ratio (LR) test. A limitation of such a test is that it ignores the timings of the exceptions. Should exceptions cluster in specific periods, this would also invalidate the VaR model (since the model would then fail to capture volatility and/or correlation changes). Backtesting techniques that address this

shortcoming are called “conditional coverage” tests and include the Christoffersen test and the dynamic quartile of Engle and Manganelli. We apply the latter.

4.2.1.3 Unconditional Coverage Test

Each trading outcome either produces a violation or does not. The number of exceptions thus follows a binomial distribution, which for large samples, as in our case, can be approximated using the normal distribution. For a (1-α)-VaR model, the Kupiec LR test checks whether the frequency of exceptions is statistically different from α; namely, the null hypothesis is

$$\text{H0: } \alpha = \hat{\alpha}, with\ \hat{\alpha} = \frac{x}{n} \tag{4.8}$$

where x is the number of exceptions, n is the sample size, and hence $\hat{\alpha}$ is the observed exception frequency.

The test is conducted as a likelihood ratio and the test statistic takes the form

$$Kupiec\ LR = -2ln\left(\frac{\alpha^x(1-\alpha)^{n-x}}{\hat{\alpha}^x(1-\hat{\alpha})^{n-x}}\right) \tag{4.9}$$

Under H0, the statistic asymptotically follows a chi-squared distribution with one degree of freedom.

In order to further test the validity of the foregoing modeling approach, we computed the test statistic and associated p-values for both long (quantile losses) and short (quantile profits) positions. Annex 1 presents the results’ tables. They show that the backtesting results are mixed and that, in a significant proportion of cases, the null hypothesis that the frequency of exceptions is equal to the VaR confidence level is rejected. Specifically, we observe that the frequency of exceptions on long positions (quantile losses) exceeds that expected under a normality assumption, a finding that is

consistent with our earlier analysis of non-normality of the data. This observation applies to all considered confidence levels. We also note that results are far more mixed for short positions (quantile profits), highlighting the asymmetric impact of news. Negative news (evidenced by price drops) is known to have a greater impact on volatility than positive news (evidenced by price increases) of a similar magnitude, which is what we find. This is known as the leverage or asymmetric effect (as an illustration, the volatility index (VIX) tends to increase in a bearish stock market and decrease in a bullish one).

4.2.1.4 Conditional Coverage Test

A limitation of unconditional tests such as the Kupiec LR test is that the timing of exceptions is ignored. Engle and Manganelli (2004) argue that, for a VaR model to be validated, exceptions must be uncorrelated as well as unbiased and that any noise introduced into the VaR measure would change the conditional probability of an exception. Rather than modeling the whole distribution, their approach is to model the quantile directly. Specifically, they apply a conditional autoregressive quantile specification (called CAViaR).

Let θ be the probability associated with VaR, let x_t be a vector of time t observable variables (chosen to be lagged returns), and let β_θ be a p-vector of unknown parameters. Finally, let $f_t(\beta) \equiv f_t(x_{t-1}, \beta\theta)$ denote the time t θ -quantile of the distribution of portfolio returns formed at time t-1, where the θ subscript is suppressed for β_θ for notational convenience. We now have

$$f_t(\beta) = \beta_0 + \sum_{i=1}^{q} \beta_i \, f_{t-i}(\beta) + \sum_{j=1}^{r} \beta_j \, l(x_{t-1t-j}) \qquad (4.10)$$

where p=q+r+1 is the dimension of β and l is a function of a finite number of lagged values of observables. The autoregressive terms $\beta_i f_{t-i}(\beta)$,i = 1,..., q, ensure that the quantile changes "smoothly" over time. The role of $l(x_{t-j})$ is to link $f_t(\beta)$ to observable variables that belong to the information set. In our analysis, we use p=5.

Under the assumptions of consistency and asymptotic normality, we now proceed to derive a dynamic quantile test based on a regression of the exceptions on their lags, which follows a chi-squared distribution.

Annex 2 contains all the results (for both individual companies and the indices). The results largely conform to the Kupiec LR test results.

4.2.2 EGARCH and the Asymmetric Impact of News

One weakness of GARCH models is that they do not consider the asymmetric impact of news: Negative news (evidenced by price drops) is known to have a greater impact on volatility than positive news (evidenced by price increases) of a similar magnitude. This is known as the leverage or asymmetric effect. As an illustration, the VIX (an equity volatility index) tends to increase in a bearish stock market and decrease in a bullish one. One method to address this asymmetric news impact is to use an exponential GARCH (EGARCH) model. The EGARCH model differs from GARCH in two respects. First, it allows negative unexpected returns to have a greater impact on volatility than positive unexpected returns. Second, it allows big news (as evidenced by the absolute size of the unexpected return) to have a greater impact than in GARCH. EGARCH takes the following form:

$$\log(h_t) = a + c.\log(h_{t-1}) + \gamma.\frac{\varepsilon_{t-1}}{\sqrt{h_{t-1}}} + b.\left[\frac{|\varepsilon_{t-1}|}{\sqrt{h_{t-1}}} - \sqrt{\frac{2}{\pi}}\right] \quad (4.11)$$

where a, b, c, and γ are constants and γ is generally negative so that positive return shocks will have a lower impact on volatility than negative return shocks.

Engle and Ng (1993) derive what they call the "news impact curve" of both GARCH and EGARCH. This curve measures the way that past returns' shocks (ε_{t-1}) are incorporated into current volatility estimates (h_t). The news impact curve of the GARCH model is symmetric (quadratic) and is centered around ε_t=0: Positive and negative return shocks of the same magnitude generate the same amount of volatility. In contrast, the news impact curve of EGARCH has a greater impact on volatility for negative shocks than positive (since γ is typically negative), as expected. Engle and Ng (1993) also show that EGARCH allows for large shocks, independently of their sign, to have a greater impact than with GARCH.

Engle and Ng (1993) examine whether some variables observed in the past and not included in the volatility model can predict the squared normalized residuals. Should these variables predict the squared normalized residuals, the variance model would be invalidated. The authors propose four Lagrange multiplier (LM) diagnostic tests to examine whether we can predict the squared normalized residuals by past variables not included in the linear volatility model: the sign test, the negative sign bias test, the positive sign bias test, and a joint test for the three prior effects.

The sign test examines the impact of positive and negative news on the conditional variance not predicted by the linear model. Let S_{t-1}^{-} and be a dummy variable that takes the value 1 when ε_{t-1} is negative and 0 otherwise. The test looks at whether S_{t-1}^{-} has any predictive power on the standardized squared residuals ε_t^2/h_{0t}, where h_{0t} is the unconditional variance under the null hypothesis. The sign test (as

well as the three following tests described below) is calculated as a t-ratio using a regression model.

The negative sign bias test looks at whether the linear model explains the different effects between small and large negative shocks. This is undertaken by looking at $S_{t-1}^{-}.\ \varepsilon_{t-1}$. Similarly, the positive sign bias test considers whether the linear model explains the different effects of small and large positive shocks by examining $S_{t-1}^{+}.\ \varepsilon_{t-1}$, where S_{t-1}^{+} is a dummy variable that takes the value 1 when ε_{t-1} is positive and 0 otherwise. Finally, the joint test looks at the three prior effects simultaneously.

Annex 3 presents the results of the four tests for our EWMA RiskMetrics version of GARCH. In all cases, the null hypothesis that the conditional variance follows an EWMA RiskMetrics process cannot be rejected at the 5% confidence level. This implies that we have found no evidence that our model failed to account for an asymmetric news impact fully.

4.3 Hedging Analysis Methodology

In this section, we present our methodology on the time-varying features of correlation (estimated with a dynamic conditional correlation (DCC)-GARCH model) between conventional bond and sukuk indices, both before and after the collapse of Lehman Brothers. Correlations are a key input in both hedging and asset allocation. Hedges require estimates of the correlation of the assets in the hedged portfolio. Further, if the correlations are changing, the hedge ratio should be adjusted accordingly. The construction of an optimal asset allocation relies on the specification of a variance-covariance matrix.

The DCC-GARCH model first proposed by Engle in 2002 is based on assuming a GARCH volatility process of the second moment of returns. This model allows for measuring the level of linear interdependence between markets over time. It calculates the time-varying correlations between any two markets. We estimate the DCC-GARCH model in a two-step process. In the first step, we compute a time-varying conditional variance using a multivariate GARCH(1,1) process. In the second step, we calculate the time-varying correlation matrix using the standardized residuals from the first step's GARCH model.

4.3.1 DCC-GARCH Model

Following Engle (2002), let $y_t = [r_{it}, \dots, r_{Nt}]'$ be a $N \times 1$ vector of log changes in indices of asset markets. The conditional mean equations can then be written as

$$A(L)r_t = \varepsilon_t, \text{where } \varepsilon_t \mid \Omega_{t-1} \sim N(0, H_t), \text{and } t = 1, \dots, T \qquad (4.12)$$

where A is a matrix, L is the lag operator, and ε_t is the vector of innovations based on the information set, Ω, that is available at time $t-1$. The ε_t vector has the following conditional variance–covariance matrix:

$$H_t = D_t R_t D_t \qquad (4.13)$$

where $D_t = diag\left(h_{i,t}^{1/2}, \dots, h_{N,t}^{1/2}\right)$ is a diagonal matrix that contains conditional volatilities and $h_{i,t}$ can be estimated by using a univariate GARCH(1,1) model. The R matrix is written as $R_t = diag(Q_t)^{-\frac{1}{2}} Q_t diag(Q_t)^{-\frac{1}{2}}$. The time-varying conditional correlations between conventional bonds and sukuk are elements in the time varying R matrix and are computed as

$$\rho_{ij,t} = q_{ij,t} / \sqrt{q_{ii,t} q_{jj,t}} \ for\ i \neq j \qquad (4.14)$$

We focus on these conditional correlations in this analysis. The $Q_t \equiv q_{ij,t}$ matrix is an N square symmetric positive-definite matrix that is obtained from the estimated univariate GARCH models of the variables and given by the following form:

$$Q_t = (1 - \alpha - \beta)\bar{Q} + \alpha u_t \acute{u}_{t-1} + \beta Q_{t-1} \tag{4.15}$$

where $u_t = (u_{1t}, \dots, u_{Nt})'$ is an $N \times 1$ vector of the standardized residuals of the first-step estimation, Q is an $N \times N$ unconditional variance matrix of u_t, and α and β are non-negative scalar parameters with a sum of less than unity that capture the effects of prior shocks and dynamic conditional correlations on current correlations.

When the restriction $a = \beta = 0$ is imposed, $\overline{Q}$ reduces to the constant conditional correlation (CCC) model. The conditional correlation coefficient $\rho_{ij,t}$ can now be expressed as follows:

$$\rho_{ij,t} = \frac{q_t^{ij}}{\sqrt{q_t^{ii} q_t^{jj}}}, \forall\, i \neq j \tag{4.16}$$

where $\rho_{ij,t}$ indicates the direction and strength correlation between asset markets. If the estimated $\rho_{ij,t}$ is positive and statistically significant, the correlation between asset returns is rising and moving in the same direction or vice versa.

Finally, the parameters in the multivariate DCC-GARCH model are estimated by using the quasi-maximum likelihood (QML) method of Bollerslev and Wooldridge (1992) that takes into account the fact that a joint multivariate normal distribution is violated often for financial series.[2] We employ Ljung–Box (LB) statistics for the

[2] We use the quasi-Newton method of Broyden, Fletcher, Goldfarb, and Shanno's (BFGS) algorithm with a convergence criterion of 0.00001. We estimate the multivariate DCC-GARCH model with WinRats 9.0 software.

squared standardized residuals to determine the adequacy of the estimated model of the conditional variances.

4.3.2 Hedge Ratios and Optimal Portfolio Weights

The estimated results derived from the multivariate DCC-GARCH model can be used to construct trading strategies that minimize unwanted risk without reducing expected returns for holding a two-asset portfolio. This study analyzes two trading strategies necessary to determine active portfolio risk management of bond stock prices with sukuk. More specifically, we compute the time-varying optimal hedge ratios and optimal portfolio weights. Following Kroner and Sultan (1993), we first consider the hedging problem as determining the rate at which a long position of one US dollar in one market (say market i) could be hedged by taking short positions in the other market (say market j) that minimize risk while keeping the same expected returns. Thus, for a holding portfolio of two market returns, the minimizing problem is given by[3]

$$\min_{\beta_t} var(r_{pt}) = \min_{\beta_t} \{var(r_{it}) + \beta_t^2 \times var(r_{jt}) + 2\beta_t \times cov(r_{it}, r_{jt})\} \qquad (4.17)$$

By solving the risk-minimizing problem (by the first-order and second-order derivatives of $var(r_{pt})$), the time-varying optimal hedge ratio $(\beta_{ij,t}^*)$ can be derived as

$$\beta_{ij,t}^* = \frac{Cov(r_{it}, r_{jt})}{var(r_{jt})} = \frac{h_{ij,t}}{h_{jj,t}} \qquad (4.18)$$

[3] This model specification agrees with most prior studies (Basher & Sadorsky, 2016; Bessler et al., 2016; Lin et al., 2014; Lin & Li, 2015; Sadorsky, 2012, 2014; among many others) on DCC hedging.

Alternatively, conditional volatilities from the DCC model can be used to construct an optimal portfolio that minimizes the portfolio risk without lowering the portfolio expected returns. Following the methods of Hammoudeh et al. (2014) and Kroner and Ng (1998), among others, the optimal weight ($w^*_{ij,t}$) for two assets is

$$w^*_{ij,t} = \frac{h_{jj,t} - h_{ij,t}}{h_{ii,t} - 2h_{ij,t} + h_{jj,t}}, \text{with } w^*_{ij,t} = \begin{cases} 0, & if \quad w^*_{ij,t} < 0 \\ w^*_{ij,t}, & if \quad 0 \leq w^*_{ij,t} \leq 1 \\ 1, & if \quad w^*_{ij,t} > 1 \end{cases} \qquad (4.19)$$

where $w^*_{ij,t}$ is weight of the asset i in a one US dollar portfolio at time t, $h_{ij,t}$ is the conditional covariance between i and j at time t; $h_{ii,t}$ and $h_{jj,t}$ are the conditional variances of i and j respectively. The weight of asset j in the considered portfolio is computed by $(1 - w^*_{ij,t})$.

Chapter 5: Data Description

5.1 Introduction

This chapter introduces the data used in this thesis for individual companies and indices. The chapter first describes the data. With regard to individual companies, a brief description of each company's business and industry is followed by explaining the actual conventional bond and sukuk issues used in the analysis. The daily prices for conventional bonds and sukuk are obtained from Datastream. With regard to the indices (the Dow Jones Sukuk Index (DJSI) and the Dow Jones Corporate Bond Index), we introduce the indices' composition and the computing methodology.

We then proceed to introduce market risk analytic approaches and qualitatively describe the data prices and returns.

5.2 The Dow Jones Sukuk Index

Following the growing popularity of sukuk, Standard & Poor's (S&P's) Dow Jones, one of the leading global providers of financial information, has developed an index that focuses only on Shari'ah-compliant bonds. The DJSI helps to measure the performance of sukuk at the global level. The DJSI is a market-value-weighted index that comprises US dollar-denominated instruments that have been screened for Shari'ah compliance in accordance with measures undertaken in the DJIMI.

For a finance instrument to be considered eligible under the DJSI and DJIMI, it must pass through industry and financial ration screens. Under the industry screen, the primary business must be halal; thus, companies dealing with alcohol, entertainment, weapons and defense, tobacco, and conventional financial services are

considered ineligible. Under the financial ratio screen, the following elements must be less than 33%.

1. Total debt divided by trailing 24-month average market capitalization.
2. The sum of a company's cash and interest-bearing securities divided by trailing 24-month average market capitalization.
3. Account receivables divided by trailing 24-month average market capitalization.

A unique aspect of the DJSI is that it provides a benchmark for investors seeking exposure to fixed-income investments that comply with Shari'ah. For bonds to be considered eligible for inclusion under the DJSI, they must not only be Shari'ah compliant but must also meet the standards that are issued by the AAOIFI.

The earliest base date for sukuk is September 30, 2005 when the index was first created. As of 2012, the index contained 39 instruments, with a combined market value of US$32.6 billion (source: S&P DJ). The stated coupons carry fixed rates and floating rates with a minimum maturity of one year. In most cases, maturity is much longer: the MacCaulay duration of the index is 4.12. Other details about the sukuk in the index are that the minimum size outstanding is US$200 million and the minimum quality is BBB (the breakdown is as follows: AAA US$2.9 billion; AA US$8.1 billion; A US$14 billion; and BBB US$7.5 billion). Calculation frequency is daily and components must be bullet or make-whole structures. We use the total return (ex-reinvestment) version of the index (Bloomberg ticker DJSUKTXR).

The use of DJSI in this thesis is mainly because of its comprehensive nature. Sukuk in this index are from diverse countries and exchanges such as London, Frankfurt, and Dubai. The daily calculation frequency used for DJSI also makes it

possible to identify subtle changes in prices and returns, and consequently the associated market risk.

5.2.1 Features of the Dow Jones Islamic Market Index

The creation of the DJIMI in 1999 was a major step in the development of Islamic finance. According to Siddiqui (2007, p. 496), it represents "the first institutional approach by a Western index provider (the Dow Jones Index) to publish an index with a methodology that applies Shari'ah screens to define a universe of Shari'ah-compliant stock in the global marketplace." In that same year, another major Western index, the Financial Times Stock Exchange (FTSE), also engaged in creating a similar index, namely the Global Islamic Index Series (GIIS), reflecting the growing interest in the emerging world of Islamic finance.

In principle, the purpose of DJIMI was to define the borders of a universe of Islamic finance in which components meet specific Shari'ah-based laws and to recognize the growing need for investments that are compliant with these laws. However, the creators of DJIMI were also aware that, after 400 years in which conventional finance dominated the world of economics and finance, identifying systems characterized by pure Islamic finance is almost impossible. Accordingly, the creation of DJIMI represented a quantum leap toward the globalization of Islamic finance and was the starting point of a long journey of creating and defining the universe of Islamic finance.

At the most fundamental level, the DJIMI and other Islamic indices aim to ensure that the principles of Islamic Shari'ah are recognized and implemented by the businesses listed in the index. In this regard, El-Khamlichi, Sarkar, Arouri, and Teulon (2014) identify five major principles. The first is the principle of PLS. In conventional

finance, investors are interested in sharing profits while avoiding losses. In Islamic finance, however, the sharing of profit and loss is essential on the basis of the recognition that nothing can be guaranteed and that risk taking is about the sharing of both positive and negative outcomes. The second principle is the prohibition of interest, which is a fundamental principle in Islamic law. The third principle is asset-backing, which essentially means that financing operations must be backed by assets to reduce risks, maximize trustworthiness, and ensure that business growth is founded on solid grounds. The fourth principle is the prohibition of excessive uncertainty; namely, extremely high uncertainty that could be potentially harmful to investors, regardless of how promising or lucrative the outcomes may be. This principle is also consistent with Islamic principles and teachings that prohibit Muslims from taking unnecessary and potentially destructive risks. The last principle is the exclusion of sectors that are inconsistent with fundamental Islamic teachings and ways of life. These specific sectors include industries that deal with the production, processing, and trade in pork, alcohol, tobacco, weapons, and defense, in addition to entertainment (e.g., casinos and music) and conventional finance; namely, all financial industries or businesses whose operations are based on interest.

From its inception, DJIMI was intended to maintain the highest and most stringent standards and quality criteria in management, supervision, and performance, especially as it was expected to be perceived as the leading authority on the definition and development of the universe of Islamic finance. This is evident, for example, in the advanced institutional approach and the level of commitment exhibited by the Dow Jones management toward the supervision of operations. For example, the GIIS relies on outsourced supervision from a variety of Islamic supervisory boards and sources; however, the DJIMI took the unconventional and costly step of creating and

maintaining its own Shari'ah supervisory board that reflects Shari'ah views drawn from several major Islamic countries (Siddiqui, 2007). This unusual step by a Western institution had several purposes. First, it was intended to reflect the high level of commitment of the Dow Jones to Islamic finance. Second, it sought to highlight the recognition of Shari'ah supervision as a fundamental and vital aspect of Islamic financing. Third, the plan was to institutionalize the processes of screening and compliance and to ensure that high and consistent criteria and standards were developed and maintained within the index itself to avoid any conflicts that could arise when relying on several external supervisory boards.

The supervisory board of DJIMI is responsible not only for screening and selecting the companies represented in the index, but also for ensuring continuous oversight on a permanent level. However, the screening and component selection processes are taken to be among the most critical functions of the supervisory board. The process of screening and selection is conducted at two levels; namely, the primary business level and the financial ratios level.

According to Siddiqui (2007), the process of screening and selection at the primary business level is simple and direct, and is mainly intended to confirm that the businesses that comprise the index satisfy the most fundamental codes of Islamic Shari'ah in terms of compliance. This implies the exclusion of businesses that operate or that may be associated with the industries that are either excluded or that Islam forbids, such as industries that involve pork, alcohol, and un-Islamic entertainment. At the financial ratio level, the main objective of screening is to ensure compliance with the financial principles and criteria of *Shari'ah*, such as the avoidance of excessive risk, observing the PLS principle, and the prohibition of interest. For example, among

the criteria that must be observed is that a company's board of directors must have an explicitly "judiciary duty of care and loyalty to examine, entertain and implement decisions in the best interests of the company that will enhance shareholder value" (Siddiqui, 2007, p. 14).

5.3 The Dow Jones Corporate Bond Index

Our proxy for the performance of conventional bonds is the Dow Jones Equal Weight US-issued Corporate Bond Index. The index comprises 96 recently issued investment-grade bonds spanning a variety of maturities.

The market value of the index components is US$209 billion (financials US$96 billion, industrials US$97 billion, and utilities US$16 billion) while the modified duration of the index is around 7.5 (compared with 4.1 for the DJSI index).

5.4 Companies Included in the Portfolio Market Risk Analysis: Conventional and Sukuk Bonds

In order to investigate the possible existence of a difference(s) between the market risk of sukuk and that of conventional bonds, we selected pairs of sukuk and conventional securities with the same characteristics (same issuer, rating, and maturity). We also selected only those bonds (Islamic and conventional) that have complete data for 2008 to 2013. Thus, the final sample included the Bank of London and the Middle East (BLME), MAF, Petronas, Rasmala, Tamweel, Dubai, and DP World.

In order to compute and aggregate possible risks in the sukuk market, relevant data were collected from seven companies. These included Bank of London and the Middle East (BLME), MAF, Petronas, Rasmala, Tamweel, Dubai, and DP World.

5.4.1 BLME

BLME is a well-established Shari'ah-compliant bank based in the UK. Since its inception in 2006, the bank has specialized in offering financial services in three core areas: corporate, wealth management, and treasury. We use two BLME funds in our analysis: BLME Asset Management High Yield US and BLME Asset Management Shari'ah Dollar Income. Note that January 2011 is the start date of the BLME data.

5.4.2 MAF

MAF Global Securities Limited is a debt-issuing vehicle based in the Cayman Islands. The parent company is the Majib Al Futtaim Group, an Emirati holding company that owns and operates shopping malls and leisure centers. The bond used in the analysis is the 5¼% 2019 bullet issue, while the sukuk is the 5.85% 2017. Both issues originated in 2012. The exchange markets in consideration are Frankfurt for the conventional bond and London for the sukuk.

5.4.3 Petronas

Petronas is a state-owned fully integrated energy company that is based in Malaysia but has a global presence. The company's conventional bond under consideration is the 5¼% 2019, issued as a 10-year fixed coupon bond in August 2009 and listed on the Frankfurt exchange. The sukuk is a five-year 4¼% fixed coupon bond that was also issued in 2009 and matured in Aug 2014.

5.4.4 Rasmala Investment Bank

Rasmala is an investment management company established in 1999 and based in the UK. Two funds are used as our proxies for conventional bonds and sukuk: Rasmala GCC Fixed Income and Rasmala Global Sukuk.

5.4.5 Tamweel Funding

Tamweel Funding Limited, a subsidiary of Tamweel PJSC, was incorporated in 2009 and is currently based in Saint Helier, the Channel Islands. The conventional bond under consideration is a convertible five-year fixed coupon bond issued in January 2008. The Tamweel stock lost 85% of its value in November 2008 and Dubai Islamic Finance acquired a majority stake in 2010. Thus, the equity option component of the convertible can largely be ignored and the instrument considered a conventional bond. The Tamweel sukuk was issued as a floating rate bond in 2008 in the Dubai Financial Market. This five-year bond matured in 2013.

5.4.6 Dubai Department of Finance

Bonds issued by the Dubai Department of Finance (DOF) were also included in the portfolio. The conventional bond used in the analysis is a 4.9% fixed coupon bond that was issued as a five-year bond in 2012 (the maturity date was May 2, 2017). The sukuk used is a floating rate five-year bond issued in 2009 in the London Exchange.

5.4.7 DP World

DP World Limited is a company that owns ports and terminals worldwide. In 2007, the company issued a 30-year straight fixed coupon bond (6¼% 2037). A sukuk in the form of a straight 10-year 6.85% fixed coupon bond was also issued in 2007.

One should note the significant difference in duration between the conventional bond and the sukuk under consideration for this company. Other things being equal, one would expect greater price and returns volatility for the conventional bond.

5.5 Market Risk Analysis

5.5.1 Price and Returns of Conventional Bonds Compared with Sukuk

In quantitatively evaluating the market risk associated with sukuk relative to conventional bonds, price and return data will be used extensively in further chapters. The present section qualitatively describes the data and the associated graphs.

5.5.1.1 BLME's Prices and Returns

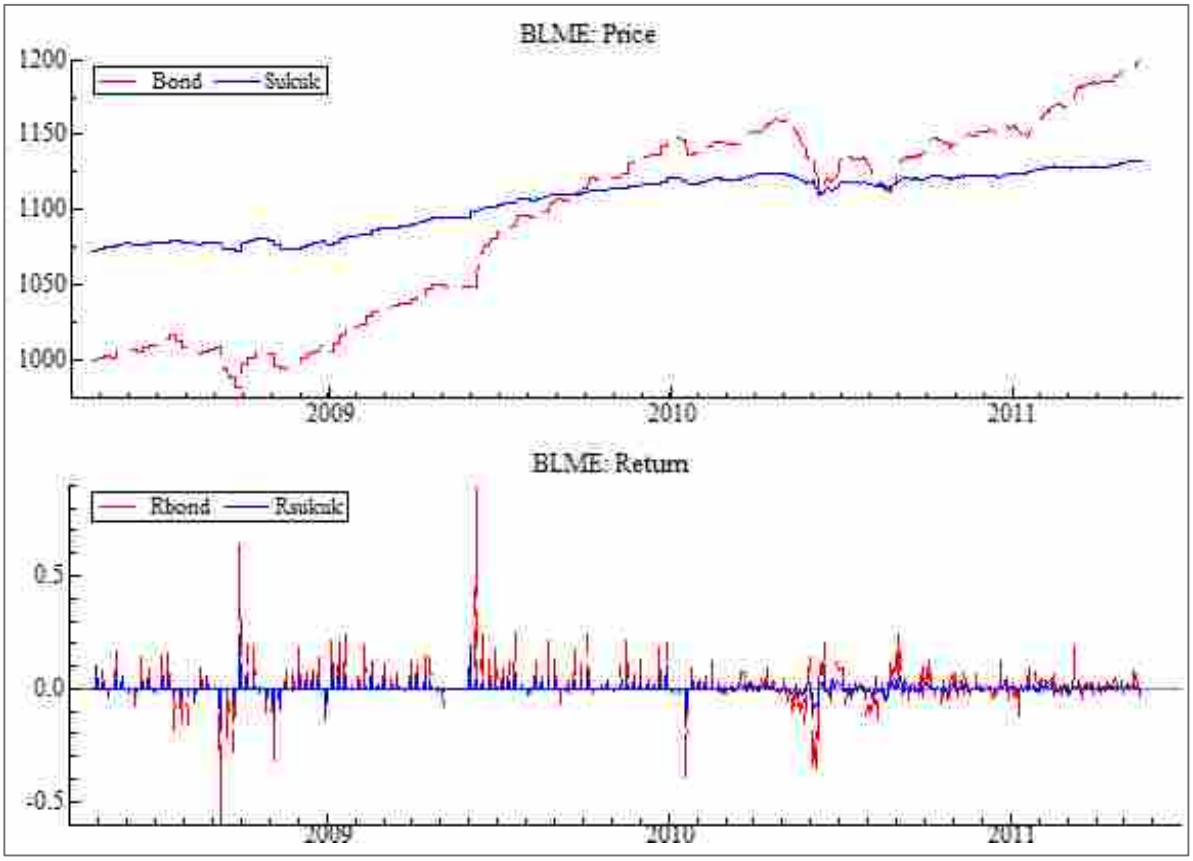


Figure 5.1: BLME's prices and returns

Figure 5.1 shows BLME's prices and returns for the conventional bond and the sukuk first issued in 2011. Notably, prices for the sukuk fund remain relatively stable through the date of issue to maturity with the increase being gradual. In contrast, BLME's bond prices have significant variations through the period to maturity. The volatility of returns is clearly greater for the conventional bond than for the sukuk.

5.5.1.2 MAF's Prices and Returns

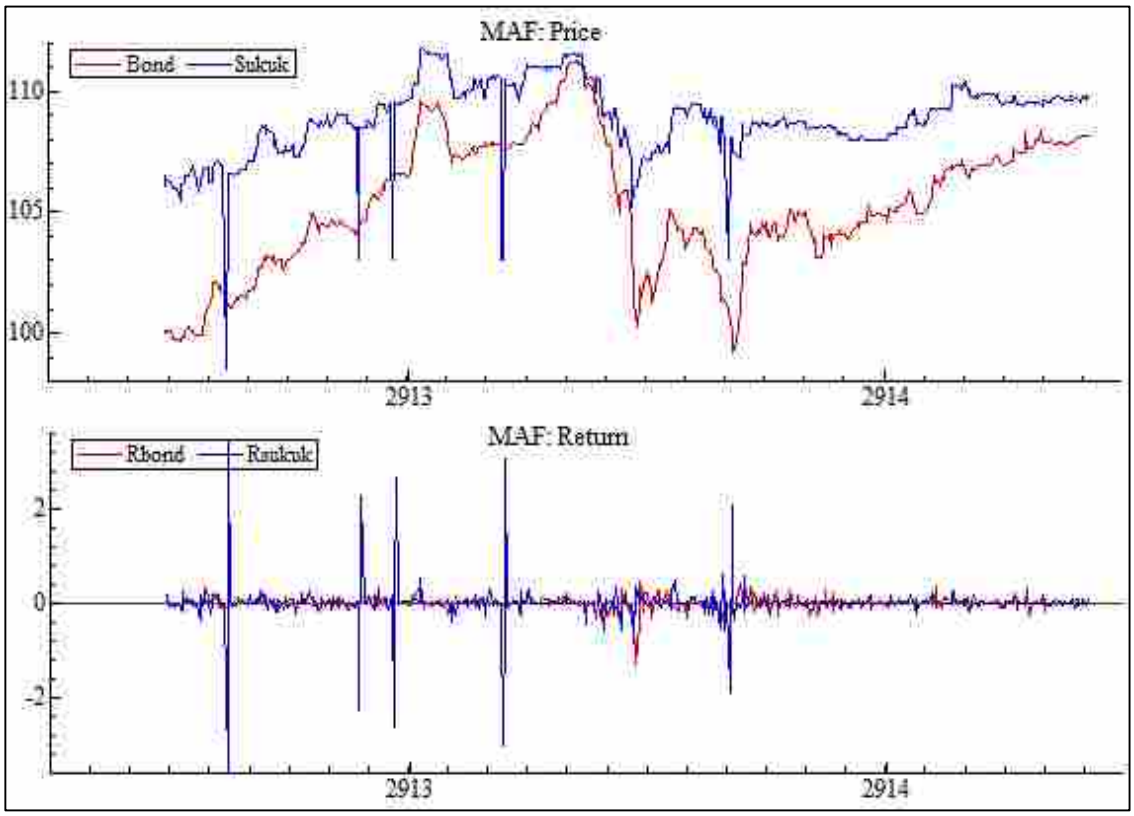


Figure 5.2: MAF's prices and returns

The volatility of returns for the conventional bond and for the sukuk exhibit relatively similar trends, with increases and decreases occurring at almost similar times. This similarity in returns movement in part suggests that market factors may have relatively similar impacts on the prices of the two instruments. One important

comment is that the observed spikes in the sukuk returns are likely to be the result of illiquidity and/or imperfections in the data as shown in Figure 5.2.

5.5.1.3 Petronas' Prices and Returns

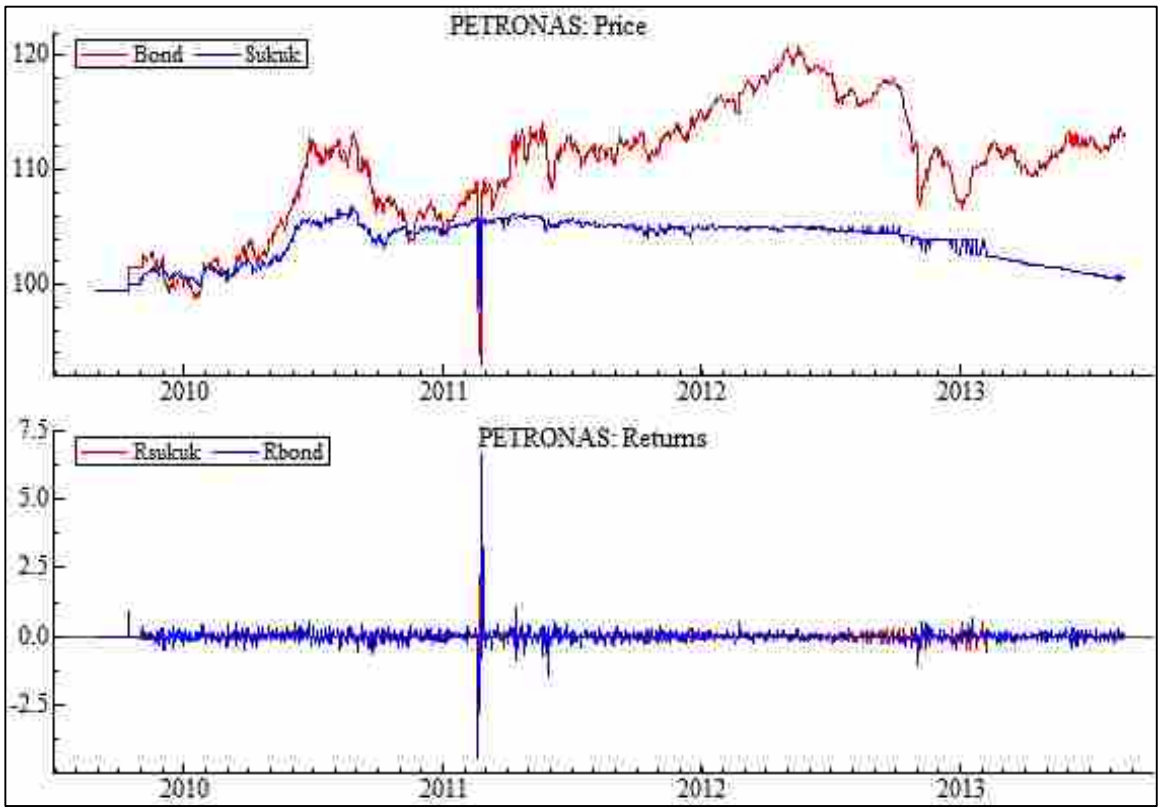


Figure 5.3: Petronas' prices and returns

Figure 5.3 shows that over the three-year period ending in 2013, the price for Petronas' conventional bond remains consistently above the company's sukuk price (from a common base of 100 for both bonds at the start). It is, however, apparent that the higher bond returns are associated with a greater volatility level.

5.5.1.4 Rasmala's Prices and Returns

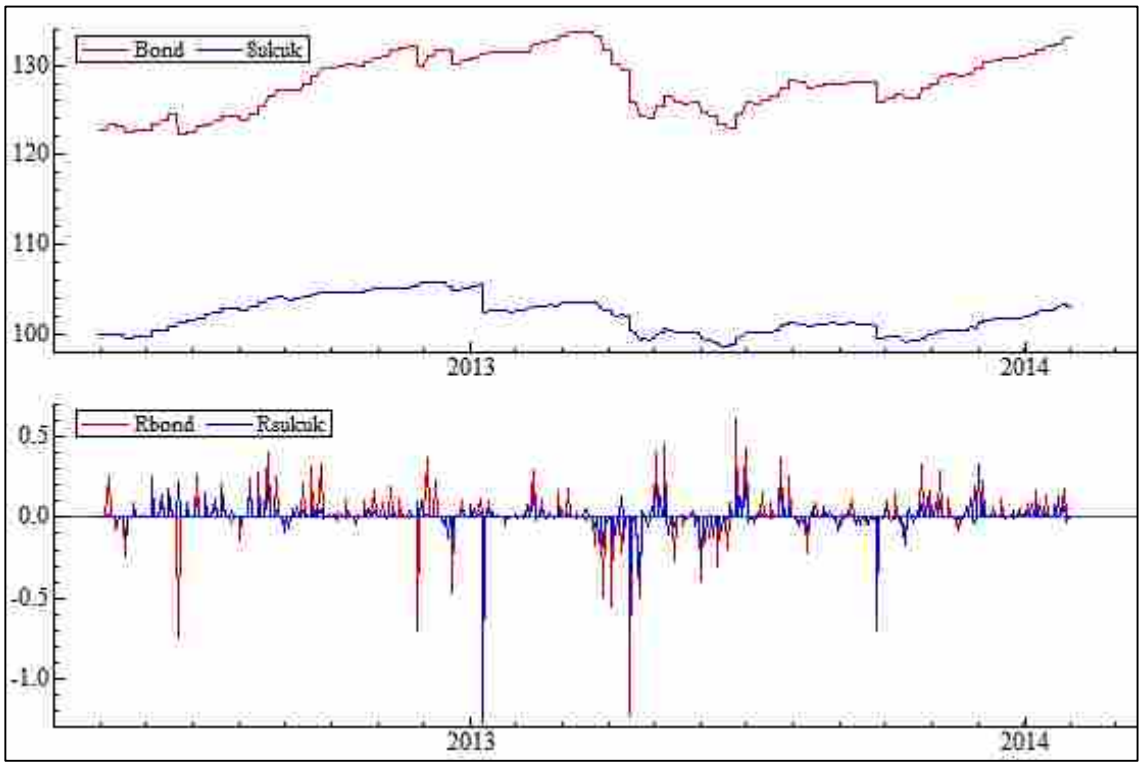


Figure 5.4: Rasmala's prices and returns

Based on the two-year data, a relatively similar trend in price movement is evident, thereby suggesting that the prices of the conventional bond and the sukuk respond in a similar manner to market conditions. Rasmala's conventional bond also yields greater returns compared with the sukuk but is more volatile (Figure 5.4).

5.5.1.5 Tamweel's Prices and Returns

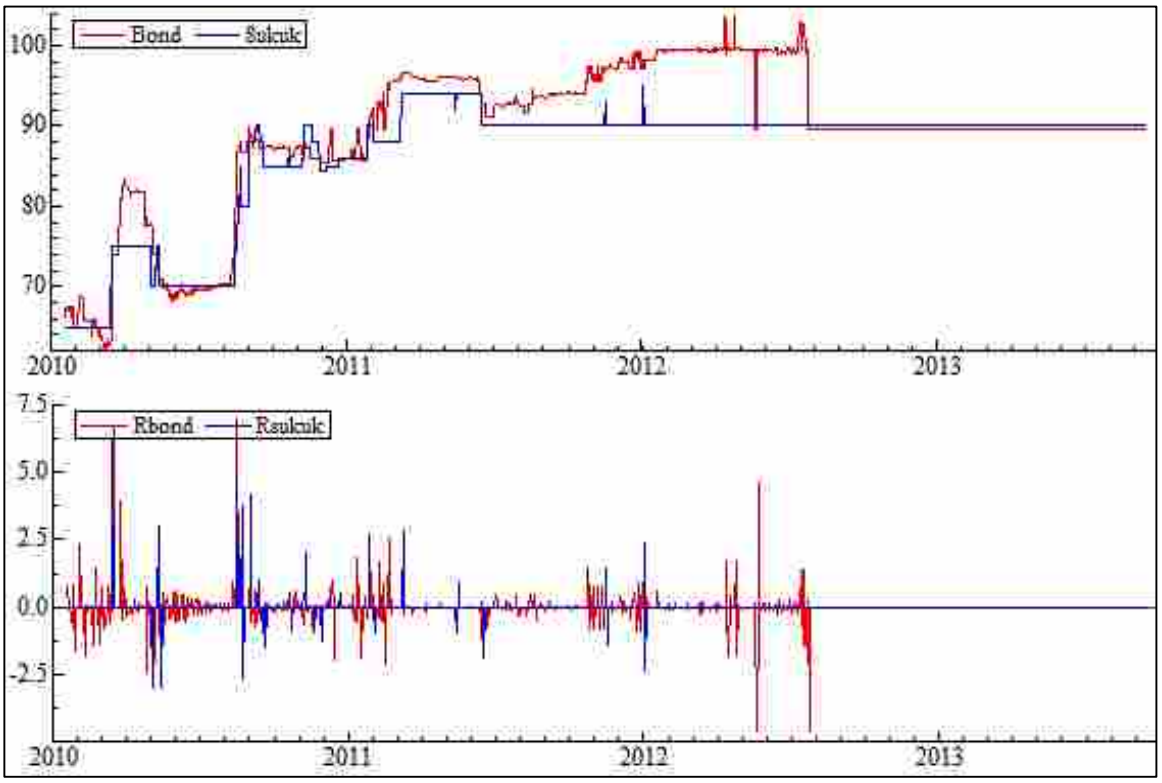


Figure 5.5: Tamweel's prices and returns

During the four-year period ending 2014, the conventional bond and the sukuk issued by Tamweel exhibit similar price movements over the first one-and-a-half years. Thereafter, a higher price for the conventional bond is notable while the sukuk remains stable. It is worth noting the number of "no price movement" days for the sukuk. These are more likely to be the result of illiquidity (Figure 5.5). This issue will be explored in the next chapter.

5.5.1.6 Dubai's Prices and Returns

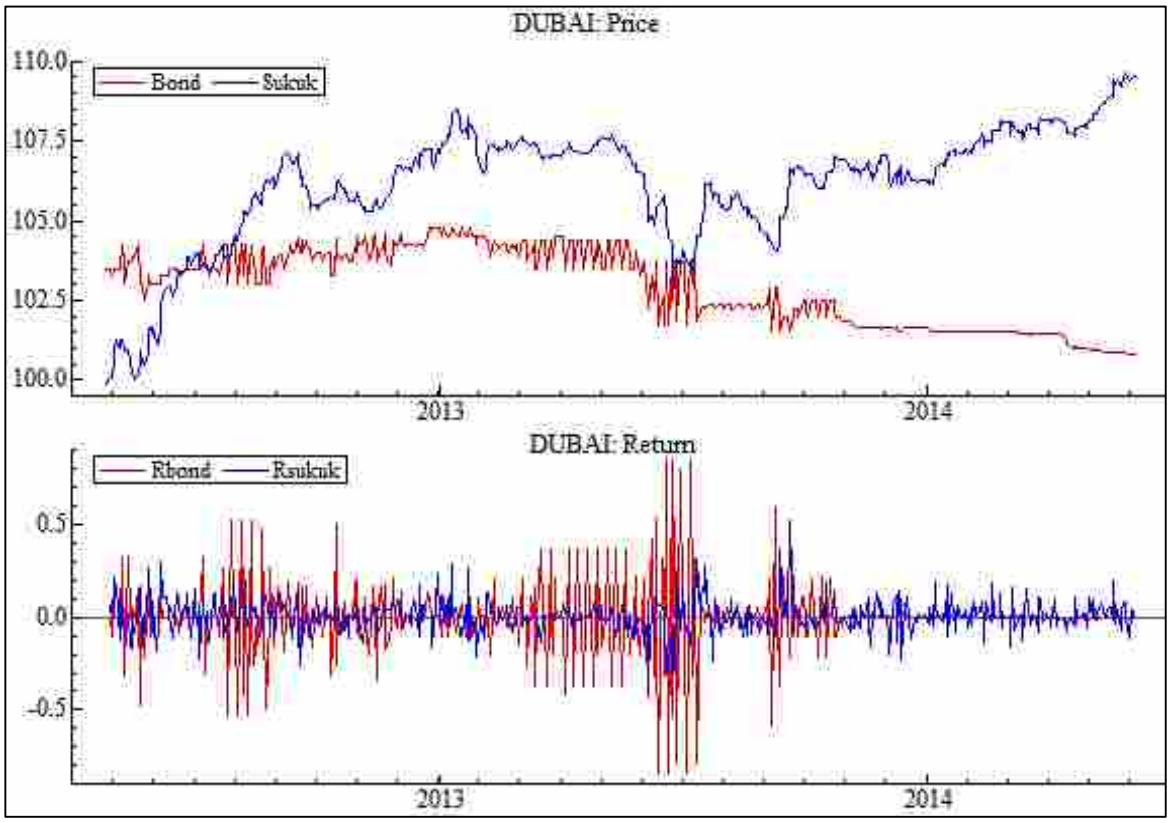


Figure 5.6: Dubai's prices and returns

A cursory look at the price data shown in Figure 5.6 that the performance of the sukuk far exceeds that of the conventional bond. As such, the sukuk is better at withstanding market conditions compared with the bond. Further, the sukuk market for the Dubai Department of Finance is also less volatile compared with the bond market, which experienced highly positive and negative returns particularly in 2012 and 2013.

5.5.1.7 DP World's Prices and Returns

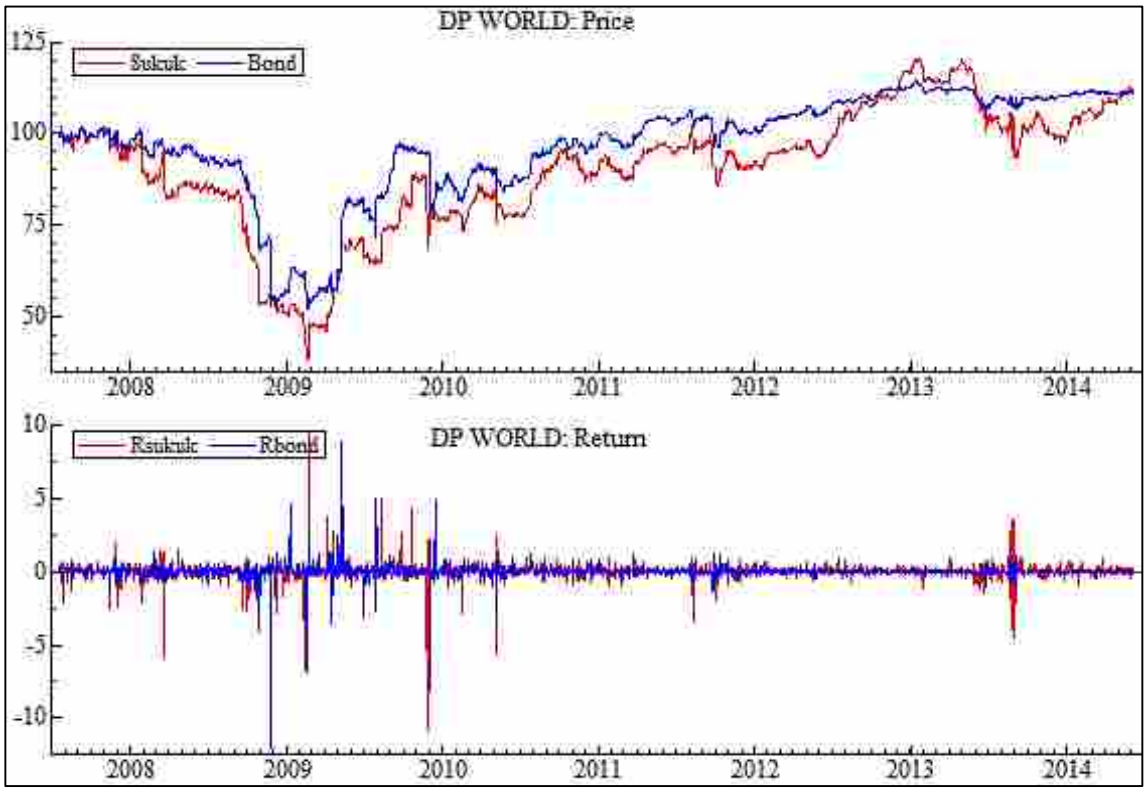


Figure 5.7: DP World's prices and returns

Figure 5.7 explains the qualitative and graphical analyses of the prices and returns of DP World's conventional bond and sukuk are inconclusive because relatively similar movements are observed during the seven-year period. To some extent, this is surprising given the significant difference of duration between the conventional bond (30 years) and the sukuk (five years).

5.5.2 Overall Price and Return Comparison for All Companies

From the graphical analysis of prices and returns for the seven companies under consideration, high correlations between sukuk and conventional bonds are evident only for a few companies such as Tamweel and DP World. The lack of perfect correlations between sukuk and conventional bonds means that a reduction in VaR is expected. In other words, it is likely that the inclusion of sukuk as part of a portfolio

could lead to diversification and consequently a reduction in VaR. Another notable aspect pertaining to conventional bonds and sukuk is that the latter are in most cases less volatile in terms of significant variations in prices and returns. This finding indicates that sukuk markets are relatively insulated to changes in interest rates when compared with conventional bond markets, possibly owing to their specific characteristics (among others, a greater reliance on the performance of the financed asset).

5.6 Descriptive Statistics: Minimum, Maximum, Mean, and Standard Deviation

Table 5.1 contains the descriptive statistics for bonds and sukuk over the entire sample period. DP World has the most volatile returns (with a standard deviation of 0.77%, a lowest return of -11.97%, and a highest return of +8.813%). The sukuk market was also marked by substantial variations for some of the companies. DP World records the largest negative return at -10.77% and, at the same time, the highest return at a maximum of 8.81% (with a standard deviation of 0.68%). Comparatively, sukuk recorded relatively lower standard deviations than bonds, except for MAF. Thus, the sukuk market appears to be relatively stable while the bond market has high levels of market volatility.

Table 5.1: Descriptive statistics bond and sukuk returns (%)

	Conventional Bonds				Sukuk			
	Min.	**Mean**	**Max.**	**Standard Deviation**	**Min.**	**Mean**	**Max.**	**Standard Deviation**
BLME	-0.59	0.01	0.89	0.07	-0.17	0	0.24	0.023
MAF	-1.3	0.01	0.44	0.13	-3.58	0.003	3.44	0.41
Petronas	-4.41	0.004	6.6	0.26	-2.83	0	3.24	0.18
Rasmala	-1.22	0.01	0.61	0.11	-1.27	0.002	0.32	0.06
Tamweel	-10.63	0.01	15.91	1.18	-6.9	0.01	14.31	0.89
Dubai	-4.61	0.01	6.91	0.51	-2.99	0.01	6.22	0.39
DP World	-11.97	0.003	8.813	0.77	-10.77	0.002	9.43	0.68

5.7 Conclusion

This chapter has described the data that will be used throughout the rest of this thesis for sukuk and conventional bonds, and for individual companies and Dow Jones indices. We have also presented the qualitative prices and returns associated with the data. The next chapter focuses on a quantitative, comparative assessment of the risk–return characteristics of sukuk and conventional bonds.

Chapter 6: Empirical Results

6.1 Introduction

In order to model the returns distribution, the following traditional techniques are used: (1) stress testing (scenario analysis); (2) the parametric technique (analytic based); (3) Monte Carlo simulation; and (4) historical simulation (Al-Zoubi & Maghyereh, 2007).

However, there are certain Islamic finance indices in the capital market that could be utilized for the calculation and measurement of sukuk risks. The DJCSI is formulated to evaluate the performance of global Islamic fixed-earnings investments. The overall approach from the set of Citigroup fixed earnings indices and the DJIMI approach for inspecting investments for Shari'ah compliance are followed by the DJCSI. This index could be benchmarked by traders in sukuk. US dollar-denominated investment-grade sukuk issued within the international market that have been verified as Shari'ah compliant are also included in the index. In the Islamic indices, the usual return is an expected 83.94%. However, there is a more sensible 8.45% in the five-year return of the Islamic indices (Al-Zoubi & Maghyereh, 2007).

One problem with the variance–covariance (VCV) method is that it assumes homoskedasticity (constant variance over time). There is ample evidence of volatility clustering. The GARCH method allows for heteroscedasticity and may yield better results. We implement GARCH and EWMA RiskMetrics methods.

The rest of this chapter is organized as follows: Section 6.2 presents and analyses the results and section 6.3 summarizes the findings.

6.1 Results

6.2.1 Company-level results

Table 6.1 presents the results for VCV and historical simulation (HS) VaR calculations at the 90%, 95%, and 99% confidence levels for the full sample and the most recent year of data. It should be noted here that the lack of secondary market activity for some of the securities poses a significant challenge to computing HS VaR. As an example, Rasmala's conventional bond has so few actual price movements (non-zero returns) that, at the 90% level, HS VaR is 0. The sample size is 443 observations, but there are only 35 strictly negative returns; hence a VaR of 0. Likewise, Tamweel's sukuk has too few price movements to make the 90% and 95% HS VaR deviate from 0 while using the full sample. The one-year HS VaR for Tamweel's conventional bond and sukuk cannot be computed because of no price movements in the prior year. The VaR of 0 is not indicative of a lack of risk; it is the consequence of a lack of liquidity in the secondary market for these securities.

Table 6.1: Bond VaR vs. Sukuk VaR

		Full Sample			Over One Year			Full Sample			Over One Year		
		90%	**95%**	**99%**	**90%**	**95%**	**99%**	**90%**	**95%**	**99%**	**90%**	**95%**	**99%**
BLME	Bond VaR	0.06%	0.12%	0.42%	0.09%	0.15%	0.29%	0.22%	0.28%	0.39%	0.16%	0.21%	0.30%
	Sukuk VaR	0.02%	0.04%	0.15%	0.03%	0.04%	0.12%	0.07%	0.09%	0.13%	0.05%	0.06%	0.09%
DP World	Bond VaR	0.87%	1.43%	5.51%	0.77%	1.17%	5.33%	2.02%	2.59%	3.66%	1.88%	2.41%	3.41%
	Sukuk VaR	0.58%	0.99%	2.29%	0.23%	0.34%	2.15%	1.69%	2.17%	3.07%	0.57%	0.73%	1.03%
Dubai	Bond VaR	0.36%	0.72%	1.28%	0.12%	0.24%	1.59%	0.53%	0.68%	0.96%	0.47%	0.60%	0.85%
	Sukuk VaR	0.23%	0.29%	0.56%	0.19%	0.26%	0.53%	0.26%	0.34%	0.48%	0.27%	0.34%	0.48%
MAF	Bond VaR	0.26%	0.42%	0.79%	0.37%	0.50%	0.84%	0.39%	0.50%	0.70%	0.46%	0.59%	0.84%
	Sukuk VaR	0.19%	0.47%	1.98%	0.14%	0.33%	1.30%	1.20%	1.54%	2.17%	0.63%	0.81%	1.15%
Petronas	Bond VaR	0.42%	0.64%	1.23%	0.36%	0.50%	0.81%	0.84%	1.08%	1.53%	0.42%	0.55%	0.77%
	Sukuk VaR	0.21%	0.37%	0.77%	0.06%	0.16%	1.13%	0.54%	0.69%	0.97%	0.35%	0.45%	0.64%
Rasmala	Bond VaR	0.00%	0.08%	1.14%	0.00%	0.12%	1.02%	0.35%	0.45%	0.63%	0.39%	0.50%	0.70%
	Sukuk VaR	0.02%	0.12%	0.42%	0.07%	0.13%	0.80%	0.25%	0.32%	0.46%	0.25%	0.32%	0.45%
Tamweel*	Bond VaR	0.27%	0.97%	3.32%	N/A	N/A	N/A	1.51%	1.93%	2.73%	N/A	N/A	N/A
	Sukuk VaR	0.00%	0.00%	1.73%	N/A	N/A	N/A	1.14%	1.46%	2.07%	N/A	N/A	N/A
Index Pre-crisis	Bond VaR	0.32%	0.44%	0.73%	0.43%	0.70%	0.93%	0.34%	0.43%	0.61%	0.45%	0.58%	0.82%
	Sukuk VaR	0.01%	0.06%	0.43%	0.09%	0.19%	0.54%	0.12%	0.16%	0.22%	0.18%	0.23%	0.32%
Index Post-crisis	Bond VaR	0.35%	0.56%	0.98%	0.38%	0.51%	0.79%	0.46%	0.59%	0.84%	0.39%	0.50%	0.71%
	Sukuk VaR	0.11%	0.18%	0.50%	0.13%	0.18%	0.35%	0.79%	1.02%	1.44%	0.19%	0.24%	0.34%

*No price movement in the last year

Table 6.1: The conventional bonds' VaR compared with the sukuk's VaRs we can see in Table 6.1, at the 99% level, HS VaR rises significantly (more than the normal distribution would suggest). This may be due to data quirks rather than actual risk: while implementing HS at the 99% level with just 250 observations, the third biggest loss (if we are conservative) is the VaR, meaning that just a couple of outliers can make a large difference.

For each issuer's conventional bond and sukuk, we compare, at the 90%, 95%, and 99% confidence intervals and for both the whole sample and one year of data, the results for the VCV and HS VaR. Should the observed returns be normal, the results should be identical (since the VCV standard deviation is computed historically using the same returns as used for HS). Indeed, the results are markedly different because of the non-normality of returns. Table 6.2 presents the ratio of VCV to HS VaR for all issuers and for both the full sample and the most recent year of data.

Table 6.2: Ratio of VCV to HS VaR: full sample and one year

		Full Sample			One Year		
		90%	**95%**	**99%**	**90%**	**95%**	**99%**
BLME	Sukuk	3.27	2.25	0.83	1.60	1.40	0.72
	Bond	3.71	2.27	0.93	1.91	1.37	1.03
DP World	Sukuk	2.94	2.20	1.34	2.42	2.14	0.48
	Bond	2.31	1.81	0.66	2.44	2.05	0.64
Dubai	Sukuk	1.18	1.19	0.87	1.42	1.34	0.91
	Bond	1.47	0.93	0.74	3.79	2.45	0.53
MAF	Sukuk	6.21	3.26	1.10	4.55	2.49	0.88
	Bond	1.51	1.17	0.89	1.25	1.18	1.00
Petronas	Sukuk	2.53	1.86	1.27	6.07	2.79	0.56
	Bond	2.02	1.70	1.24	1.17	1.10	0.95
Rasmala	Sukuk	12.61	2.62	1.09	3.62	2.34	0.56
	Bond	N/A*	5.80	0.56	N/A*	4.28	0.69
Tamweel	Sukuk	N/A*	N/A*	1.20	N/A*	N/A*	N/A*
	Bond	5.58	1.99	0.82	N/A*	N/A*	N/A*
Index Pre-crisis	Sukuk	12.56	2.64	0.52	2.01	1.19	0.60
	Bond	1.06	0.99	0.84	1.05	0.83	0.89
Index Post-crisis	Sukuk	7.30	5.57	2.89	1.43	1.35	0.96
	Bond	1.33	1.05	0.86	1.04	1.00	0.90

* HR VaR is 0

At the 90% confidence level, all the VCV VaRs of the conventional bonds and sukuk are higher than HS VaR for both the full sample and the one-year sample. The ratio of VCV to HS VaR ranges between 12.61 (Rasmala's sukuk, full sample) and 1.17 (Petronas' conventional bond, one-year sample).

At the 95% confidence level, all the VCV VaRs of the conventional bonds and sukuk are higher than HS VaR for both the full sample and the one-year sample, except for one occurrence (Dubai's conventional bond, full sample, 0.93). The ratio of VCV to the HS VaR ranges from 0.93 to 5.80 (Rasmala's conventional bond, full sample). At the 99% confidence level, 25 out of 34 ratios are smaller than 1. The values range from 0.48 (DP World's sukuk, one-year sample) to 1.34 (DP World's sukuk, full sample).

The fact that the VCV/HS ratios differ significantly from 1 indicates the non-normality of returns. The fact that the ratio is higher at the 90% confidence level and relatively lower at the 99% confidence level points to a distribution that implies that returns are clustered around the mean and outliers are more numerous than predicted by the normal distribution. Later on, we provide further evidence of this issue.

One problem in computing VaR for the conventional bonds and sukuk in our data set is the lack of secondary market trading activity. A simple way to provide evidence of illiquidity is to consider the number of days with no price change. While it is of course possible that no price change on a trading day indicates that the perceived fundamental value has not changed, it is reasonable to assume that a high number of no price movements is a good indicator of illiquidity. Table 6.3 provides, for each security, the number of no trading days. The impact of such illiquidity on the results will be discussed later. Note that in the case of the sukuk indices, the number of no

trading days may be misleading. Over September 30, 2005 to September 12, 2008, our data set contains 1080 data points for the conventional bonds and only 759 for the sukuk. The remaining 321 days can be attributed largely to a lack of secondary activity.

Table 6.3: Evidence of illiquidity: days with no price movements

		No Price Movement	Sample Size	Percentage of No Movement
BLME	Bond	408	802	50.87%
	Sukuk	417	802	52.00%
DP World	Bond	57	1797	3.17%
	Sukuk	85	1797	4.73%
Dubai	Bond	168	550	30.55%
	Sukuk	49	550	8.91%
MAF	Bond	46	505	9.11%
	Sukuk	87	505	17.23%
Petronas	Bond	123	1244	9.89%
	Sukuk	189	1244	15.19%
Rasmala	Bond	443	549	80.69%
	Sukuk	356	549	64.85%
Tamweel	Bond	606	1144	52.97%
	Sukuk	1079	1144	94.32%
Index Pre-crisis	Bond	0	1080	0.00%
	Sukuk	0	769	0.00%
Index Post-crisis	Bond	1	1812	0.06%
	Sukuk	0	1427	0.00%

For each issuer, the VaRs of the conventional bond and the sukuk are computed and compared. Table 6.4 presents the results for each issuer and for both the whole sample and one year of data. With regard to Tamweel, only the results for the whole sample are presented because there is no price movement for either the conventional bond or the sukuk over the prior year. Table 6.4 presents indicators that show, for each issuer and sample size, whether the VaR of the conventional bond ("B") or that of the sukuk ("S") is the highest. Of the 102 comparisons, the conventional bond has the highest VaR 83 times, while the sukuk has the highest VaR 19 times. Of these 19 occurrences, nine relate to MAF and four to Rasmala. In the Rasmala case, the conventional bond's illiquidity is high (443 out of 549 observations are 0) and also higher than for the sukuk (356 out of 549). With regard to the conventional bond, only 35 returns are strictly negative, meaning that the 99% confidence level of the HS VaR is 0 and the 95% confidence level of the VaR is very low (0.077%, compared with a standard deviation of 0.273%). Similar observations can be made over a one-year horizon.

Table 6.4: Bond Var vs. Sukuk Var- Bond VaR highest(B)/ Sukuk VaR highest (S)

	Historical Simulation						**Variance–Covariance**							
	Full Sample			Over One Year			Full Sample			Over One Year				
	90%	**95%**	**99%**	**90%**	**95%**	**99%**	**90%**	**95%**	**99%**	**90%**	**95%**	**99%**	Total B	Total S
BLME	B	B	B	B	B	B	B	B	B	B	B	B	12	0
DP World	B	B	B	B	B	B	B	B	B	B	B	B	12	0
Dubai	B	B	B	S	S	B	B	B	B	B	B	B	10	2
MAF	**B**	**S**	**S**	**B**	**B**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**3**	**9**
Petronas	B	B	B	B	B	S	B	B	B	B	B	B	11	1
Rasmala	S	S	B	S	S	B	B	B	B	B	B	B	8	4
Tamweel*	B	B	B	N/A	N/A	N/A	B	B	B	N/A	N/A	N/A	6	0
Index Pre-crisis	B	B	B	B	B	B	B	B	B	B	B	B	12	0
Index Post-crisis	B	B	B	B	B	B	S	S	S	B	B	B	9	3
													83	19

*No price movement in the last year

The VCV method uses historical volatility (as opposed to implied volatility) calculated with the same data used for HS. Should returns be normal (in a statistical sense), the results would be the same for both the HS and VCV method. This is not what we observe in Table 6.5, which presents the ratios of HS to VCV VaR. Thus, we provide evidence of the non-normality of log returns, looking first at the skewness and kurtosis of the observed distributions, providing histograms as evidence. We then compare the number of outliers to what we would expect should the returns be normal.

Table 6.5: Logreturns Skewness and Kurtosis – Full Sample

		Bond	Sukuk
BLME	Skewness	2.02	1.31
	Kurtosis	42.87	29.35
DP World	Skewness	-1.92	-4.97
	Kurtosis	72.41	178.77
Dubai	Skewness	-0.12	0.37
	Kurtosis	7.96	3.61
MAF	Skewness	-1.96	-0.11
	Kurtosis	20.46	46.21
Petronas	Skewness	6.86	1.55
	Kurtosis	276.34	162.07
Rasmala	Skewness	-3.00	-7.52
	Kurtosis	32.29	102.46
Tamweel	Skewness	3.77	6.68
	Kurtosis	76.18	112.21
Index pre-crisis	Skewness	-0.12	-3.59
	Kurtosis	2.11	40.57
Index post-crisis	Skewness	-0.48	-9.50
	Kurtosis	7.39	321.72

Table 6.6: The full sample's log returns for Skewness and Kurtosis

		Bond	Sukuk
BLME	Skewness	2.02	1.31
	Kurtosis	42.87	29.35
DP World	Skewness	-1.92	-4.97
	Kurtosis	72.41	178.77
Dubai	Skewness	-0.12	0.37
	Kurtosis	7.96	3.61
MAF	Skewness	-1.96	-0.11
	Kurtosis	20.46	46.21
Petronas	Skewness	6.86	1.55
	Kurtosis	276.34	162.07
Rasmala	Skewness	-3.00	-7.52
	Kurtosis	32.29	102.46
Tamweel	Skewness	3.77	6.68
	Kurtosis	76.18	112.21
Index Pre-crisis	Skewness	-0.12	-3.59
	Kurtosis	2.11	40.57
Index Post-crisis	Skewness	-0.48	-9.50
	Kurtosis	7.39	321.72

Table 6.6 reveals that as further evidence of non-normality we note that, for each conventional bond and sukuk, the number of (negative) log returns is more than three standard deviations away from the mean return; thus, we divide the number by the total number of returns. This frequency of "3σ outliers" is then compared with the frequency predicted by the normal distribution (0.135%).

Table 6.7 summarizes the results. For all conventional bonds and sukuk, the number of outliers is higher than predicted by the normal distribution. The ratio of actual to normal outliers is as high as 12.14 for Rasmala's conventional bond and has a minimum value of 1.79 for Petronas' sukuk.

Table 6.7: Actual compared with normal frequencies of returns less than three standard deviations away from the mean

		Bond	Sukuk		Bond	Sukuk
	Sample Size	Log Returns <-3 σ		Normal	Ratio Actual/Normal	
BLME	802	7	8	1.083	6.465	7.389
DP World	1797	21	10	2.426	8.656	4.122
Dubai	550	6	4	0.743	8.081	5.387
MAF	505	4	5	0.682	5.867	7.334
Petronas	1244	4	3	1.679	2.382	1.786
Rasmala	549	9	5	0.741	12.143	6.746
Tamweel	1144	11	8	1.544	7.123	5.180
Index Pre-crisis	1080/769	8	13	1458/1.025	5.487	12.687
Index Post-crisis	1817/1427	12	6	2.446/1.926	4.906	3.115

Finally, for each time-series return, we apply the Jarque–Bera (JB) normality test. The JB test is a goodness-of-fit test with the null hypothesis that the returns have a skewness and kurtosis matching that of a normal distribution. We find, in all cases, that the p-value associated with the test is 0 (when rounded to the sixth decimal place), leading us to reject the null hypothesis and conclude that returns are non-normal. The results are shown in of annex 4.

While the fact that financial returns exhibit kurtosis is a known phenomenon, we believe that the illiquidity of the conventional bonds and sukuk under consideration have contributed to our observations on the distribution of returns (clustering around the mean and fat tails effect).

Consider the following example. Assume that the "true" (or fundamental) values of a security in successive days are 100, 100.5, 101, and 103. The "true" log returns are then 0.50%, 0.99%, and 1.47%. Now assume that because of illiquidity, the security does not trade between day one and day four. The daily end-of-day prices now read 100, 100, 100, and 103, and the associated log returns are 0%, 0%, and 2.96%. It is easy to see how a repeat of this scenario (persistent illiquidity) would lead to a high number of observed returns clustered around 0 and a fatter tail (or kurtosis). This is exactly what we observe in our data.

6.2.2 Indices' Results

Although less directly apparent, the problem of illiquidity also exists for indices, for which the number of days with no price change is a lesser indicator of illiquidity (if only one component of the index has a price movement, so will the index).

The sukuk index in particular has several features associated with illiquidity: a smaller number of data points than the bond index over the same period, greater skewness and kurtosis (40.57 pre-2008 and 321.72 post-2008) and large outliers. The frequencies of "3σ outliers" are 12.687 times (pre-2008) and 3.115 times (post-2008) greater than those suggested by the normal distribution and post-crisis. The sukuk index has five data points with more than six standard deviations from the mean, including one with 25 standard deviations from the mean.

The bond index displays lower illiquidity than the sukuk, as expected, with lower skewness (-0.12 pre-crisis and -0.48 post-crisis) and lower kurtosis (2.11 pre-crisis and 7.39 post-crisis), while still displaying a larger number of "3σ outliers" than predicted by the normal distribution (by a ratio 5.457 pre-crisis and 4.906 post-crisis).

For both the sukuk and Bond indices, the number of "no price movements" is close to 0. This is to be expected because it only takes trading in one of the index components for the index to change. Consequently, this finding cannot be taken as an indicator of satisfactory liquidity. In addition, the number of data points, over the same time span, is smaller for the sukuk than for the conventional bond, further pointing to the illiquidity of the former.

The results of a comparison of VCV and HS VaR for the indices are consistent with those of individual companies (a higher VCV VaR at the 90% and 95% confidence levels and a higher HS VaR at the 99% confidence level) with one notable exception: the pre-crisis VCV VaR for the sukuk is 2.89 times that of the HS VaR. A closer inspection of the data shows that there are a limited number of extreme outliers (up to 25 standard deviations from the mean). These impact the standard deviation calculation (and hence the VCV VaR) while having only a limited impact on the HS

VaR (because of their low number: whether an outlier is just beyond the VaR level or many standard deviations away will not impact the HS VaR provided the number of such extreme outliers is low). Consequently, the observation that the HS VaR is generally higher at the 99% confidence level while the VCV VaR is higher at the 90% and 95% confidence levels still stands and is consistent with illiquidity (with returns clustered around 0 and fatter tails than predicted by the normal distribution).

6.2.3 Expected Shortfall

We implement expected shortfall (ES) for our data, using the HS results, for the individual companies and the indices. We then discuss the results. ES values are computed at the 90%, 95%, and 99% confidence levels for both the last year of data and the whole sample. The results are presented in the Table 6.8. Table 6.9 contains binary indicators that (for each company, sample, and confidence level) take the value "B" when the conventional bond is riskier and "S" when the sukuk is riskier.

Table 6.8: Expected shortfall

	Bond			Sukuk		
	One Year			One Year		
	99%	**95%**	**90%**	**99%**	**95%**	**90%**
BLME	0.624%	0.297%	0.206%	0.173%	0.096%	0.067%
DP World	9.684%	3.447%	2.230%	2.322%	1.030%	0.659%
Dubai	1.883%	0.995%	0.583%	0.695%	0.432%	0.329%
MAF	2.009%	0.903%	0.661%	3.140%	1.069%	0.653%
Petronas	0.902%	0.656%	0.541%	1.212%	0.837%	0.466%
Rasmala	2.214%	0.804%	0.422%	1.443%	0.539%	0.324%
Tamweel	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%
Index Pre-crisis	1.304%	0.847%	0.728%	0.841%	0.467%	0.304%
Index Post-crisis	1.109%	0.735%	0.591%	0.913%	0.353%	0.253%
	Full Sample			Full Sample		
	99%	**95%**	**90%**	**99%**	**95%**	**90%**
BLME	0.99%	0.46%	0.30%	0.37%	0.15%	0.10%
DP World	9.57%	3.63%	2.39%	7.28%	2.54%	1.66%
Dubai	1.90%	1.13%	0.81%	0.69%	0.45%	0.35%
MAF	1.37%	0.76%	0.56%	6.17%	1.92%	1.14%
Petronas	2.44%	1.14%	0.83%	1.83%	0.78%	0.53%
Rasmala	1.80%	0.70%	0.13%	1.48%	0.49%	0.10%
Tamweel	5.57%	2.41%	1.47%	4.18%	0.89%	0.44%
Index Pre-crisis	0.88%	0.63%	0.50%	0.65%	0.27%	0.15%
Index Post-crisis	1.22%	0.81%	0.61%	3.24%	0.85%	0.49%

Table 6.9: The ES of the conventional bonds compared with the ES of the sukuk

	One Year			Full Sample		
	99%	95%	90%	99%	95%	90%
BLME	B	B	B	B	B	B
DP World	B	B	B	B	B	B
Dubai	B	B	B	B	B	B
MAF	S	S	B	S	S	S
Petronas	S	S	B	B	B	B
Rasmala	B	B	B	B	B	B
Tamweel	S	S	S	B	B	B
Index Pre-crisis	B	B	B	B	B	B
Index Post-crisis	B	B	B	S	S	B
Total B	42					
Total S	12					

The results show a similar pattern to the VaR results presented in prior sections; namely, that conventional bonds are riskier than sukuk in most cases, with the notable exceptions of Tamweel's bond (because of poor data) and MAF's bond (because of the specific structure of the two securities under consideration). We conclude that the non-coherence (as defined by Acerbi & Tasche, 2002) of the VaR measure does not invalidate our results.

6.2.4 EWMA and GARCH

Financial data exhibit volatility spikes (some periods are more volatile than others) and serial correlation (or autocorrelation, meaning that these volatility spikes do not occur randomly over time). The combination of these two effects is referred to as volatility clustering; moreover, the fact that the variance may not be constant throughout the data sample is called heteroskedasticity. The VCV (and HS) VaR of prior sections uses simple historical volatility estimates, which give equal weight to all

the error terms in the sample (the homoskedasticity assumption). In the presence of heteroskedasticity, these VaR measures would misrepresent risk. In this section, we implement two alternative volatility measures to compute VaR and analyze the results. These measures are EWMA (which is a special instance of GARCH(1,1)) and GARCH(1,1). We find that, in most cases, GARCH(1,1) does not fit the data well (some constraints are not met); thus, we focus our analysis on EWMA, which yields better results. The following subsections present tests on autocorrelation applied to our data (Ljung–Box Q-statistics and the Engle autoregressive conditional heteroskedasticity (ARCH) test), specify the model's setup, and present the fitting results. Further subsections describe backtesting to check the validity of the results.

6.2.4.1 Evidence of Autocorrelation

We use the Ljung–Box Q-statistics to test for autocorrelation in our returns data. The test is defined as testing the null hypothesis that the data is independently distributed compared with the alternative hypothesis that the data is serially correlated (i.e., we test whether the observed autocorrelation coefficient is statistically different from 0). The Q(h)-statistic is computed as follows:

$$Q(h) = n(n+2)\sum_{k=1}^{h}\frac{\hat{p}_k{}^2}{n-k} \tag{6.1}$$

where n is the sample size, h is the number of lags, and $\hat{p}_k$ is the autocorrelation at lag k. Q(h) follows a chi-squared distribution with h degrees of freedom. The Ljung–Box statistic tests the null hypothesis that the residuals are independently distributed compared with the alternative hypothesis that serial correlation is present. Table 6.10 presents the Q-statistics and the associated p-values for all companies in our data set, with lags of 5, 10, 20, and 50 observations and for both raw and squared residuals.

Table 6.10: Ljung-Box Q statistics and associated p-values (p-values>0.95 in bold)

Raw Data								
	BLME bond	**BLME sukuk**	**MAF bond**	**MAF sukuk**	**Petronas bond**	**Petronas sukuk**	**Rasmala bond**	**Rasmala sukuk**
Q(5)	49.6483 [0.00000]	20.5525 [0.00098]	40.9540 [0.00000]	57.9161 [0.00000]	6.91029 [0.22734]	352.139 [0.00000]	48.3197 [0.00000]	13.7359 [0.01738]
Q(10)	58.4428 [0.00000]	26.0852 [0.00362]	52.3293 [0.00000]	59.9994 [0.00000]	104.861 [0.00000]	353.463 [0.00000]	49.0289 [0.00000]	15.6749 [0.10932]
Q(20)	70.7522 [0.00000]	50.4168 [0.00019]	68.6041 [0.00000]	70.4475 [0.00000]	109.074 [0.00000]	354.896 [0.00000]	50.9469 [0.00000]	19.7247 [0.47527]
Q(50)	155.940 [0.00000]	118.099 [0.00000]	121.353 [0.00000]	74.8026 [0.01310]	140.514 [0.00000]	373.699 [0.00000]	62.0766 [0.00000]	30.8077 [0.98505]
	Tamweel bond	**Tamweel sukuk**	**Dubai bond**	**Dubai sukuk**	**DP World bond**	**DP World sukuk**	**Index bond**	**Index sukuk**
Q(5)	26.9458 [0.00006]	28.4044 [0.00003]	26.9458 [0.00006]	28.4044 [0.00003]	5.58588 [0.34862]	23.4484 [0.00028]	15.3548 [0.00895]	6.57679 [0.25406]
Q(10)	42.7137 [0.00001]	81.1560 [0.00000]	42.7137 [0.00001]	81.1560 [0.00000]	32.7779 [0.00030]	36.2237 [0.00008]	30.2536 [0.00078]	7.34219 [0.69279]
Q(20)	56.4181 [0.00003]	89.0956 [0.00000]	56.4181 [0.00003]	89.0956 [0.00000]	55.2117 [0.00004]	43.9466 [0.00153]	61.4994 [0.00000]	22.0904 [0.33563]
Q(50)	86.6699 [0.00049]	135.991 [0.00000]	89.6699 [0.00049]	135.991 [0.00000]	104.553 [0.00001]	99.4832 [0.00004]	101.645 [0.00002]	163.153 [0.00000]

Table 6.10: Ljung-Box Q statistics and associated p-values (p-values>0.95 in bold) (Continued)

Squared Data								
	BLME bond	**BLME sukuk**	**MAF bond**	**MAF sukuk**	**Petronas bond**	**Petronas sukuk**	**Rasmala bond**	**Rasmala sukuk**
Q(5)	12.4425 [0.02920]	19.0833 [0.00186]	24.6022 [0.00017]	58.3233 [0.00000]	0.60774 [0.98765]	455.616 [0.00000]	25.3315 [0.00012]	0.58623 [0.98862]
Q(10)	16.2907 [0.09161]	25.5162 [0.00449]	41.3629 [0.00001]	58.9791 [0.00000]	170.507 [0.00000]	455.686 [0.00000]	45.5807 [0.00000]	0.73803 [0.99996]
Q(20)	43.9541 [0.04135]	111.988 [0.00000]	55.5402 [0.00003]	62.5850 [0.00000]	170.560 [0.00000]	455.935 [0.00000]	95.6539 [0.00000]	1.26925 [1.00000]
Q(50)	68.6134 [0.04135]	216.272 [0.00000]	61.5505 [0.12673]	66.8816 [0.05551]	171.595 [0.00000]	456.357 [0.00000]	137.631 [0.00000]	2.32407 [1.00000]
	Tamweel bond	**Tamweel sukuk**	**Dubai bond**	**Dubai sukuk**	**DP World bond**	**DP World sukuk**	**Index bond**	**Index sukuk**
Q(5)	5.68891 [0.33768]	12.8065 [0.02526]	5.68891 [0.33768]	12.8065 [0.02526]	0.25680 [0.99834]	9.64491 [0.08594]	173.070 [0.00000]	0.06365 [0.99995]
Q(10)	18.6455 [0.04500]	31.8341 [0.00043]	18.6455 [0.04500]	31.8341 [0.00043]	4.05972 [0.94461]	42.3191 [0.00007]	419.920 [0.00000]	0.09127 [1.00000]
Q(20)	19.5306 [0.48762]	53.3242 [0.00007]	19.5306 [0.48762]	53.3242 [0.00007]	8.94420 [0.98354]	42.7728 [0.00219]	904.361 [0.00000]	1.36403 [1.00000]
Q(50)	28.6338 [0.99345]	84.1283 [0.00180]	28.6338 [0.99345]	84.1283 [0.00180]	23.7390 [0.99941]	61.9321 [0.11997]	1426.55 [0.00000]	30.3014 [0.98753]

With regard to testing the raw residuals, a low p-value indicates that positive (negative) returns tend to be followed by more positive (negative) returns. With regard to testing squared residuals, a low p-value indicates that large (low) absolute returns tend to be followed by further large (low) absolute returns; namely, volatility clusters over time.

Our results show that, using the raw data, the null hypothesis can be rejected in many cases. We can thus conclude that there is strong evidence of serial correlation in our data. In order to further test for volatility clustering, we apply Engle's ARCH test. An uncorrelated time series may still be serially dependent because of dynamic conditional variance (or autocorrelation of the squared residual series). Such series display ARCH effects. Engle's ARCH test examines such heteroskedasticity. The alternative hypothesis for Engle's ARCH test is autocorrelation in the squared residuals, given by the regression

$$H_a: e^2_t = \alpha_0 + \alpha_1 e^2_{t-1} + \ldots + \alpha_m e^2_{t-m} + u_t, \quad (6.2)$$

where u_t is a white noise error process. The null hypothesis is

$$H_0: \alpha_0 = \alpha_1 = \ldots = \alpha_m = 0 \quad (6.3)$$

The test statistic is the F statistic of the regression of residuals. We apply Engle's ARCH test to our residuals for two, five, and 10 lag terms (m). Table 6.11 presents the p-values for all our time series.

Table 6.11: p-values for Engle's ARCH tests

	ARCH 1-2 F test	ARCH 1-5 F test	ARCH 1-10 F test
BLME bond	0.9638	0.0318	0.1564
BLME Sukuk	0.7608	0.0021	0.0139
MAF bond	0.0004	0.0021	0.0009
MAF Sukuk	0.0000	0.0000	0.0000
Petronas bond	0.8203	0.9885	0.0000
Petronas Sukuk	0.0000	0.0000	0.0000
Rasmala bond	0.5980	0.0002	0.0001
Rasmala Sukuk	0.9608	0.9895	1.0000
Tamweel bond	0.0614	0.3478	0.0491
Tamweel Sukuk	0.4439	0.0295	0.0023
Dubai bond	0.0614	0.3478	0.0491
Dubai Sukuk	0.4439	0.0295	0.0023
DP world bond	0.8856	0.9984	0.9477
DP world Sukuk	0.1802	0.1242	0.0000
Index bond	0.0000	0.0000	0.0000
Index Sukuk	0.9772	0.9999	1.0000

Annex 3 contains all the results (for individual companies and the indices). The results largely conform to the Kupiec LR test results. Annex 4 presents the results of the four tests for our EWMA RiskMetrics version of GARCH. In all cases, the null hypothesis that the conditional variance follows an EWMA RiskMetrics process cannot be rejected at the 5% confidence level; thus, we find no evidence that our model has failed to adequately take into account asymmetric news impacts.

6.2.4.2 The VaR of Conventional Bonds Compared with the VaR of Sukuk

The VaR of conventional bonds is generally, and significantly, higher than the VaR of the sukuk from the same issuer (MAF is a notable exception).

Table 6.4 presents indicators that show, for both the HS and VCV methods and over the full sample and the last year of data, whether the VaR of conventional bonds is highest (B) or whether the VaR of sukuk (S) is highest. Of 102 comparisons, the VaR of conventional bonds was highest 83 times and that of Sukuk was highest 19 times. The results were discussed in more detail in the prior section.

Al-Zoubi and Maghyereh (2007) found that, over 1996–2005, VaR for the DJII is lower than that of the Dow Jones World Index, implying a lower risk. Our results confirm and expand these findings, using individual companies as well as indices and over a time frame that spans the 2008 financial crisis.

The PLS mechanism of Islamic finance is based on either the mudarabah or the musharaka principle. Under the mudarabah principle, lenders share the profits in good circumstances (the return being higher than interest rates) but bear the losses in bad circumstances (provided there is no misbehavior on the borrower's part). Under the musharaka principle, lenders and borrowers both share profits and losses.

The Islamic finance PLS mechanism affects the payoffs of investors and lenders in the following way. Shareholders have a lower return in positive circumstances because some of the profits accrue to the lender; however, shareholders have a higher return in negative circumstances because the lender takes all (mudarabah) or part (musharaka) of the losses. Bondholders receive a higher return in positive circumstances (since profit sharing leads to returns generally higher than interest rates) and a lower return in negative circumstances because they bear all or part of the losses. One would therefore expect that (i) the shares of companies that are compliant with Islamic financial principles are less risky than non-compliant shares and (ii) sukuk are more risky than non-compliant conventional bonds.

Al-Zoubi and Maghyereh (2007) argue, and empirically prove using VaR, that the foregoing leads to a situation where the shares of companies that are compliant with Islamic principles become less risky. Our analysis also shows that sukuk are less risky than non-compliant conventional bonds.

There are several reasons why the risk of a sukuk differs from that of a conventional bond. These reasons collectively explain why sukuk risk is lower than that of non-compliant bonds despite the sharing of profits and losses. First, Islamic principles that prohibit interest or usury (riba), and place strong emphasis on the performance of underlying assets in determining the payoff to investors, have led to a smaller effect of interest rate changes on sukuk values. Further relevant characteristics of Islamic finance are the prohibition of speculation (gharar); of short selling, betting, and gambling (qimar); and of arbitrage (Jobst, 2008). Another contributing factor is that sukuk are illiquid instruments compared with conventional bonds as evidenced by the lack of secondary market activity.

Second, there are structural differences between Islamic and conventional assets. Sukuk can be based on various Islamic partnerships and leasing arrangements; however, all of these are backed by tangible assets. Moreover, most sukuk are independent of interest rate movements; thus, the profit depends upon the underlying asset's performance.

To the extent that the value of the tangible assets backing sukuk is less volatile than interest rates (or, more precisely, the impact of the value of sukuk on the movement in interest rates), one would expect the VaR of sukuk to be lower than that of conventional bonds. This is what we observe in most cases.

Third, Al-Zoubi and Maghyereh (2007) show that the additional benefits accorded by the PLS arrangements of Islamic finance are that they decrease agency costs (lenders sharing the cost of failure leads to more conservative lending policies), decrease the bankruptcy costs of companies, and eliminate conflicts between bondholders and shareholders.

6.3 Conclusions

We have shown that the observed returns are non-normal. More specifically, returns are more clustered around the mean and exhibit heavier tails than predicted by the normal distribution. While financial returns are known to exhibit heavier tails than the normal distribution, we believe that this phenomenon is exacerbated in our sample by the illiquidity of the secondary market for the securities of our data set.

Should the number of simulations be increased for the Monte Carlo VaR, the results would be the same as for the VCV VaR (they both make the same distributional assumption). Further, using GARCH does not lead to values that differ significantly from VCV. Thus, having compared the results for different VaR implementations, we focus on VCV compared with HS.

By comparing the VCV and HS VaR, we find that the impact of the non-normality of returns is twofold. First, the HS VaR is generally and significantly higher than the VCV VaR for high confidence intervals (because of the heavy tails of the observed distribution of returns). Second, the VCV VaR is generally higher than the HS VaR at the 90% confidence level (because of clustering around the mean).

The “fat tails” phenomenon exhibited by financial returns is well documented in the literature, starting, among others, with Mandelbrot (1963), who notes that “the

empirical distributions of price changes are usually too 'peaked' relative to the Gaussian property". Fama (1965) shows that, for all stocks in the Dow Jones Industrial Average, the frequency of outlier returns far exceeds that predicted by a normal distribution. In the Middle East and North Africa (MENA) region, Assaf (2009) observed tails significantly heavier than predicted by the normal distribution in four stock markets. Our results concur with these studies and provide evidence of similar characteristics for conventional bond and sukuk returns, compounded further by sukuk illiquidity.

Since illiquidity contributes to the heavy tails phenomenon, it is likely that "true" (unobservable) returns would exhibit lighter tails than observed returns. The implication is that the HS VaR possibly overstates the risk for high confidence intervals. This is particularly true for sukuk, for which illiquidity is highest.

The VaR of a conventional bond is generally and significantly higher than that of a sukuk for a given issuer, indicating a higher level of risk in holding the conventional bond relative to the sukuk. Our analysis showed that sukuk are less risky than conventional bonds. Al-Zoubi and Maghyereh (2007) demonstrate that shares of companies that are compliant with Islamic principles are less risky than non-compliant shares. These results naturally lead to the conclusion that lending compliance with Islamic finance principles should be encouraged.

Chapter 7: Hedge Analysis

7.1 Introduction

The present chapter empirically explores the diversification benefits of sukuk in fixed-income portfolios, both prior to and after the collapse of Lehman Brothers in 2008. While conventional bond returns are driven solely by changes in interest rates, sukuk place a greater emphasis on the performance of the underlying asset(s). We postulate that the lower dependence of sukuk on interest rates should mean that they are good diversifiers for a bond portfolio. We proceed to test this hypothesis in three steps.

This chapter first explores the DCC features associated with the Dow Jones bond and sukuk indices, both before and after Lehman Brothers' collapse. Next, we use the DCC results to explore the diversification benefits of introducing a sukuk allocation (constrained or unconstrained) to a bond portfolio. Finally, we run a hedge analysis on the optimal DCC bond–sukuk portfolio.

Our main contribution is to show that introducing a sukuk allocation to a fixed-income portfolio improves the risk-return trade-off in all cases considered (pre- and post-crisis for constrained/unconstrained/fixed allocations).

We use daily data for both the Dow Jones Bond Index and DJSI from October 2005 to February 2014. The eligibility criteria for the DJSI have already been outlined in Chapter 4. The DJSI construction makes it a good proxy for global sukuk performance. All analyses are completed over three time-series panels: the whole sample, pre-crisis (10/3/2005 to 9/15/2008), and post-crisis (9/16/08 to 2/3/2014) periods.The rest of this paper is organized as follows. Section 7.2 analyses the

empirical methods that are followed and section 7.3 presents the data used in this chapter. Section 7.4 then discusses the empirical findings, while section 7.5 concludes the chapter by summarizing the main results.

7.2 Empirical Results

7.2.1 DCC-GARCH results

Results from the DCC-GARCH model consist of a series of correlations demonstrating the changes in returns association over the sample period. Table 7.1 contains the estimation results of the DCC model. With regard to the conditional return-generating processes, one can observe that for the three times-series panels, the one-period lagged conventional bond and sukuk returns, denoted by AR(1) coefficients, significantly affect their current values. This finding suggests strong evidence of short-term predictability in conventional bond and sukuk price changes over time. It is also worth noting that the relatively small size of ARCH coefficients suggests that conditional volatility changes more rapidly as a result of the substantial effects of past volatility rather than past news or shocks.

Table 7.1: Estimation results of the DCC-GARCH model

	Pre-crisis Period, 10/3/2005–9/15/2008		**Post-crisis Period, 9/16/2008–2/2/2014**		**Total Period 10/3/2005–2/2/2014**	
	Bond	Sukuk	Bond	Sukuk	Bond	Sukuk
Panel A: Univariate GARCH Estimates and Univariate Diagnostic Tests						
Conditional mean equation						
ϕ_0	-0.003457	0.007002***	0.004984	0.010363***	0.001807***	0.008902***
	(0.3964)	(0.0000)	(0.1984)	(0.0000)	(0.0000)	(0.0000)
ϕ_1	-0.093874***	-0.027118	-0.027065	0.340854***	-0.047731**	0.290181***
	(0.0070)	(0.6384)	(0.3662)	(0.0005)	(0.0307)	(0.0000)
Conditional Variance Equation						
θ_0	0.008954***	0.00336***	0.0002015***	0.00762***	0.54370**	0.32467**
	(0.0000)	(0.0000)	(0.0003)	(0.0000)	(0.0437)	(0.0319)
θ_1	0.026052***	0.116304**	0.061551***	0.039241**	0.054302***	0.129102**
	(0.0064)	(0.0378)	(0.0000)	(0.0265)	(0.0000)	(0.0393)
θ_2	0.975564***	0.941540***	0.941578***	0.969330***	0.949128***	0.946501***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
$\theta_1 + \theta_2$	1.00162	1.05784			1.00343	1.07560
Univariate Diagnostic						
Q(10)	18.3823**	30.8931***	4.76230	22.4365**	10.4596	30.3186***
	(0.0488)	(0.0006)	(0.9064)	(0.0130)	(0.8631)	(0.0007)
$Q^2(10)$	29.0122**	3.43190	15.9099	0.623094	31.5032***	0.363199
	(0.0012)	(0.9693)	(0.1022)	(0.9999)	(0.0004)	(0.9999)

Table 7.1: Estimation results of the DCC-GARCH model (Continued)

	Pre-crisis Period, 10/3/2005–9/15/2008		**Post-crisis Period, 9/16/2008–2/2/2014**		**Total Period 10/3/2005–2/2/2014**	
	Bond	Sukuk	Bond	Sukuk	Bond	Sukuk
Panel B: Conditional Correlation Estimates and Multivariate Diagnostic Tests						
Multivariate DCC Equation						
α	0.00005**		0.032961*		0.025095***	
	(0.0267)		(0.0639)		(0.0020)	
β	0.883993***		0.884480***		0.813277**	
	(0.0000)		(0.0000)		(0.0417)	
Dynamic Conditional Correlations						
$\rho_{\text{Bond}-\text{Sukuk}}$	0.061651**		0.022447		0.026974	
	(0.0450)		(0.6594)		(0.3820)	
Multivariate Diagnostic						
$Li - McL\ Q(10)$	69.9251*		58.4036**		86.4572	
	(0.0517)		(0.0235)		(0.1895)	
$Li - McL\ Q^2(10)$	54.9710*		39.9745		347.803	
	(0.0868)		(0.3824)		(0.2315)	

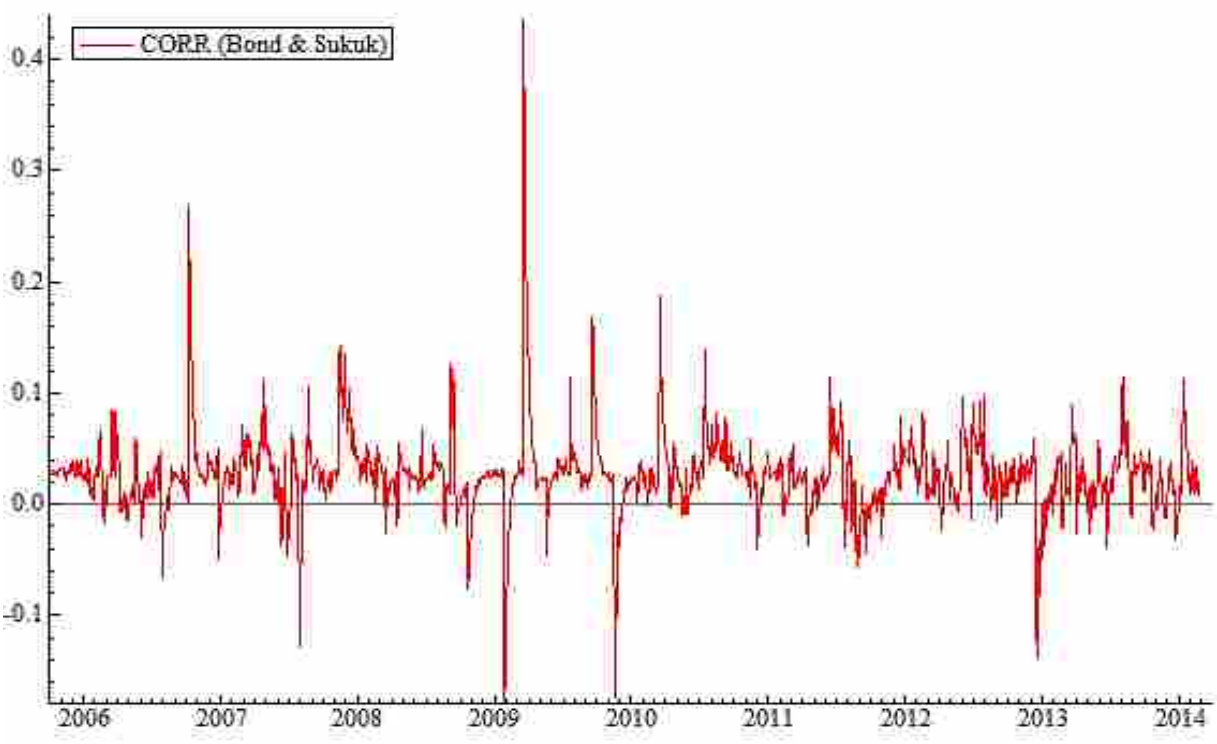
Notes: Q(10) and Q2(10) are the univariate Ljung–Box test statistics for serial correlation in standardized and squared residuals respectively. Li-McL Q(10) and Li-McL Q2 (10) are the multivariate Li and McLeod's (1981) test statistics for serial correlation in standardized and squared residuals respectively. The values in parentheses are the actual probability values. *, **, and *** indicate significant at the 10%, 5%, and 1% levels respectively.

The estimates of ARCH (θ_1) and GARCH (θ_2) coefficients that capture shock dependence and volatility persistence in the conditional variance equations are statistically significant at least at the 5% level for the three times-series panels. This finding provides evidence of a significant relationship between current volatility and lagged volatility and lagged residuals for conventional bond and sukuk market returns. The results show that $\theta_1 + \theta_2$ is close to 1 (in the range 1.00162 to 1.07560), which indicates that volatility is persistent. The DCC model seems a good fit because both a and β are significant at the 1% or 5% levels, except for alpha post-crisis, which is significant at the 10% level. In addition, the sum of a and β is inferior to 1, indicating that correlation is mean-reverting. The implication of mean reversion is that sukuk are likely to be good long-term diversifiers for a bond portfolio.

The pre-crisis conditional correlation between conventional bonds and sukuk is small (0.0617) and statistically significant at the 5% level. This points to the significant diversification potential of including sukuk in fixed-income portfolios. Interestingly, the correlation falls post-crisis (to 0.0224), suggesting that sukuk have retained their diversification potential through the crisis despite widespread evidence of increasing cross-market correlations at the time. Further evidence of the enduring low conditional correlation through the 2008 crisis is provided in Table 7.1. Care should, however, be taken because the post-crisis conditional correlation coefficient is not statistically significant at any reasonable confidence level.

Figure 7.1 shows the evolution of the DCC over time. While there is some variation in the correlation, it is worth pointing out that only over two brief episodes does

the DCC exceed 0.2, thereby confirming the diversification potential of sukuk. Note also that the jump in conditional correlations during the 2008 financial meltdown, which spikes to approximately 0.4 in early 2009, also falls afterward to a negative figure of 0.2 by the end of 2009. Indeed, following the outbreak of the global financial crisis, correlations revert back to their initial levels. The graph reconfirms the foregoing results to the extent that sukuk are weakly correlated with bonds and that they have great diversification potential in the context of global portfolios. The only point to note here is that in a crisis, sukuk do not offer comparable protection because of their association with global conventional bond increases.



Note: CORR denotes correlation.

Figure 7.1: Estimated time variations of conditional correlations from the DCC-GARCH model (10/3/2005 to 2/2/2014)

7.2.2 Implications for Portfolio Diversification Analysis

The foregoing results indicate that diversification benefits in terms of sukuk and conventional bonds could be achieved because of the lower association between the two assets. This subsection explores the diversification impact of introducing a sukuk allocation to a portfolio of conventional bonds. The analysis is conducted over three time-series panels (the whole sample, pre-crisis, and post-crisis periods) and outlines the impact of introducing a sukuk allocation (first an arbitrary allocation, followed by an unconstrained allocation) to the risk–return trade-off of the portfolio. The actual weights of minimum variance portfolios are then computed using a standard Markowitz (1952) mean variance procedure. Specifically, let w be $n \times 1$ vector of portfolio weights, H be the conditional variance–covariance matrix of the DCC-GARCH model, and n be the number of assets (two assets). The optimal weights can then be calculated by solving the optimization problem in equation 6.6.

The results are reported in Table 7.2. In the first panel (the whole sample period), if the portfolio consists only of conventional bonds, the return is 0.19%, the standard deviation is 0.0265 and the Sharpe ratio (return/standard deviation; namely, the return per unit of risk assumed) is 0.0732. Introducing a 10% sukuk allocation increases the return (to 0.25%) and reduces the standard deviation (to 0.022); thus, the Sharpe ratio rises to 0.1141. A 20% sukuk allocation leads to a further increase in the Sharpe ratio (to 0.1625). The optimal sukuk allocation from a risk–return trade-off (i.e., the allocation which maximizes the Sharpe ratio) is 35.63%. In this case, the Sharpe ratio is 0.2315, which is more than triple the ratio for the conventional bonds-only portfolio.

Table 7.2: Performance of minimum variance portfolios

	Optimal Weights (%)		Return	Standard Deviation	Sharpe Ratio	VaR% 1%	5%	10%
	Bond	Sukuk						
Panel A: Total Period, 10/3/2005–2/2/2014								
Bond only	100	0.00	0.0019	0.0265	0.0732	6.174	4.365	3.401
Sukuk only	0.00	100	0.0076	0.0478	0.1591	11.133	7.871	6.133
Bond with Sukuk (unrestricted)	64.37	35.63	0.0040	0.0171	0.2315	3.984	2.817	2.195
Bond with Sukuk (min. 70% in Bond)	70.00	30.00	0.0036	0.0174	0.2100	2.960	4.187	2.306
Bond with Sukuk (max. 10% Sukuk)	90.00	10.00	0.0025	0.0220	0.1141	5.117	3.618	2.819
Bond with Sukuk (max. 20% in Sukuk)	80.00	20.00	0.0031	0.0189	0.1625	4.406	3.115	2.427
Panel B: Pre-crisis Period, 10/3/2005–9/15/ 2008								
Bond only	100	0.000	-0.004	0.0185	-0.244	4.303	3.042	2.370
Sukuk only	0.00	100	0.006	0.0018	3.379	0.416	0.294	0.229
Bond with Sukuk (unrestricted)	6.96	93.04	0.005	0.0017	3.132	0.394	0.279	0.217

Table 7.2: Performance of minimum variance portfolios (Continued)

	Optimal Weights (%)		Return	Standard Deviation	Sharpe Ratio	VaR% 1%	5%	10%
	Bond	Sukuk						
Bond with Sukuk (min. 70% in Bond)	70.00	30.00	-0.001	0.0094	-0.143	2.189	1.547	1.206
Bond with Sukuk (max. 10% Sukuk)	90.00	10.00	-0.003	0.0151	-0.229	3.508	2.480	1.932
Bond with Sukuk (max. 20% in Sukuk)	80.00	20.00	-0.002	0.0120	-0.200	2.803	1.982	1.544
Panel C: Post-crisis Period, 9/16/2008–2/2/2014								
Bond only	100	0.00	0.0055	0.0309	0.1765	7.185	5.080	3.958
Sukuk only	0.00	100	0.0084	0.0729	0.1158	16.955	11.988	9.341
Bond with Sukuk (unrestricted)	70.21	29.79	0.0063	0.0217	0.2927	5.041	3.564	2.777
Bond with Sukuk (min. 70% in Bond)	70.21	29.79	0.0063	0.0217	0.2927	5.041	3.564	2.777
Bond with Sukuk (max. 10% Sukuk)	90.00	10.00	0.0058	0.0257	0.2235	5.987	4.233	3.298
Bond with Sukuk (max. 20% in Sukuk)	80.00	20.00	0.0060	0.0227	0.2669	5.272	3.728	2.904

In the pre-crisis panel, the optimal sukuk allocation is over 93%, driven mainly by the fact that a rising interest rate environment in that period means that the total bond return is negative (the interest received is more than offset by price depreciations caused by the higher rates). Post-crisis, the optimal sukuk allocation is over 70%; moreover, the Sharpe ratio rises from 0.1765 in the conventional bonds-only portfolio to 0.2927 in the optimal portfolio. In all cases, the introduction of sukuk increases returns and Sharpe ratios. This finding suggests that reallocating an unconstrained proportion of a conventional bond portfolio to sukuk improves the risk–return trade-off significantly.

Figure 7.2 shows the optimal portfolio weights over time. Given that the main driver of returns differs for conventional bonds (interest rates) and sukuk (performance of underlying assets), it is unsurprising that the optimal weight should vary over time. Specifically, a strong jump in the optimal sukuk allocation is observed in the period 2009–2010. In 2009–2010, in the volatile markets post-Lehman Brothers, volatility rose much more sharply for conventional bonds (which were exposed to market variables only: reference interest rates and credit spreads) than for sukuk (whose values were linked to underlying real-world assets). While falling central bank rates over that time should, in isolation, push conventional bond prices up, this effect was more than offset by the rise in credit spreads, meaning that overall risky conventional bonds' rates increased. Most importantly, volatility relating to rates and credit spreads rose sharply. As a result, the risk-adjusted return of sukuk was more attractive than that of conventional bonds. This period also coincided with greater variability of the DCC correlation (as evidenced in Figure 7.1); however, the conditional variance differential was the dominant factor and explains the high sukuk allocation.

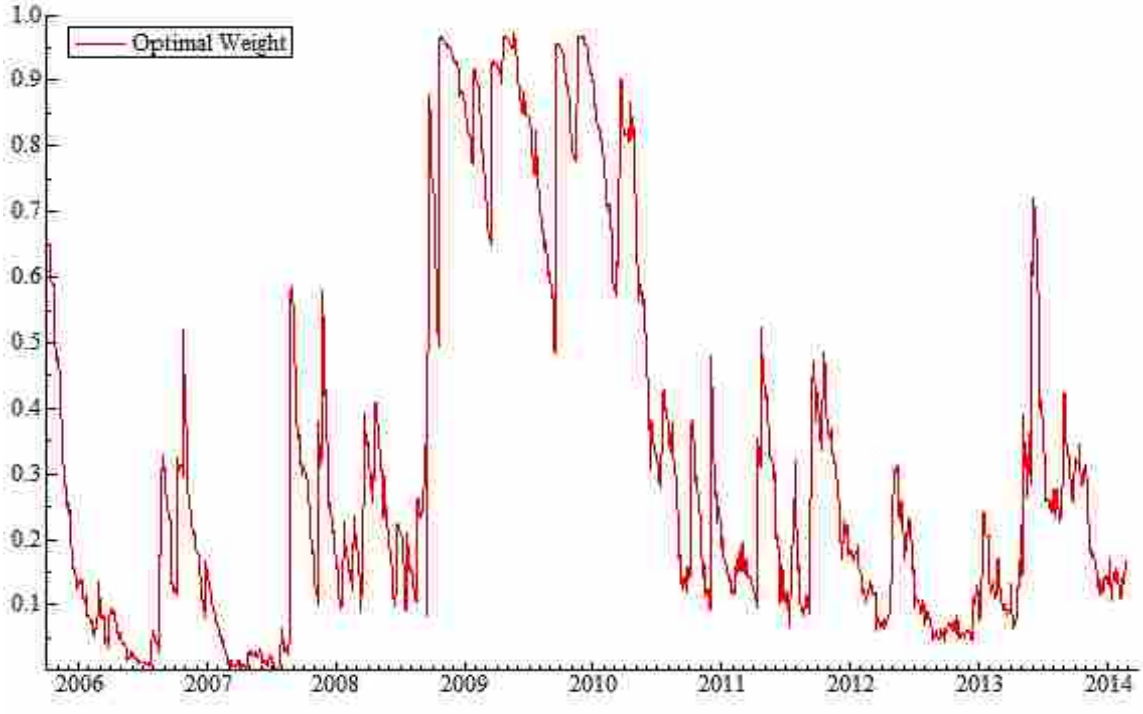


Figure 7.2: Estimated time variations of optimal weights from the DCC-GARCH model (10/3/2005 to 2/2/2014)

Figure 7.3 shows the greater variability of the returns of the optimal portfolio from the Lehman Brothers' collapse onward. This variability is further evidenced by Figure 7.4, which shows the standard deviation of the optimal portfolio rise sharply in the fourth quarter of 2008.

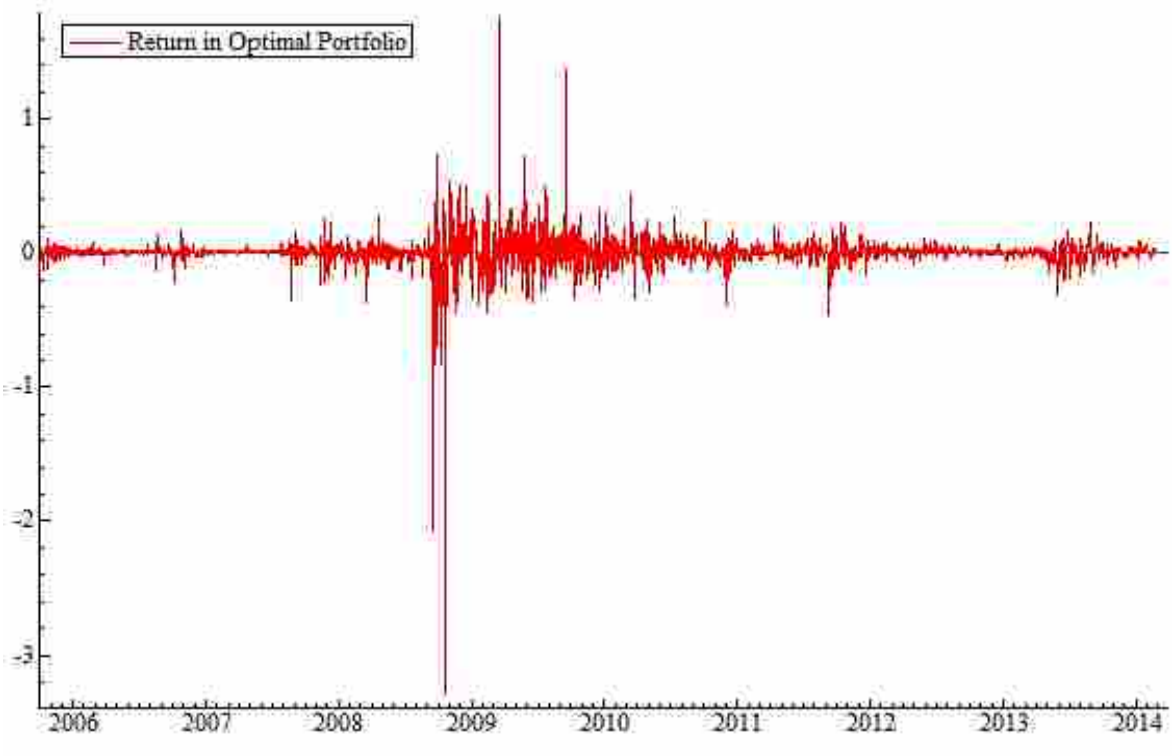


Figure 7.3: Estimated time variations of returns in an optimal portfolio from the DCC-GARCH model (10/3/2005 to 2/2/2014)

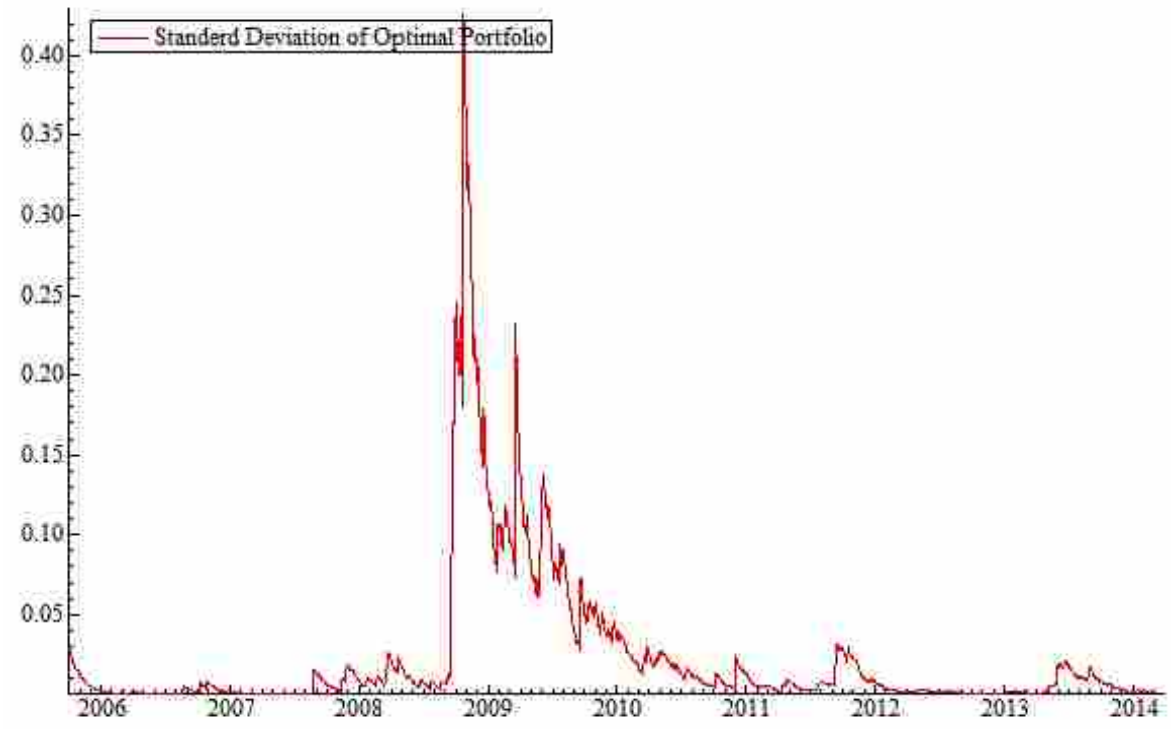


Figure 7.4: Estimated time variations of standard deviations in an optimal portfolio from the DCC-GARCH model (10/3/2005 to 2/2/2014)

One should note that introducing a sukuk allocation of 30% improves the risk–return trade-off (as measured by the Sharpe ratio) in all cases. Overall, these findings imply that investors holding assets should have more sukuk than conventional bonds in their portfolios to minimize risk, while keeping the expected return unchanged.

As aforementioned, conditional volatility estimates are used to construct hedge ratios. The average optimal hedge ratios are presented in Table 7.3. The table reports the amount of sukuk/conventional bonds that should be longed/shorted in order to hedge a US$1 portfolio. As can be seen, on average, a US$1 portfolio of conventional bonds can be hedged with a short position of 5.725 cents of sukuk. In the pre-crisis panel, the portfolio can be hedged with a short position of 8.793 cents compared with 4.060 cents in the post-crisis panel. The main finding from the table is that we observe a drop in the hedge efficiency post-crisis (from 72.8% to 16%). This is unsurprising since sukuk have already been found to be good diversifiers in a bond portfolio because of the low correlation between conventional bond and sukuk returns. If conventional bond and sukuk returns are driven by different factors, we would not expect one to have a great hedge efficiency with respect to the other (the key to hedge efficiency is to find a hedge correlated to the position to be hedged).

Table 7.3: Optimal weights, hedge ratios, returns, standard deviations, and VaR of the optimal portfolio for a conventional bond–sukuk portfolio from the DCC-GARCH model

	Total Period, 10/3/2005–2/02/2014	**Pre-crisis Period 10/3/2005–15/09/2008**	**Post-crisis Period 9/16/2008–2/2/2014**
Optimal weight % ($w_{12,t}$)	31.592	16.684	39.686
Hedge ratio % ($\beta_{12,t}$)	5.7250	8.7931	4.0602
Return %	0.6336	0.4348	0.7415
Standard Deviation %	2.2994	0.5031	3.2753
VaR			
1%	5.9336	1.2988	8.4503
5%	4.5077	0.9863	6.4196
10%	3.7832	0.8278	5.3879
Hedging Effectiveness (HE)	19.2135	72.7981	15.997

The dynamic evolution of hedging ratios is presented in Figure 7.5. The figure shows considerable variability in optimal hedge ratios across the sample period, implying that hedging positions must be adjusted frequently. Notice that the hedge ratios of sukuk/conventional bonds experience stability and are close to zero during the period 2008–2010. This situation is likely due to the world financial crisis.

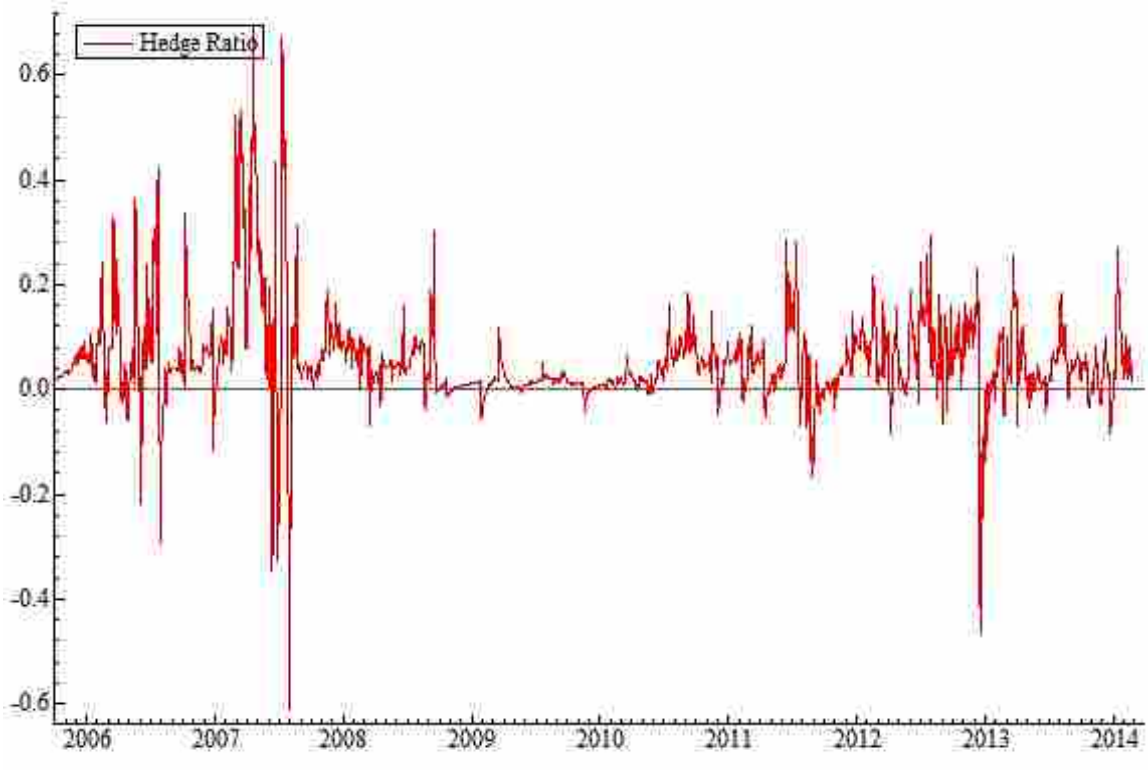


Figure 7.5: Estimated time variations of hedge ratios from the DCC-GARCH model (10/3/2005 to 2/2/2014)

Overall, our findings for optimal hedge ratios suggest that sukuk should be an integral part of a diversified portfolio of bonds, thereby helping to increase the risk-adjusted performance of the hedged portfolio.

7.3 Conclusions

The DCC analysis as applied to bonds and sukuk both before and after the collapse of Lehman Brothers shows that correlation is very low, making sukuk a great diversifier in a fixed-income portfolio that hitherto contained only conventional bonds. Moreover, the diversification potential of sukuk remained intact throughout the financial crisis (there is evidence that correlation actually went down). In addition, we have shown that the introduction of a sukuk allocation to a fixed-income portfolio (unconstrained or specified ex ante) improves risk–return trade-off in all cases, both

before and after the crisis. We have also looked at the hedging efficiency of sukuk used in a bond portfolio and found a fall in the hedge efficiency post-crisis, a result explainable by the low correlation between conventional bond and sukuk returns.

Cakir and Raei (2007) find that including sukuk in a bond portfolio reduces the portfolio's VaR significantly because of the low correlation between sukuk and bond returns. However, in their study the reduced risk is not balanced against the lower sukuk returns. While confirming the low correlation with DCC-GARCH (and hence the diversification benefit), we have gone further by showing that introducing a sukuk allocation improves the risk–return trade-off, as measured by the Sharpe ratio.

Our analysis has important consequences for asset allocation. Most importantly, conventional bond funds should be encouraged to introduce a sukuk allocation to their portfolios since doing so would improve the funds' risk–return characteristics.

Chapter 8: Conclusion and Discussion

8.1 Introduction

The sukuk market has experienced tremendous growth over the last few years. Transaction volumes increased from US$8 billion in 2003 to US$856 M globally (IIFM, 2016) because sovereign and corporate issuances aim to access the growing Islamic liquidity pool. However, despite this growth, relatively few studies have explored the market risks of sukuk relative to that of conventional bonds.

Islamic law, or Shari'ah, prohibits the payment of interest. Islamic banks operate an interest-free system guided by the principle that the profits and losses of a financed asset are shared between fund providers (depositors) and fund users (entrepreneurs). Sukuk are traded securities consistent with this principle. Unlike conventional debt instruments, sukuk returns are linked directly to the performance of a financed asset, rather than the creditworthiness of a borrower. Sukuk holders are thus exposed to a financed asset's value rather than interest rates and issuer credit spreads. This "buyer–seller" arrangement (rather than the "borrower–lender" arrangement of conventional bonds) leads to different agency characteristics. Further, the specificities of sukuk pose the question of their riskiness relative to conventional bonds.

The focus of this thesis has been on the relative market risk of sukuk and conventional bonds. In this regard, market risk is measured by VaR. The thesis has three objectives. First, we look at whether, for a set of Middle Eastern issuers, sukuk are riskier than conventional bonds. Second, we investigate whether VaR is an adequate measure of market risk for sukuk. Third, we look at the risk–return impact of including a sukuk allocation in a bond portfolio.

In chapter 5, we considered seven companies that are conventional bond and sukuk issuers (BLME, MAF, Petronas, Rasmala, Tamweel, Dubai, and DP World). We examined the relative riskiness, as measured by VaR, of both issues. We also performed a similar analysis for two indices (the DJSI and the Dow Jones Corporate Bond Index).

In order to explore the validity of VaR as a measure of market risk, we conducted unconditional (Kupiec) and conditional (Engle and Manganelli) backtesting tests. We also computed ES as an alternative market-risk measure for our data to compare results.

In chapter 6, we considered the diversification impact of including sukuk in a bond portfolio. Using a DCC-GARCH approach, we first examined the time-varying features of the correlation between conventional bond and sukuk indices. We then investigated the impact of introducing sukuk to a conventional bond portfolio on the risk–return trade-off (as measured by the Sharpe ratio).

8.2 Summary of Results

We have found that, for a given issuer, conventional bond VaR is significantly higher than sukuk VaR in most cases, indicating that sukuk are less risky. This finding holds regardless of the time horizon over which VaR is computed, the confidence interval, and the methodology used (HS and VCV).

We have also found evidence of persistent sukuk illiquidity, a consequence of which is that sukuk returns are non-normal (in a statistical sense). Specifically, sukuk returns exhibit heavier tails and are more clustered around the mean than predicted by

the normal distribution. The main consequence for VaR is that, for high confidence levels (95% and higher), HS VaR is higher than VCV VaR.

The backtesting results for our data have shown mixed results with conditional and unconditional tests. It should be noted that this observation applies equally to conventional bonds and sukuk. In addition, rerunning the analysis using ES (an alternative, coherent measure of risk) has not altered the results.

Using a DCC-GARCH approach, we have found that sukuk returns have a low correlation with conventional bond returns, making them a good diversifier. We have further shown that introducing a sukuk allocation to a conventional bond portfolio improves the risk–return trade-off, as measured by the Sharpe ratio, in all cases both before and after the 2008 crisis.

Our results have expanded the literature. Al-Zoubi and Maghyereh (2007) show that the DJIS has lower VaR than the Dow Jones Bond Index. Cakir and Raei (2007) find that introducing sukuk to a conventional bond portfolio decreases VaR because of the low correlation between sukuk and bond returns. Both studies focus on risk and do not compare the reduction in risk with the lower sukuk returns. We have confirmed these results but have gone further by showing that the risk–return tradeoff of sukuk is better than that of bonds and that it is always worthwhile to introduce a sukuk allocation to a conventional bond portfolio on a risk-adjusted basis.

8.3 Implications

Sukuk issuance should be encouraged by governments in Muslim countries for at least two reasons.

First, there is widespread evidence that efficient capital markets foster economic growth. A well-organized and liquid sukuk market can thus boost economic growth while being consistent with Shari'ah. Although the link between capital markets and economic growth can apply to all instruments (sukuk as well as conventional bonds), sukuk have added features that make them particularly attractive from a public policy perspective: Shari'ah compliance, economic system stability, reduced moral hazard and adverse selection problems, and greater conduciveness to poverty alleviation.

Second, this study has shown that sukuk carry less market risk than conventional bonds. Thus, international investors who do not specifically pursue Shari'ah-compliant investment objectives can still benefit from allocating part of their resources to sukuk. This study has shown that sukuk are proving an excellent diversifier to a bond portfolio and improve the risk–return trade-off, as measured by the Sharpe ratio.

8.4 Recommendations

Governments should foster and encourage the growth of the sukuk sector in primary as well as secondary markets.

Low secondary trading activity can make sukuk less attractive to international funds because of the lack of a wide spectrum of maturities. Low trading volumes will lead to investors demanding a liquidity premium, which would be detrimental to issuers. International bond funds would do well to include a sukuk allocation in their portfolios.

8.5 Limitations and Suggestions

We have found that, for indices, the conventional bond VaR is higher than the sukuk VaR. While this finding could point to differences in the structures and natures of both instruments (our argument), it should be noted that the modified duration of the conventional bond index is higher than that of the sukuk index (7.5 compared with 5.1), a situation that may have contributed to explaining our results. However, the index results were similar to individual companies' results, for which no significant duration differences exist. In addition, given the smaller dependence upon interest rates of sukuk, the very concept of modified duration may be flawed when assessing sukuk risks.

The superior risk–return trade-off offered by sukuk that we uncovered needs to be balanced against the persistent illiquidity of the secondary market for sukuk. Further work could be conducted to assess the extent to which the extra returns of sukuk can be explained by the "liquidity premium" frequently demanded by investors as compensation for illiquidity.

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Appendices

Appendix 1: Kupiec LR Test Results

BLME

Bond						Sukuk					
Short Positions						Short Positions					
Quantile	**Success rate**	**Kupiec LRT**	**P-value**	**ESF1**	**ESF2**	**Quantile**	**Success rate**	**Kupiec LRT**	**P-value**	**ESF1**	**ESF2**
0.95000	0.97509	12.952	0.00031958	0.25681	1.6232	0.95000	0.97136	9.0548	**0.0026201**	0.080176	1.7932
0.97500	0.98132	1.4401	0.23013	0.28640	1.5935	0.97500	0.97758	0.22777	0.63318	0.088688	1.7389
0.99000	0.98630	0.99475	0.31859	0.32161	1.5807	0.99000	0.98007	6.2011	**0.012767**	0.093209	1.5964
0.99500	0.99128	1.8234	0.17691	0.37026	1.7442	0.99500	0.98630	8.2641	**0.0040436**	0.10509	1.7029
0.99750	0.99377	3.1517	0.075849	0.43968	1.9016	0.99750	0.98755	16.209	**5.6726e-005**	0.10443	1.6477
Long Positions						Long Positions					
Quantile	**Success rate**	**Kupiec LRT**	**P-value**	**ESF1**	**ESF2**	**Quantile**	**Success rate**	**Kupiec LRT**	**P-value**	**ESF1**	**ESF2**
0.050000	0.043587	0.72548	0.39435	-0.14399	2.2129	0.050000	0.046077	0.26685	0.60545	-0.046970	2.0871
0.025000	0.027397	0.18369	0.66822	-0.18063	2.0382	0.025000	0.033624	2.2150	0.13668	-0.054463	1.8701
0.010000	0.013699	0.99475	0.31859	-0.26647	2.2163	0.010000	0.018680	4.8673	**0.027371**	-0.071423	1.9650
0.0050000	0.012453	6.3259	0.011899	-0.27751	2.0134	0.0050000	0.012453	6.3259	0.011899	-0.084327	2.1107
0.0025000	0.011208	13.082	0.00029811	-0.26887	1.8786	0.0025000	0.0099626	10.181	0.0014191	-0.095344	2.1312

MAF

Bond						Sukuk					
Short Positions						Short Positions					
Quantile	**Success rate**	**Kupiec LRT**	**P-value**	**ESF1**	**ESF2**	**Quantile**	**Success rate**	**Kupiec LRT**	**P-value**	**ESF1**	**ESF2**
0.95000	0.95050	0.0026137	0.95923	0.23488	1.4285	0.95000	0.96436	2.4247	0.11944	0.91398	-8.5469
0.97500	0.97426	0.011316	0.91528	0.27602	1.5068	0.97500	0.96832	0.85430	0.35534	0.99711	3.4383
0.99000	0.98218	2.5323	0.11153	0.26952	1.4707	0.99000	0.98218	2.5323	0.11153	1.6310	2.7936
0.99500	0.98614	5.3653	**0.020541**	0.29462	1.4589	0.99500	0.98416	7.5611	**0.0059642**	1.8139	2.3468
0.99750	0.98812	9.2737	**0.0023247**	0.31256	1.4148	0.99750	0.98416	16.157	**5.8300e-005**	1.8139	1.9673
Long Positions						Long Positions					
Quantile	**Success rate**	**Kupiec LRT**	**P-value**	**ESF1**	**ESF2**	**Quantile**	**Success rate**	**Kupiec LRT**	**P-value**	**ESF1**	**ESF2**
0.050000	0.047525	0.066182	0.79698	-0.28603	1.6082	0.050000	0.033663	3.1902	0.074080	-1.0477	2.8473
0.025000	0.033663	1.4052	0.23586	-0.32833	1.5062	0.025000	0.025743	0.011316	0.91528	-1.2819	2.8082
0.010000	0.019802	3.8131	0.050853	-0.39492	1.5168	0.010000	0.019802	3.8131	0.050853	-1.5329	2.7880
0.0050000	0.011881	3.4603	0.062859	-0.49011	1.6425	0.0050000	0.017822	10.012	**0.0015557**	-1.6930	2.6896
0.0025000	0.0099010	6.3162	0.011964	-0.54663	1.6126	0.0025000	0.015842	16.157	5.8300e-005	-1.8812	2.6575

Petronas

Bond						Sukuk					
Short Positions						Short Positions					
Quantile	**Success rate**	**Kupiec LRT**	**P-value**	**ESF1**	**ESF2**	**Quantile**	**Success rate**	**Kupiec LRT**	**P-value**	**ESF1**	**ESF2**
0.95000	0.92605	13.182	0.00028271	0.36032	1.5142	0.95000	0.93167	7.9331	0.0048539	0.25019	1.7838
0.97500	0.95740	13.105	0.00029455	0.43569	1.4437	0.97500	0.95338	19.096	1.2428e-005	0.30004	1.6575
0.99000	0.98071	8.5314	0.0034907	0.64769	1.5128	0.99000	0.96543	46.309	1.0100e-011	0.35864	1.4154
0.99500	0.98633	12.719	0.00036191	0.80368	1.5070	0.99500	0.97347	57.160	4.0190e-014	0.34646	1.3252
0.99750	0.99196	9.6176	0.0019272	1.1133	1.6581	0.99750	0.98071	56.658	5.1847e-014	0.39248	1.2807
Long Positions						Long Positions					
Quantile	**Success rate**	**Kupiec LRT**	**P-value**	**ESF1**	**ESF2**	**Quantile**	**Success rate**	**Kupiec LRT**	**P-value**	**ESF1**	**ESF2**
0.050000	0.022508	24.684	6.7547e-007	-0.61372	1.7950	0.050000	0.018489	33.923	5.7351e-009	-0.53536	1.6558
0.025000	0.012862	9.1194	0.0025291	-0.76354	2.0120	0.025000	0.014469	6.6549	0.0098884	-0.62347	1.8325
0.010000	0.0072347	1.0631	0.30250	-1.0635	2.3736	0.010000	0.0088424	0.17520	0.67553	-0.76075	1.9070
0.0050000	0.0048232	0.0079138	0.92911	-1.3454	2.7833	0.0050000	0.0064309	0.46931	0.49331	-0.93527	2.0481
0.0025000	0.0032154	0.23401	0.62857	-1.8025	3.3830	0.0025000	0.0048232	2.1124	0.14611	-1.1358	2.2337

Rasmala

Bond						Sukuk					
Short Positions						Short Positions					
Quantile	**Success rate**	**Kupiec LRT**	**P-value**	**ESF1**	**ESF2**	**Quantile**	**Success rate**	**Kupiec LRT**	**P-value**	**ESF1**	**ESF2**
0.95000	0.97450	8.3913	**0.0037703**	0.32357	1.3028	0.95000	0.98543	19.890	**8.2041e-006**	0.22109	1.1859
0.97500	0.98179	1.1432	0.28498	0.36277	1.2310	0.97500	0.99454	12.540	**0.00039837**	0.25263	1.2313
0.99000	0.98907	0.046453	0.82935	0.38393	1.1850	0.99000	0.99818	5.6111	**0.017847**	0.32216	1.3978
0.99500	0.99089	1.4959	0.22130	0.38889	1.1223	0.99500	0.99818	1.4760	0.22440	0.32216	1.2966
0.99750	0.99636	0.25177	0.61583	0.50529	1.1745	0.99750	0.99818	0.11199	0.73789	0.32216	1.2150
Long Positions						Long Positions					
Quantile	**Success rate**	**Kupiec LRT**	**P-value**	**ESF1**	**ESF2**	**Quantile**	**Success rate**	**Kupiec LRT**	**P-value**	**ESF1**	**ESF2**
0.050000	0.025501	8.3913	**0.0037703**	-0.48903	4.9360	0.050000	0.038251	1.7300	0.18841	-0.24008	3.3884
0.025000	0.023679	0.039971	0.84154	-0.48846	3.8198	0.025000	0.027322	0.11798	0.73124	-0.30076	3.0601
0.010000	0.021858	5.8258	**0.015793**	-0.51662	3.0881	0.010000	0.021858	5.8258	**0.015793**	-0.35681	2.6852
0.0050000	0.020036	14.154	**0.00016845**	-0.53585	2.8218	0.0050000	0.012750	4.6290	**0.031435**	-0.46588	3.2913
0.0025000	0.018215	22.601	**1.9942e-006**	-0.56701	2.6567	0.0025000	0.010929	8.4857	**0.0035794**	-0.51692	3.2265

Tamweel

Bond						Sukuk					
Short Positions						Short Positions					
Quantile	**Success rate**	**Kupiec LRT**	**P-value**	**ESF1**	**ESF2**	**Quantile**	**Success rate**	**Kupiec LRT**	**P-value**	**ESF1**	**ESF2**
0.95000	0.95892	2.0332	0.15389	1.0240	-1.8426	0.95000	0.99126	61.541	**4.3299e-015**	3.2368	3.4575
0.97500	0.97028	0.98704	0.32047	1.3159	-0.37742	0.97500	0.99126	16.492	**4.8855e-005**	3.2368	3.0578
0.99000	0.97727	13.759	0.00020783	1.4893	-1.4881	0.99000	0.99126	0.19121	0.66191	3.2368	2.6963
0.99500	0.97990	29.714	5.0076e-008	1.6036	2.5952	0.99500	0.99126	2.6284	0.10496	3.2368	2.4957
0.99750	0.98339	39.907	2.6637e-010	1.7085	2.3276	0.99750	0.99126	10.800	**0.0010150**	3.2368	2.3349
Long Positions						Long Positions					
Quantile	**Success rate**	**Kupiec LRT**	**P-value**	**ESF1**	**ESF2**	**Quantile**	**Success rate**	**Kupiec LRT**	**P-value**	**ESF1**	**ESF2**
0.050000	0.029720	11.519	**0.00068903**	-0.89015	0.98364	0.050000	0.0096154	58.066	**2.5313e-014**	-1.6189	3.0104
0.025000	0.020105	1.2041	0.27251	-1.1154	1.1333	0.025000	0.0078671	18.731	**1.5050e-005**	-1.7546	2.6025
0.010000	0.012238	0.54015	0.46237	-1.3527	1.2804	0.010000	0.0078671	0.56721	0.45137	-1.7546	2.0465
0.0050000	0.010490	5.2572	**0.021856**	-1.5066	1.2323	0.0050000	0.0078671	1.6081	0.20476	-1.7546	1.7900
0.0025000	0.0087413	10.800	**0.0010150**	-1.6440	1.2722	0.0025000	0.0061189	4.2663	**0.038876**	-1.9770	1.7943

Dubai

Bond						Sukuk					
Short Positions						Short Positions					
Quantile	**Success rate**	**Kupiec LRT**	**P-value**	**ESF1**	**ESF2**	**Quantile**	**Success rate**	**Kupiec LRT**	**P-value**	**ESF1**	**ESF2**
0.95000	0.95892	2.0332	0.15389	1.0240	-1.8426	0.95000	0.99126	61.541	4.3299e-015	3.2368	3.4575
0.97500	0.97028	0.98704	0.32047	1.3159	-0.37742	0.97500	0.99126	16.492	**4.8855e-005**	3.2368	3.0578
0.99000	0.97727	13.759	**0.00020783**	1.4893	-1.4881	0.99000	0.99126	0.19121	0.66191	3.2368	2.6963
0.99500	0.97990	29.714	**5.0076e-008**	1.6036	2.5952	0.99500	0.99126	2.6284	0.10496	3.2368	2.4957
0.99750	0.98339	39.907	**2.6637e-010**	1.7085	2.3276	0.99750	0.99126	10.800	0**.0010150**	3.2368	2.3349
Long Positions						Long Positions					
Quantile	**Success rate**	**Kupiec LRT**	**P-value**	**ESF1**	**ESF2**	**Quantile**	**Success rate**	**Kupiec LRT**	**P-value**	**ESF1**	**ESF2**
0.050000	0.029720	11.519	**0.00068903**	-0.89015	0.98364	0.050000	0.0096154	58.066	**2.5313e-014**	-1.6189	3.0104
0.025000	0.020105	1.2041	0.27251	-1.1154	1.1333	0.025000	0.0078671	18.731	**1.5050e-005**	-1.7546	2.6025
0.010000	0.012238	0.54015	0.46237	-1.3527	1.2804	0.010000	0.0078671	0.56721	0.45137	-1.7546	2.0465
0.0050000	0.010490	5.2572	**0.021856**	-1.5066	1.2323	0.0050000	0.0078671	1.6081	0.20476	-1.7546	1.7900
0.0025000	0.0087413	10.800	**0.0010150**	-1.6440	1.2722	0.0025000	0.0061189	4.2663	**0.038876**	-1.9770	1.7943

DP World

Bond						Sukuk					
Short Positions						Short Positions					
Quantile	**Success rate**	**Kupiec LRT**	**P-value**	**ESF1**	**ESF2**	**Quantile**	**Success rate**	**Kupiec LRT**	**P-value**	**ESF1**	**ESF2**
0.95000	0.95492	0.94762	0.33033	0.70562	2.3251	0.95000	0.96049	4.4718	0.034458	1.2509	1.7250
0.97500	0.96828	3.0719	0.079657	0.86896	1.8950	0.97500	0.97329	0.21123	0.64580	1.4507	1.6753
0.99000	0.98275	7.8432	**0.0051011**	1.2970	2.1194	0.99000	0.98219	8.9810	**0.0027280**	1.7088	1.6306
0.99500	0.98609	19.280	**1.1289e-005**	1.3631	1.7013	0.99500	0.98609	19.280	**1.1289e-005**	1.8684	1.6077
0.99750	0.98998	23.054	**1.5754e-006**	1.6774	1.6453	0.99750	0.98887	28.852	**7.8106e-008**	2.1150	1.6019
Long Positions						Long Positions					
Quantile	**Success rate**	**Kupiec LRT**	**P-value**	**ESF1**	**ESF2**	**Quantile**	**Success rate**	**Kupiec LRT**	**P-value**	**ESF1**	**ESF2**
0.050000	0.046745	0.40945	0.52225	-0.98078	2.0991	0.050000	0.043406	1.7186	0.18988	-1.6317	2.1001
0.025000	0.033945	5.3152	**0.021140**	-1.2132	2.0432	0.025000	0.032276	3.5799	0.058484	-1.9048	2.0370
0.010000	0.022816	21.879	**2.9045e-006**	-1.5759	2.0283	0.010000	0.024485	27.125	**1.9067e-007**	-2.1950	1.9625
0.0050000	0.017251	33.025	**9.0987e-009**	-1.8500	2.0895	0.0050000	0.020590	49.148	**2.3737e-012**	-2.4001	1.9258
0.0025000	0.013912	45.044	**1.9267e-011**	-2.1138	2.1308	0.0025000	0.017807	71.062	**0.00000**	-2.5959	1.8906

Index

Bond						Sukuk					
Short Positions						Short Positions					
Quantile	**Success rate**	**Kupiec LRT**	**P-value**	**ESF1**	**ESF2**	**Quantile**	**Success rate**	**Kupiec LRT**	**P-value**	**ESF1**	**ESF2**
0.95000	0.94711	0.49839	0.48021	0.29057	1.4070	0.95000	0.95984	4.7706	0.028950	0.22387	1.4477
0.97500	0.96647	7.8135	**0.0051858**	0.32136	1.3437	0.97500	0.96805	3.9954	0.045626	0.27239	1.1934
0.99000	0.97822	30.327	**3.6499e-008**	0.35930	1.2587	0.99000	0.97764	25.038	**5.6220e-007**	0.34476	1.7947
0.99500	0.98548	34.733	**3.7817e-009**	0.38109	1.2335	0.99500	0.98083	51.240	**8.1757e-013**	0.38181	1.0950
0.99750	0.98894	45.856	**1.2728e-011**	0.38915	1.1867	0.99750	0.98403	71.185	**0.00000**	0.44323	2.0965
Long Positions						Long Positions					
Quantile	**Success rate**	**Kupiec LRT**	**P-value**	**ESF1**	**ESF2**	**Quantile**	**Success rate**	**Kupiec LRT**	**P-value**	**ESF1**	**ESF2**
0.050000	0.067058	16.085	**6.0547e-005**	-0.27476	1.4138	0.050000	0.036057	9.8908	**0.0016611**	-0.25435	2.7236
0.025000	0.039060	20.085	**7.4089e-006**	-0.32078	1.3703	0.025000	0.026016	0.091500	0.76228	-0.33637	2.4939
0.010000	0.023159	36.903	**1.2414e-009**	-0.35117	1.3115	0.010000	0.020539	18.841	**1.4205e-005**	-0.41075	2.1192
0.0050000	0.016592	48.471	**3.3517e-012**	-0.37211	1.2728	0.0050000	0.016431	35.859	**2.1214e-009**	-0.49915	2.1955
0.0025000	0.011753	51.963	**5.6566e-013**	-0.40317	1.2502	0.0025000	0.014605	60.244	**8.3267e-015**	-0.54745	1.6949

Index Pre-crisis

Bond						Sukuk					
Short Positions						Short Positions					
Quantile	**Success rate**	**Kupiec LRT**	**P-value**	**ESF1**	**ESF2**	**Quantile**	**Success rate**	**Kupiec LRT**	**P-value**	**ESF1**	**ESF2**
0.95000	0.94265	1.1776	0.27785	0.23329	1.4210	0.95000	0.95460	0.35462	0.55151	0.063991	1.6906
0.97500	0.96207	6.4145	**0.011319**	0.25482	1.3391	0.97500	0.96887	1.1035	0.29350	0.080205	1.6700
0.99000	0.97687	13.729	**0.00021115**	0.29400	1.2690	0.99000	0.98314	3.0400	0.081238	0.11466	1.8409
0.99500	0.98520	13.643	**0.00022104**	0.31538	1.2612	0.99500	0.98573	8.8443	**0.0029401**	0.12607	1.8023
0.99750	0.98705	23.580	**1.1980e-006**	0.30532	1.1870	0.99750	0.98573	20.279	**6.6923e-006**	0.12607	1.6595
Long Positions						Long Positions					
Quantile	**Success rate**	**Kupiec LRT**	**P-value**	**ESF1**	**ESF2**	**Quantile**	**Success rate**	**Kupiec LRT**	**P-value**	**ESF1**	**ESF2**
0.050000	0.073080	10.678	**0.0010841**	-0.22775	1.3816	0.050000	0.029831	7.6706	**0.0056129**	-0.15614	3.0244
0.025000	0.049029	20.090	**7.3897e-006**	-0.25486	1.2808	0.025000	0.023346	0.088423	0.76619	-0.18799	2.9578
0.010000	0.024052	15.473	**8.3687e-005**	-0.28079	1.2467	0.010000	0.022049	8.4172	**0.0037169**	-0.19774	2.5614
0.0050000	0.014801	13.643	**0.00022104**	-0.30557	1.2275	0.0050000	0.019455	18.633	**1.5845e-005**	-0.21166	2.4833
0.0025000	0.012026	20.344	**6.4705e-006**	-0.31529	1.1600	0.0025000	0.019455	35.633	**2.3819e-009**	-0.21166	2.2721

Index Post-crisis

Bond						Sukuk					
Short Positions						Short Positions					
Quantile	**Success rate**	**Kupiec LRT**	**P-value**	**ESF1**	**ESF2**	**Quantile**	**Success rate**	**Kupiec LRT**	**P-value**	**ESF1**	**ESF2**
0.95000	0.94926	0.021064	0.88460	0.32665	1.3984	0.95000	0.96341	5.9050	**0.015098**	0.34196	1.5857
0.97500	0.96691	4.4305	**0.035303**	0.35557	1.3263	0.97500	0.97396	0.061983	0.80339	0.46320	1.2098
0.99000	0.97904	16.722	**4.3272e-005**	0.39619	1.2496	0.99000	0.97959	11.950	**0.00054638**	0.53012	1.7142
0.99500	0.98566	21.081	**4.4036e-006**	0.42153	1.2143	0.99500	0.98311	24.841	**6.2261e-007**	0.60690	2.1086
0.99750	0.99117	17.500	**2.8732e-005**	0.43416	1.2119	0.99750	0.98874	23.373	**1.3346e-006**	0.89040	1.9447
Long Positions						Long Positions					
Quantile	Success rate	Kupiec LRT	P-value	ESF1	ESF2	Quantile	Success rate	Kupiec LRT	P-value	ESF1	ESF2
0.050000	0.062879	5.8739	**0.015367**	-0.31062	1.4406	0.050000	0.038705	4.1245	0.042267	-0.34835	1.8821
0.025000	0.035852	7.7385	**0.0054055**	-0.36807	1.4126	0.025000	0.026742	0.17298	0.67747	-0.42853	2.3967
0.010000	0.023718	24.879	**6.1058e-007**	-0.38896	1.3317	0.010000	0.019001	9.1987	**0.0024218**	-0.57089	1.3427
0.0050000	0.016547	30.180	**3.9365e-008**	-0.41911	1.3114	0.0050000	0.013371	13.689	**0.00021575**	-0.79333	1.7892
0.0025000	0.012135	34.744	**3.7602e-009**	-0.44843	1.2882	0.0025000	0.0091485	14.898	**0.00011349**	-1.1316	2.5373

Appendix 2: Engle and Manganelli Test Results

BLME

Bond			Sukuk		
Short Positions			Short Positions		
Quantile	**Statistics**	**P-value**	**Quantile**	**Statistics**	**P-value**
0.95000	50.535	3.6715e-009	0.95000	48.068	1.1451e-008
0.97500	31.038	2.4925e-005	0.97500	19.829	0.0029707
0.99000	6.3216	0.38815	0.99000	29.567	4.7505e-005
0.99500	16.479	0.011402	0.99500	10.092	0.12082
0.99750	1.9648	0.92291	0.99750	13.368	0.037554
Long Positions			Long Positions		
Quantile	**Statistics**	**P-value**	**Quantile**	**Statistics**	**P-value**
0.050000	15.962	0.013961	0.050000	24.407	0.00043944
0.025000	5.5650	0.47364	0.025000	17.448	0.0077703
0.010000	31.382	2.1431e-005	0.010000	16.469	0.011446
0.0050000	17.378	0.0079912	0.0050000	4.3053	0.63543
0.0025000	14.186	0.027627	0.0025000	4.9610	0.54882

MAF

Bond			Sukuk		
Short Positions			Short Positions		
Quantile	**Statistics**	**P-value**	**Quantile**	**Statistics**	**P-value**
0.95000	3.6375	0.72559	0.95000	8.5163	0.20266
0.97500	3.8037	0.70321	0.97500	3.4156	0.75517
0.99000	6.9035	0.32986	0.99000	6.9626	0.32432
0.99500	12.025	0.061403	0.99500	10.591	0.10189
0.99750	4.1733	0.65323	0.99750	12.577	0.050268
Long Positions			Long Positions		
Quantile	**Statistics**	**P-value**	**Quantile**	**Statistics**	**P-value**
0.050000	21.871	0.0012777	0.050000	9.7315	0.13642
0.025000	26.887	0.00015203	0.025000	2.8005	0.83343
0.010000	25.055	0.00033348	0.010000	6.6717	0.35228
0.0050000	14.982	0.020399	0.0050000	9.9741	0.12575
0.0025000	22.378	0.0010338	0.0025000	12.577	0.050268

Petronas

Bond			Sukuk		
Short Positions			Short Positions		
Quantile	**Statistics**	**P-value**	**Quantile**	**Statistics**	**P-value**
0.95000	14.314	0.026315	0.95000	11.039	0.087174
0.97500	13.812	0.031814	0.97500	19.057	0.0040679
0.99000	8.2690	0.21905	0.99000	34.963	4.3804e-006
0.99500	8.2053	0.22345	0.99500	26.699	0.00016484
0.99750	5.2103	0.51714	0.99750	21.326	0.0016029
Long Positions			Long Positions		
Quantile	**Statistics**	**P-value**	**Quantile**	**Statistics**	**P-value**
0.050000	58.272	1.0092e-010	0.050000	77.313	1.2768e-014
0.025000	15.575	0.016226	0.025000	26.619	0.00017063
0.010000	1.6674	0.94761	0.010000	9.3317	0.15576
0.0050000	0.15787	0.99992	0.0050000	19.046	0.0040865
0.0025000	0.26450	0.99965	0.0025000	36.611	2.0962e-006

Rasmala

Bond			Sukuk		
Short Positions			Short Positions		
Quantile	**Statistics**	**P-value**	**Quantile**	**Statistics**	**P-value**
0.95000	61.536	2.1924e-011	0.95000	84.325	4.4409e-016
0.97500	51.236	2.6554e-009	0.97500	38.648	8.3903e-007
0.99000	14.196	0.027524	0.99000	20.207	0.0025439
0.99500	22.352	0.0010452	0.99500	3.0601	0.80126
0.99750	0.23514	0.99975	0.99750	0.14836	0.99994
Long Positions			Long Positions		
Quantile	**Statistics**	**P-value**	**Quantile**	**Statistics**	**P-value**
0.050000	36.276	2.4362e-006	0.050000	25.992	0.00022343
0.025000	11.044	0.087027	0.025000	25.071	0.00033132
0.010000	16.884	0.0097199	0.010000	30.879	2.6730e-005
0.0050000	22.605	0.00094002	0.0050000	12.627	0.049357
0.0025000	27.916	9.7457e-005	0.0025000	17.833	0.0066622

Tamweel

Bond			Sukuk		
Short Positions			Short Positions		
Quantile	**Statistics**	**P-value**	**Quantile**	**Statistics**	**P-value**
0.95000	294.85	0.00000	0.95000	236.76	0.00000
0.97500	296.53	0.00000	0.97500	45.274	4.1294e-008
0.99000	227.14	0.00000	0.99000	10.289	0.11299
0.99500	245.39	0.00000	0.99500	11.946	0.063178
0.99750	211.45	0.00000	0.99750	15.272	0.018242
Long Positions			Long Positions		
Quantile	**Statistics**	**P-value**	**Quantile**	**Statistics**	**P-value**
0.050000	148.68	0.00000	0.050000	205.66	0.00000
0.025000	81.345	1.8874e-015	0.025000	43.415	9.6545e-008
0.010000	178.08	0.00000	0.010000	1.0411	0.98401
0.0050000	152.61	0.00000	0.0050000	1.5781	0.95414
0.0025000	124.49	0.00000	0.0025000	2.6869	0.84699

Dubai

Bond			Sukuk		
Short Positions			Short Positions		
Quantile	**Statistics**	**P-value**	**Quantile**	**Statistics**	**P-value**
0.95000	294.85	0.00000	0.95000	236.76	0.00000
0.97500	296.53	0.00000	0.97500	45.274	4.1294e-008
0.99000	227.14	0.00000	0.99000	10.289	0.11299
0.99500	245.39	0.00000	0.99500	11.946	0.063178
0.99750	211.45	0.00000	0.99750	15.272	0.018242
Long Positions			Long Positions		
Quantile	**Statistics**	**P-value**	**Quantile**	**Statistics**	**P-value**
0.050000	148.68	0.00000	0.050000	205.66	0.00000
0.025000	81.345	1.8874e-015	0.025000	43.415	9.6545e-008
0.010000	178.08	0.00000	0.010000	1.0411	0.98401
0.0050000	152.61	0.00000	0.0050000	1.5781	0.95414
0.0025000	124.49	0.00000	0.0025000	2.6869	0.84699

DP World

Bond			Sukuk		
Short Positions			Short Positions		
Quantile	Statistics	P-value	Quantile	Statistics	P-value
0.95000	4.2058	0.64885	0.95000	66.801	1.8482e-012
0.97500	6.2379	0.39708	0.97500	56.724	2.0779e-010
0.99000	8.2392	0.22110	0.99000	42.076	1.7763e-007
0.99500	13.070	0.041941	0.99500	61.743	1.9905e-011
0.99750	14.750	0.022296	0.99750	55.185	4.2529e-010
Long Positions			Long Positions		
Quantile	Statistics	P-value	Quantile	Statistics	P-value
0.050000	12.800	0.046318	0.050000	19.126	0.0039553
0.025000	21.075	0.0017785	0.025000	17.917	0.0064419
0.010000	29.940	4.0348e-005	0.010000	29.026	6.0164e-005
0.0050000	41.874	1.9467e-007	0.0050000	24.963	0.00034681
0.0025000	27.972	9.5129e-005	0.0025000	26.315	0.00019451

Index

Bond			Sukuk		
Short Positions			Short Positions		
Quantile	Statistics	P-value	Quantile	Statistics	P-value
0.95000	6.3967	0.38025	0.95000	7.8350	0.25044
0.97500	12.227	0.057087	0.97500	6.6951	0.34997
0.99000	27.046	0.00014195	0.99000	17.644	0.0071869
0.99500	24.117	0.00049709	0.99500	26.091	0.00021409
0.99750	22.047	0.0011876	0.99750	27.843	0.00010059
Long Positions			Long Positions		
Quantile	Statistics	P-value	Quantile	Statistics	P-value
0.050000	25.863	0.00023612	0.050000	17.960	0.0063327
0.025000	21.718	0.0013619	0.025000	5.5543	0.47491
0.010000	29.627	4.6279e-005	0.010000	20.786	0.0020043
0.0050000	38.858	7.6314e-007	0.0050000	23.603	0.00061770
0.0025000	30.157	3.6696e-005	0.0025000	25.111	0.00032570

Index Pre-crisis

Bond			Sukuk		
Short Positions			Short Positions		
Quantile	**Statistics**	**P-value**	**Quantile**	**Statistics**	**P-value**
0.95000	9.0870	0.16874	0.95000	31.920	1.6903e-005
0.97500	12.577	0.050274	0.97500	10.409	0.10846
0.99000	33.561	8.1776e-006	0.99000	3.4184	0.75479
0.99500	10.670	0.099136	0.99500	5.5741	0.47255
0.99750	13.868	0.031149	0.99750	8.4589	0.20637
Long Positions			Long Positions		
Quantile	**Statistics**	**P-value**	**Quantile**	**Statistics**	**P-value**
0.050000	21.672	0.0013882	0.050000	15.367	0.017584
0.025000	22.314	0.0010622	0.025000	3.1109	0.79480
0.010000	21.679	0.0013841	0.010000	8.6402	0.19485
0.0050000	22.892	0.00083353	0.0050000	13.199	0.039982
0.0025000	33.936	6.9224e-006	0.0025000	16.393	0.011792

Index Post-crisis

Bond			Sukuk		
Short Positions			Short Positions		
Quantile	**Statistics**	**P-value**	**Quantile**	**Statistics**	**P-value**
0.95000	3.4059	0.75644	0.95000	14.836	0.021567
0.97500	9.5238	0.14619	0.97500	4.3153	0.63409
0.99000	12.448	0.052698	0.99000	10.477	0.10596
0.99500	13.820	0.031713	0.99500	14.375	0.025714
0.99750	9.0418	0.17124	0.99750	10.768	0.095827
Long Positions			Long Positions		
Quantile	**Statistics**	**P-value**	**Quantile**	**Statistics**	**P-value**
0.050000	12.515	0.051426	0.050000	6.3440	0.38577
0.025000	13.685	0.033359	0.025000	3.2348	0.77886
0.010000	18.824	0.0044710	0.010000	12.792	0.046465
0.0050000	17.425	0.0078432	0.0050000	12.528	0.051166
0.0025000	15.469	0.016907	0.0025000	7.5569	0.27239

Appendix 3: Engle and Ng Sign Test Results and the Associated P-values

BLME

Bond			Sukuk		
		P-values			P-values
Sign Bias t-Test	0.73766	0.46072	Sign Bias t-Test	1.07273	0.28339
Negative Size Bias t-Test	0.07148	0.94302	Negative Size Bias t-Test	0.46534	0.64169
Positive Size Bias t-Test	0.12839	0.89784	Positive Size Bias t-Test	0.13215	0.89486
Joint Test for the Three Effects	1.03824	0.79200	Joint Test for the Three Effects	1.87426	0.59891

MAF

Bond			Sukuk		
		P-values			P-values
Sign Bias t-Test	0.39473	0.69304	Sign Bias t-Test	0.17510	0.86100
Negative Size Bias t-Test	0.1.40423	0.16025	Negative Size Bias t-Test	1.87989	0.06012
Positive Size Bias t-Test	0.31064	0.75607	Positive Size Bias t-Test	0.09985	0.92046
Joint Test for the Three Effects	2.09215	0.55350	Joint Test for the Three Effects	4.12143	0.24865

Petronas

Bond			Sukuk		
		P-values			P-values
Sign Bias t-Test	0.71826	0.47260	Sign Bias t-Test	0.29579	0.76739
Negative Size Bias t-Test	0.03852	0.96928	Negative Size Bias t-Test	0.23982	0.81047
Positive Size Bias t-Test	0.68315	0.49451	Positive Size Bias t-Test	0.31519	0.75262
Joint Test for the Three Effects	0.85440	0.83642	Joint Test for the Three Effects	1.25341	0.96854

Rasmala

Bond			Sukuk		
		P-values			P-values
Sign Bias t-Test	0.79899	0.42430	Sign Bias t-Test	0.46611	0.64114
Negative Size Bias t-Test	0.62098	0.53461	Negative Size Bias t-Test	0.14457	0.88505
Positive Size Bias t-Test	0.11803	0.90605	Positive Size Bias t-Test	0.05364	0.95722
Joint Test for the Three Effects	1.69275	0.63855	Joint Test for the Three Effects	0.50076	0.91872

Tamweel

Bond			Sukuk		
		P-values			P-values
Sign Bias t-Test	1.09790	0.27225	Sign Bias t-Test	0.15921	0.87351
Negative Size Bias t-Test	0.81306	0.41618	Negative Size Bias t-Test	0.21917	0.82652
Positive Size Bias t-Test	0.73015	0.46530	Positive Size Bias t-Test	0.08420	0.93289
Joint Test for the Three Effects	2.11775	0.54833	Joint Test for the Three Effects	0.06457	0.99572

Dubai

Bond			Sukuk		
		P-values			P-values
Sign Bias t-Test	1.09790	0.27225	Sign Bias t-Test	0.15921	0.87351
Negative Size Bias t-Test	0.81306	0.41618	Negative Size Bias t-Test	0.21917	0.82652
Positive Size Bias t-Test	0.73015	0.46530	Positive Size Bias t-Test	0.08420	0.93289
Joint Test for the Three Effects	2.11775	0.54833	Joint Test for the Three Effects	0.06457	0.99572

DP World

Bond			Sukuk		
		P-values			P-values
Sign Bias t-Test	0.80164	0.42276	Sign Bias t-Test	1.27623	0.20187
Negative Size Bias t-Test	0.46698	0.64051	Negative Size Bias t-Test	0.31564	0.75227
Positive Size Bias t-Test	0.08815	0.92976	Positive Size Bias t-Test	0.40906	0.68250
Joint Test for the Three Effects	1.18057	0.75767	Joint Test for the Three Effects	2.52539	0.47072

Index

Bond			Sukuk		
		P-values			P-values
Sign Bias t-Test	1.12720	0.25966	Sign Bias t-Test	1.23420	0.21713
Negative Size Bias t-Test	1.81182	0.07001	Negative Size Bias t-Test	0.63397	0.52610
Positive Size Bias t-Test	0.69036	0.48997	Positive Size Bias t-Test	0.48784	0.62567
Joint Test for the Three Effects	5.17941	0.15912	Joint Test for the Three Effects	2.19690	0.53256

Appendix 4: Jarque-Bera Test Results

		Bond	Sukuk
BLME	Test statistic	6.1242	2.8685
	p-value	0.000000	0.000000
DP World	Test statistic	291510	391510
	p-value	0.000000	0.000000
Dubai	Test statistic	276890	603420
	p-value	0.000000	0.000000
MAF	Test statistic	8947	44031
	p-value	0.000000	0.000000
Petronas	Test statistic	393590	>1000000
	p-value	0.000000	0.000000
Rasmala	Test statistic	24221	240890
	p-value	0.000000	0.000000
Tamweel	Test statistic	>1000000	603420
	p-value	0.000000	0.000000
Index	Test statistic	6413	14221
	p-value	0.000000	0.000000