Ankara Üniversitesi
SBF Dergisi,
Cilt 77, No.3, 2022, s. 609 - 627

Araştırma Makalesi
DOI: 10.33630/ausbf.1130774

THE LONG TERM COMOVEMENT BETWEEN SUKUK AND CONVENTIONAL FIXED INCOME MARKETS *

Dr. Berkan Ataş
İstanbul Üniversitesi
İşletme Fakültesi
ORCID: 0000-0003-3049-3195

Prof. Dr. Ali Hepşen
İstanbul Üniversitesi
İşletme Fakültesi
ORCID: 0000-0002-3379-7090

• • •

Abstract

Sukuk markets have made significant progress both in terms of market volumes and international awareness in recent years. These financial products are specially designed for investors who avoid interest gain. On the other hand, it is an ongoing issue in the literature whether these markets are a useful alternative for conventional fixed income investors as well. Our main purpose is to explore sukuk market as an investment alternative for conventional fixed income market investors' points of view. Since the integration of assets is one of the key criteria for portfolio investments, this study investigated the long-term comovements between sukuk and other fixed-income indexes via Johansen and Engle-Granger cointegration technique. To proxy international fixed income portfolio, international bond indexes which are prepared by FTSE (Financial Times Stock Exchange Group) are employed. Besides, the vector error correction model is also applied to deepen the results. According to the findings, there is a limited causality in the long run between sukuk markets and conventional bond markets. This can make international sukuk assets highly beneficial diversification alternative to conventional bond portfolios. The study aims to contribute to the literature by examining the benefits of sukuk markets as an investment alternative to conventional, wide-range fixed income markets.

Keywords: Sukuk market, Market integration, International portfolio diversification, Cointegration analysis, Vector error correction model

Sukuk ve Konvansiyonel Sabit Getirili Piyasaların Uzun Dönemli Dengesi

Öz

Piyasa hacmi ve uluslararası bilinirliği artan sukuk piyasaları son yıllarda önemli gelişme kaydetmektedir. Bu ürünler faizden kaçınan yatırımcılar için özel olarak dizayn edilmektedir. Diğer taraftan bu varlıkların konvansiyonel yatırımcılar açısından da faydalı bir yatırım alternatifi olabileceği de literatürde son yıllarda sıklıkla tartışılan konulardan biridir. Bu çalışmanın amacı sukuk ve konvansiyonel sabit getirili piyasaların oluşturdukları uzun dönemli dengenin incelenerek sukuğun uluslararası çeşitlendirme açısından değerlendirilmesidir. Varlıklar arası uzun dönemli fiyat dengesi portföy yatırımlarında en önemli göstergelerden biridir. Bu nedenle çalışmada Engle-Granger ve Johansen koentegtasyon analizi kullanılmıştır. Çalışmada FTSE (Financial Times Stock Exchange Group) sabit getiri endeksleri kullanılmıştır. Çalışmaya derinlik kazandırmak için VECM modeli (Vector Error Correction Model) uygulanmıştır. Çalışmanın bulguları sukuk ve sabit getirili varlıklar arasında sınırlı düzeyde nedensellik olduğunu göstermektedir. Sukuk piyasası konvansiyonel sabit getirili portföyler için faydalı bir yatırım alternatifi olabilir. Bu çalışmada sukuk varlıklarının sabit getirili varlıklar açısından denge ilişkisi oldukça geniş bir perspektifte ele alınarak, yatırım alternatifi olarak irdelenmektedir.

Anahtar Sözcükler: Sukuk piyasaları, Piyasa entegrasyonu, Uluslararası portföy Yatırımları, Koentegrasyon analizi, Vektör hata düzeltme modeli

---

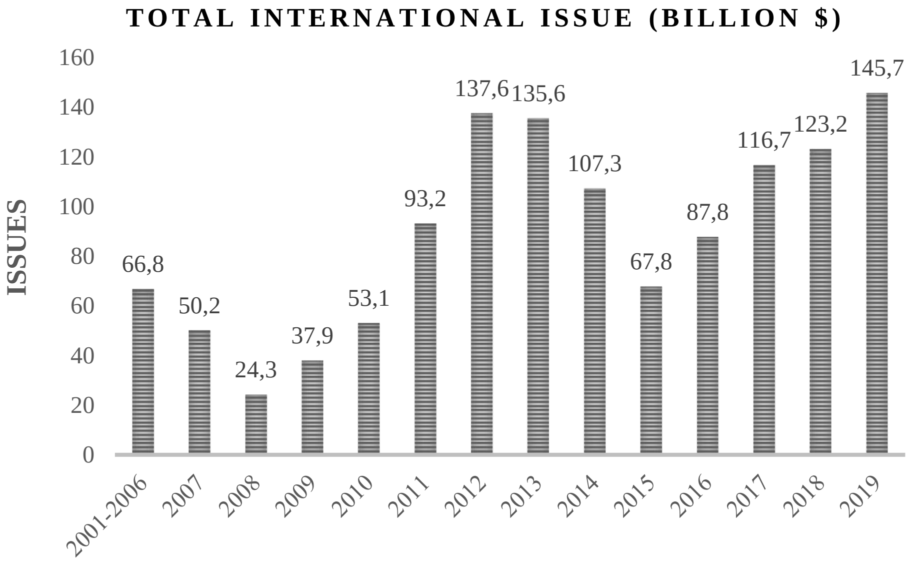
* Makale geliş tarihi: 07.06.2021
Makale kabul tarihi: 15.11.2021
Erken görünüm tarihi:15.06.2022

The Long Term Comovement Between Sukuk And Conventional Fixed Income Markets

Introduction

Islamic fixed-income investment instruments known as sukuk all over the world are a special type of bond designed according to religious sensitivities. Interest-free financial products, which first developed in East Asian countries in the 1970s, are seen to have a significant prevalence in all the world markets. Today, Islamic financial products are not only limited to Muslim countries, but they are also issued and traded in the markets of developed countries such as USA, England, and Canada. One of the biggest reasons for this is the effort to offer attractive products for rising capital savings, especially in Islamic regions in recent years. In the figure 1 below, the total size of the sukuks issued in the world in US dollars is given yearly. According to the graph, the total sukuk issuances in 2019 have increased by approximately 18% compared to the previous year and are realized at the level of approximately 146 billion dollars. It is understood from the graph that global sukuk issuance sizes have fluctuated over the years. Considering the size of the market, it is observed that the market has grown considerably compared to the 2000s, but it is also seen that the size is greatly affected by the global financial crisis, which first emerged in the USA in 2007 and subsequently spread to all the world markets. Despite its wavy structure, it is easily seen that the size of the issuances has expanded in an increasingly growing way. The increasing awareness and size of sukuk investments have made this market important for international portfolio investments. Sukuk differs from other fixed income assets as it is a special product. These differences can make it attractive options for international portfolio investments in today's world where financial integration is gradually increasing (IIFM, 2019)

Figure 1: International Sukuk Issuance



Source: IIFM

In this study, we investigate if international sukuk markets provide diversification benefits for conventional fixed income market investors. Diversification can be defined as bringing together multiple different assets or groups of assets for investment purposes and minimizing the risk of the investment. This optimization of a portfolio depends, of course, on certain conditions. The most important of these is that markets do not exhibit similar price behavior, in other words, they are not highly integrated. Markets are assumed to be integrated if a fluctuation in one market produces a similar or same fluctuation in another. International diversification benefit from investment portfolios decreases if markets are highly integrated. Nowadays, due to the increasing globalization and the decrease in the cost of access to information, the spillover between the markets as well as integration has risen considerably. This makes it difficult for investors to achieve optimal portfolios. In our study, we investigate if the international sukuk market provides a diversification benefit for conventional fixed income market investors. For this purpose, the long term relationship between the sukuk index and other conventional fixed-income bond indexes are examined. We employ the International Sukuk index and other fixed-income indexes which are prepared by FTSE. While our findings support (Naifar, 2016; Sclip et al., 2016; Hassan et al., 2018; Bhuiyan et al., 2018; Asutay and

Hakim, 2018; Bhuiyan et al., 2019) partially different findings are obtained with (Aloui, et al., 2015; Naifar, et al., 2017).

Diversification is the process of investing in multiple assets to minimize the risk of the portfolio. Through diversification, since each type of asset is subject to different non-systematic risks (idiosyncratic risk), it is possible to completely avoid it. Harry Markowitz, who is very famous for the works of Markowitz (1952), and Markowitz, (1959), is known as the founder of modern portfolio theory. Before Markowitz, the benefits of investment diversification were well known, but Markowitz's mathematical modeling gave financial literature a whole new dimension. According to Markowitz, investors can eliminate the whole idiosyncratic risk of each asset in a perfectly diversified portfolio. Composing a portfolio with assets that react differently to the same information ensures that the investment is completely free from their idiosyncratic risks of the underlying assets. Thus, risk-return optimization is provided by minimizing the risk while keeping the return constant (Yiğiter and Akkaynak, 2017: 287). The main objective of the theory is based on the risk-return optimization. The theory assumes that the price series of the assets do not move together perfectly in the same manner of direction. Risk can be reduced to some point due to assets that react differently to the same information (Okuyan and Deniz, 2017: 74). Besides, investors can have more optimized portfolios via enriching their investment pool by investing in international assets rather than just assets in their own countries (Omet, 2015, 187). Through international diversification, it will be possible to invest in more optimized portfolios than those created only with local assets. Systematic risks (such as interest, inflation, exchange rate) are risks that affect all assets in a country. According to modern portfolio theory, it is not possible to avoid systematic risks by diversification. However, by international diversification, it is also possible to partially avoid it. For example, a fluctuation in macroeconomic data in the Chinese market will have little or no impact on the Argentinean market. Therefore, since markets in different countries react differently to the same systematic impact, the possibility of systematic risk aversion might also be accomplishable (Okuyan and Deniz, 2017: 76).

After the 1960s, as a result of deregulations towards international capital flows, the concept of international diversification began to enter the literature. Today, many countries have partially or completely released international capital flows. In this way, investments in overseas countries have become quite easy. Thanks to the international capital flows that have gained freedom and developing technology, international portfolio investments have reached quite a big size today. As a natural consequence of this condition, international markets nowadays have become more integrated than ever in history. Fluctuation in a market now affects not only the markets of its own country but also causes fluctuations in international markets as well. Increasing international integration in markets is a phenomenon that limits the benefits of international diversification. As a result of increasing integration in international markets, researches are carried out to determine optimal products and markets in academic research (Solnik, 1974: 52). Today, there are capital flows from developed countries to developing countries and vice versa and this enables more optimized portfolios to be created (Gilmore and McManus, 2002: 70-71).

We investigate an answer to the ongoing question of whether sukuk is a useful alternative for international fixed-income portfolio investments. For this reason, the international FTSE fixed income indices, which are one of the most reputable indicators of fixed income market, are employed in the study. The first part reveals the literature on international diversification and sukuk assets. The second part constructs the empirical model and the third part reports the result.

1. Literature Review

Although international diversification is a new concept in the financial literature in recent years, there are many studies on this subject. One of the most important issues for international diversification research is the investigation of the most optimal markets and products for risk-return optimization. The main issue in terms of this optimization is the integration between the markets of different countries. Despite the high integration between the markets today, it is still possible to benefit from international diversification with the right product and market preferences. Perhaps the most popular of the studies in the field of international diversification is the analysis of Solnik (1974) which explores the benefits of diversification among major developed countries. According to this study, which is one of the cornerstones of the literature in this field, developed countries have the potential of serious international diversification for US market.

An important part of the literature on international diversification is focused on investigating optimal products and markets. Oloko (2018) observed that Nigerian stock markets can provide a significant diversification benefit for the US and the UK. However, there are different results for different observation intervals. Yunus (2013) investigated the integration of the stock markets of 10 different developed and developing countries. According to the results of the study, although it decreases during periods of increasing crisis, the stock markets of countries are favorable in terms of international diversification. In another similar but more regionally designed study Guidi and Uğur (2014) examined the integration of the stock markets of southeast European countries with Germany, the United Kingdom, and the USA. The results show that Southeast European countries can only offer diversification in short-term investments. Fat and Dezsi

(2012) observed that the markets of developed countries are highly integrated, so diversification opportunities remain limited, but diversification may be possible between developed and emerging markets.

In recent years, studies about sukuk regarding international diversification gain importance with the growth of these markets. Hassan et al. (2018) argues that sukuk provides good diversification for corporate bonds. Although the results vary due to increased integration during crisis periods, the study shows that sukuk would be a useful alternative for corporate bonds portfolio under normal conditions. Likewise, due to increased integration during crisis periods Sclip et al. (2016) and Naifar et al. (2017) have similar results. Both studies show that stock and sukuk portfolios behave similarly in crisis periods, they can be beneficial investment alternatives for diversification in only normal periods. Bhuiyan et al. (2018) investigates the relationship between the bond markets of major countries and sukuk markets with the GARCH model. According to the results, the sukuk market can be a good alternative for the diversification of the bond portfolio with one exception; Malaysia. On the other hand, Malaysia is considered to differ from other countries as it is one of the largest sukuk issuers. In another study Bhuiyan et al. (2019) focused only on the Malaysian sukuk market, the study argues that this market will be a useful alternative for the bond market of developed countries. In another regional study Aloui et al. (2015) investigates the integration between the participation indices and sukuk of the Gulf Cooperation Council (GCC) countries. According to the results, these two types of assets move together to a large extent. Asutay and Hakim (2018) investigates the integration of the largest Sukuk markets according to the "Standard Perfect Financial Integration Indicators (SPFII)" model of (Arribas et al., 2011). Result shows that most of the markets are integrated.

Studies investigating the diversification benefit of Islamic financial products with regard to stock markets are also quite common. Abu-Alkhail et al. (2017) investigates the possibility of diversification between participation indices and conventional indices. According to the results, these two types of assets can provide diversification benefits in 30 out of the 31 countries in the study. Naifar (2016) investigates the integration between the Saudi Arabian sukuk market and the stock market. The results of the study support the findings of Sclip et al. (2016), Naifar et al. (2017) and Hassan et al. (2018). The results show that during periods of increased volatility dependence increases, and the possibility of diversification decreases, while in the normal period, markets may be suitable alternatives to diversification. Rahim and Masih (2016) investigates the diversification relationship between the Malaysian stock market and the participation indexes of China, Singapore, Malaysia, and the USA and observed that despite the increasing international integration, there is an opportunity to diversify with the right product and market choices.

Sukuk assets are special products designed to bring the savings of investors who avoid interest for religious reasons into the financial system. For this reason, it differs from conventional fixed income investment instruments. This differentiation can make sukuk an attractive investment product for international portfolio investors. However, for this to happen, structural differences between sukuk and conventional products must also be reflected in pricing. Many studies, as mentioned, find that Islamic financial products can be a useful alternative for conventional investors. This study explores the relationship between sukuk and conventional bonds within a wider regional framework and seeks the opportunities offered by sukuk to all world markets.

2. Data and Methodology

2.1 Data

In the study, bond indices prepared by FTSE, are used to measure the performance of fixed income securities worldwide. The study aims to examine the long-term relationship of the International Sukuk Index with other fixed income indices. This is why, due to the nature of the analysis, it is necessary to work with long-term indices that are accessible for extended periods. This limits the number of indexes that can be appropriate for the analysis. Fortunately, the FTSE has been preparing indices based on fixed income underlying assets, such as the international sukuk index, for many years.

In this study, we prefer to use monthly data. The reason for the use of monthly data is to prevent short-term noise fluctuations from adversely affecting the result. Besides, it is widely accepted that monthly data are more compatible with cointegration analysis. The last closing date of each month is preferred. All of the data are obtained from the Bloomberg data terminal.

Since cointegration analysis measured the long-term relationship, the data must have access for the long term. Considering the sukuk index is first prepared in October 2005 and the long-term relationship between the international sukuk index and other indices is examined, the longest possible period has chosen for each variable if available. However, some indices have started to be prepared after October 2005. These indices; Asian Broad Bond Index, Chinese Government Bond Index, and Latin American Government Bond Index. As these indices have begun to be prepared later, they are included in the analysis as long as possible with regard to data length. The following table shows all the indices and the data lengths.

Table 1: The Data[1] of the Study

Index Code	Index Name	Period Covered	Market Size
SBKU	International Sukuk Index	October 2005 - November 2020	$ 0.068 Trillion
SBABBI	Asian Broad Bond Index	October 2008 - November 2020	$ 0.73 Trillion
SBBIG	US Broad Investment-Grade Bond Index	October 2005 - November 2020	$ 19.6 Trillion
SBCNU	Chinese Government Bond Index	April 2011 - November 2020	$ 1.35 Trillion
SBEB	Euro Broad Investment-Grade Bond Index	October 2005 - November 2020	$ 11.7 Trillion
SBEGU	EMU Government Bond Index	October 2005 - November 2020	$ 7.1 Trillion
SBGIMS	Emerging Markets US Dollar Government Bond Index	October 2005 - November 2020	$ 0.67 Trillion
SBLGBIU	Latin American Government Bond Index	September 2011 - November 2020	$ 0.36 Trillion
SBWGU	World Government Bond Index	October 2005 - November 2020	$ 20.9 Trillion

Source: FTSE

2.2. Methodology

Engle-Granger (1987) and Johansen (1988) cointegration models are used to measure the long-term relationship between the indices. Since the cointegration technique is also used in many studies related with international diversification such as Yunus (2013), Guidi and Ugur (2014), Abu-Alkhail et al. (2017) it has been decided appropriate for the study. Nonetheless, our aim is to explain the long-term relationship by keeping the observation period as long as possible. For this reason, cointegration analysis stands out as the method that best responds to our requests. Besides, the vector error correction model is also

1 Another important factor in bond investments is the credit ratings of bonds. Among the table:1, the underlying asset credit ratings consist of the grades between AAA and CCC according to the S&P system.

employed to determine the causality between cointegrated series and to bring more depth into the analysis.

2.2.1. Engle-Granger Two-Step Method

The Engle-Granger two-stage cointegration analysis consists of two stages, as the name suggests. Regression of two different series with the least-squares method is taken in the first stage. In the second stage, the existence of long-term relationship is determined by using the error terms obtained from the regression. However, both variables should be non-stationary and become stationary in the same order. Otherwise, this method cannot be used. Let's assume that x and y are two different time series.

$$y_t = \alpha + \beta x_t + u_t$$

y_t is the dependent variable, x_t is the independent variable, β is the coefficient of the variable and u_t is the error term that indicates the difference between the estimated y_t's and the actual y_t's in the model. If the x in the model has a high power to define the y in the model, then the difference between the realized y' and the predicted y' will be low, and therefore the series of u_t error terms will not contain a unit root and become stationary, as there will be no high fluctuations in error terms over time. In the case that the error terms are stationary as a result of unit root tests, it is inferred that the series come into equilibrium with each other in the long term and thus the error terms remain stable by not fluctuating much (Brooks, 2014: 376).

2.2.2. Johansen Method

Unlike the Engle-Granger cointegration method, Johansen uses the maximum likelihood estimator instead of the least-squares. In this way, it allows having more than one cointegrated vectors and more than two variables in the same system. Johansen method is based on VAR (vector autoregression) system model where different lags of variables are in the same regressive order (Alexander, 2001: 348-352). In order to apply VAR models, the optimal length of the model should be known. Since Johansen cointegration analysis is also based on the VAR system, it is necessary to determine the optimal lag length and to apply the system accordingly. The most commonly used information criteria for determining lag length are the Schwarz Information Criterion (SC), the Akaike Information Criterion (AIC), and the Hannan Quinn Information Criterion (HQ). In the study, these three information criteria are used to determine the optimal lag length and the most appreciated lag is chosen for each system.

The Johansen cointegration model, which describes how many cointegrated vectors are in the VAR system, is as follows:

$$\Delta X_t = \mu + \sum_{i=!}^{n} \tau X_{t-i} + \alpha\beta' X_{t-i} + \varepsilon_t$$

$X_t = n \times 1$ vector for non-stationary variables

$\tau = (n \times n)$ matrix

$\alpha = (n \times r)$ matrix error correction term coefficient

$\beta = (n \times r)$ matrix cointegrated vector

Johansen developed two different test statistics for the cointegration test. One is the Maximum Eigenvalue test, and the other is the Trace test. The null hypothesis of the Trace test is the intersection test that shows no cointegration (H0: r=0). In the alternative hypothesis, it shows at least one or more cointegrated vector (H1: r≥0). The maximum eigenvalue statistic employs a separate test for each eigenvalue, and the null hypothesis shows no cointegrated vectors, while the alternative hypothesis shows r and r + 1, etc. (Brooks, 2014: 373-376).

$$\lambda_{trace}(r) = -T \sum_{i=r+1}^{g} ln\,(1-\lambda_i)$$

$$\lambda_{max}(r, r+1) = -T\, ln(1-\lambda_{r+1})$$

r = number of cointegrated vectors

$\lambda_i =$ eigenvalues estimated from the $\alpha\beta^i$ matrix

In this case, the non-zero and significant eigenvalue indicates the significant cointegrated vector.

2.2.3. Vector Error Correction Model

Vector Error Correction Model (VECM) is the model obtained by adding the lagged error term in the autoregressive regression system. The model includes different endogen and exogen variables as well as the error terms resulted in the previous period. With this aspect, the vector error correction model is a model that measures the degree and direction of both short-term and long-term relationships. While the variables with different lag lengths in the system indicate the short-term relationship, the error terms in the model provide information about the long-term.

$$\Delta y_t = \beta_0 \sum\nolimits_{i=1}^{n} \beta_i \Delta y_{t-i} + \sum\nolimits_{i=0}^{n} \delta_i \Delta x_{t-i} + \vartheta z_{t-1} + \mu_t$$

$$y_t = \beta_0 + \beta_1 x_t + \varepsilon_t$$

$$z_{t-1} = ECT_{t-1} = y_{t-1} + \beta_0 + \beta_1 x_{t-1}$$

The above is given to show the equation of vector error correction model. $\delta_i \Delta x_{t-i}$ represents the short-term relationship. The relationship here has a direction since y is a dependent variable and the relationship is from independent (x) to dependent (y). In order for this relationship to be significant, the coefficients of x with all lags must be significant as a system. If this occurs, one can infer there is significant short-term causality from x to y. Wald test is used for the significance of the coefficients. There can also be more than one independent variable in the VAR equation. In this case, the significance of the coefficients for each variable should be evaluated separately. Thus, it can be examined whether the other independent variables have a significant causality on y in the short term (Brooks, 2014). On the other hand, ϑz_{t-1} in the equation represents the long-term relationship. This term is actually the error term of the previous period. If the previous period error terms are left alone within $\beta_0 + \beta_1 x_t + \varepsilon_t$ equation, $z_{t-1} = y_{t-1} + \beta_0 + \beta_1 x_{t-1}$ is achieved. This parameter should be theoretically negative because it contains past error terms and has the correction function in the system. If the coefficient is positive, it is concluded that there is no long-term causality in the system, even if statistically significant. In order to determine long-term causality, this parameter must be theoretically appropriate by taking a negative value and at the same time need to be statistically significant. Just like in short-term causality, long-term causality has a direction from independent to dependent in the system.

3. Findings

In this study, we have investigated the long-term relationship between the international sukuk index and other fixed income indexes. Two different cointegration methods are used to determine the existence of long-term relationship. These methods are Engle Granger and Johansen cointegration methods. The long-term relationship also provides an inference for international portfolio diversification. Nowadays, because of the fact that access to information is very fast and costs are low, investors with similar expectations make similar investment decisions. This can be said to be one of the reasons for the increase in the interdependence of different investment instruments. International diversification, as mentioned earlier, promises a higher optimization.

3.1 Unit Root Test Result

In order to apply both Engle-Granger and Johansen cointegration tests, the values of the series before taking the differences must contain a unit root, in other words, they should not be stationary. Also, after taking the first differences, the series should become stationary I (1). The cointegration test is considered as a useful and feasible analysis in terms of financial time series since they usually contain unit root in level and become stationary after taking the first differences. As a matter of fact, the situation is the same for 9 different financial time series.

Table 2: Unit Root Tests Before and After Taking First Difference

Index	Method*	t statistic	Probability**	Index	Method*	t statistic	Probability**
SBKU	ADF	-3.209	0.0864	D(SBKU)	ADF	-9.260	0.00
SBABBI	ADF	-3,340	0.0649	D(SBABBI)	ADF	-10.152	0.00
SBBIG	ADF	-0.720	0.9693	D(SBBIG)	ADF	-11.872	0.00
SBCNU	ADF	-2.857	0.1816	D(SBCNU)	ADF	-6.563	0.00
SBEB	ADF	-1.732	0.733	D(SBEB)	ADF	-11.434	0.00
SBEGU	ADF	-3.002	0.135	D(SBEGU)	ADF	-12.819	0.00
SBGIMS	ADF	-2.123	0.5285	D(SBGIMS)	ADF	-11.183	0.00
SBLGBIU	ADF	-2.422	0.3656	D(SBLGBIU)	ADF	-10.212	0.00
SBWGU	ADF	-1.681	0.7551	D(SBWGU)	ADF	-11.988	0.00

Note: On the right side, the results after taking the first difference are given.
* Augmented Dickey Fuller test with constant and trend is employed for unit root test.
** H:0=Series has a unit root.

The left side of the table above provides the unit root test result which is used to measure the stationarity of the indices. According to t statistics and corresponding p values, all the indexes which are in level have unit root. In other words, all series are not stationary. On the right side, the result after taking the first difference is given. It is seen that each of them is below the 5% significance level. We can conclude that the series became stationary after taking the differences and are appropriate for cointegration testing.

3.2. Engle Granger Cointegration Test Results

In the Engle-Granger method, which is also called the 2-stage cointegration technique, in the first stage, linear regression is applied between two different index series. After that, the stationarity of the error term is examined. However, MacKinnon (2010) critical values are used here.

Table 3: Engle Granger Cointegration Test Results

Index	Method*	t statistic	Probability
SBKU/SBABBI	**ADF, Constant and Trend**	**-3.940186**	**0.0133****
SBKU/SBBIG	ADF, Constant and Trend	-2.72486	0.2282
SBKU/SBCNU	ADF, Constant and Trend	-3.341181	0.0663
SBKU/SBEB	ADF, Constant and Trend	-3.318575	0.067
SBKU/SBEGU	ADF, Constant and Trend	-2.746304	0.2198
SBKU/SBGIMS	**ADF, Constant and Trend**	**-3.669129**	**0.0274****
SBKU/SBLGBIU	ADF, Constant and Trend	-2.854919	0.1824
SBKU/SBWGU	ADF, Constant and Trend	-1.97341	0.6109

* Augmented Dickey Fuller test with constant and trend is employed for unit root test.
** Cointegregrated series with 5% significance level; Ho: There is no cointegration.

The first column of the table above shows the index pairs whose long-term relationship is investigated. ADF[2] test with constant and trend is used to test the stationarity of error terms. According to the Engle-Granger cointegration test results, SBKU has a long-term relationship with only SBABBI and SBGIMS at a significance level of 5%. SBKU, statistically, has no long term relationship with the remaining 6 indexes. For the only 2 cointegrated index pairs, we can conclude that SBKU has converged in equilibrium with SBABBI and SBGIMS in the long run. Therefore, no international diversification benefit can be achieved by investing in these two indexes or identical portfolios. On the other hand, the sukuk index has no relationship with the remaining six bond indices. In this case, we conclude that the International Sukuk Index can provide international diversification benefits for the other 6 remaining bond indices.

3.3. Johansen Cointegration Analysis Results

Two different statistical tests are utilized in the Johansen cointegration method. The first of these is the Max Eigen Value test statistic, while the other is the Trace statistic. In terms of the decision of existence of cointegration, we decide if both tests at the same time give the same result and reject if any of the tests indicate no cointegration. In order to be applied in Johansen cointegration analysis, the optimum lag length must also be determined. Numerous different

2 Augmented Dickey Fuller Test

tests are used in the literature to determine the optimal lag length. In this study, we only use the Akaike Information Criterion (AIC), Schwarz Information Criterion (SC) and Hannan Quinn Information Criterion (HQ). Of these three different tests, which lag is preferred more is determined as the appropriate lag length for each index pairs.

Table 4: Determination of Johansen Lag Length

	AIC	SC	HQ	Optimal Lag
SBKU/SBABBI	1	1	1	1
SBKU/SBBIG	2	1	2	2
SBKU/SBCNU	2	2	2	2
SBKU/SBEB	2	1	2	2
SBKU/SBEGU	2	1	2	2
SBKU/SBGIMS	2	1	2	2
SBKU/SBLGBIU	1	1	1	1
SBKU/SBWGU	2	1	2	2

Note: Optimum lag length is determined by selecting the more favorable lag in terms of 3 lag length criteria

The above table shows the optimal lag lengths in terms of (AIC), (SC), (HQ). For example, for (SBKU / SBABBI) VAR system, the first lag is selected because the same result is obtained according to all three information criteria. On the other hand, in the (SBKU / SBBIG) VAR system, AIC and HQ support the second lag while SC supports the first lag. In this case, since the second lag are more favorable, we decide so.

Table 5: Johansen Cointegration Results

Index	Test	Value	0,05 Critical Value	Probability**
SBKU/SBABBI	**Trace Test**	**31.30023**	**15.49471**	**0.0001***
SBKU/SBBIG	Trace Test	14.49238	15.49471	0.0704
SBKU/SBCNU	**Trace Test**	**15.75105**	**15.49471**	**0.0458***
SBKU/SBEB	Trace Test	13.19113	15.49471	0.1080
SBKU/SBEGU	Trace Test	9.265648	15.49471	0.3414
SBKU/SBGIMS	**Trace Test**	**17.17506**	**15.49471**	**0.0277***
SBKU/SBLGBIU	Trace Test	7.521535	15.49471	0.5147
SBKU/SBWGU	Trace Test	8.173379	15.49471	0.4470

SBKU/SBABBI	**Max Eigenvalue**	**23.64513**	**14.2646**	**0.0013***
SBKU/SBBIG	Max Eigenvalue	11.15568	14.2646	0.1466
SBKU/SBCNU	Max Eigenvalue	11.68585	14.2646	0.1230
SBKU/SBEB	Max Eigenvalue	13.00684	14.2646	0.0782
SBKU/SBEGU	Max Eigenvalue	8.590106	14.2646	0.3219
SBKU/SBGIMS	**Max Eigenvalue**	**16.36373**	**14.2646**	**0.0229***
SBKU/SBLGBIU	Max Eigenvalue	5.98591	14.2646	0.6151
SBKU/SBWGU	Max Eigenvalue	5.989285	14.2646	0.6146

* It is found to be significant at a 5% significance level
** MacKinnon (2010) critical values

In the table above, Johansen cointegration test results which are made according to both trace statistics and maximum eigenvalue statistics are given. According to the trace test results, SBKU is cointegrated only with SBABBI and SBGIMS. On the other hand, the Maximum Eigenvalue test indicates SBKU is cointegrated with SBABBI, SBGIMS, and SBCNU. The intersection of both tests states that SBKU is cointegrated with the SBABBI and the SBGIMS. Therefore, the long-run relationship between these two indices with the International Sukuk Index is significant. In this case, the Johansen cointegration test results are similar to the Engle-Granger results. SBKU has converged in equilibrium with SBABBI and SBGIMS in the long run. Therefore, no international diversification benefit can be achieved by investing in these two indexes or identical portfolios. On the other hand, the sukuk index has no integration with the remaining six bond indices. In this case, we conclude that sukuk index can provide international diversification benefits for the other 6 remaining bond indices.

3.4. Vector Error Correction Model (VECM) Results

So far, we have investigated the integration between some of the FTSE international fixed income indexes and the FTSE International Sukuk Index via cointegration tests. According to both Engle-Granger and Johansen cointegration tests, we have observed that the SBKU is cointegrated with SBABBI and SBGIMS. However, although the method of cointegration determines the existence of a long-term relationship, it does not detect the degree and direction. VECM model is used to overcome this issue. This model allows deeper analysis for the cointegrated series.

The cointegration technique only detects the existence of a long-term relationship but the short-term relationship is ignored. The vector error correction model is employed to test the short-term relationship as well. The VECM, which is an autoregressive model, has systems that are created by dependent and independent variables with their lags. The existence of a short-term relationship is tested with the systems of independent variables. With different combinations of variables, the direction of the short-term relationship is analyzed. In addition, the Vector Error Correction Model also allows determining the direction and degree of a long-term relationship. In the error correction autoregressive system, the past periods' error term parameter, called error correction term, represents the long-term relationship within the system. Since this parameter is the error correction term of past results, it should have a negative sign theoretically. It is assumed to be theoretically invalid if it has a positive value, even if it has a statistically significant coefficient.

Table 6: Vector Error Correction Model Short Term Causality Results

Direction	Chi Square Value*	Probability**
SBABBI > SBKU	0.664946	0.4148
SBKU > SBABBI	1.444318	0.2294
SBGIMS > SBKU	2.003185	0.3673
SBKU > SBGIMS	1.949071	0.3798

* Walt test Chi Square values
** Ho: There is no short-term causality

The above table indicates the chi-square values of short term causality which is derived from the VECM model. According to the results obtained at the level of 5% significance, there is no short-term causality from the SBABBI towards the SBKU or vice versa. Similarly, short-term causality could not be determined from the SBGIMS to the SBKU in both direction. The results show that both one-sided and two-sided short-term causality doesn't exist between cointegrated variables.

Table 7: Vector Error Correction Model Long Term Causality Results

Long Term Causality	ECT Coefficient**	t-statistic	Probability*
SBABBI > SBKU	-0.286995**	-4.093845	0.0001*
SBKU > SBABBI	0.021684	0.413837	0.6798
SBGIMS > SBKU	-0.145948**	-2.80572	0.0057*
SBKU > SBGIMS	-0.017036**	-0.355071	0.723

*Significant relationships at 5% confidence level.
** Error correction terms with negative coefficient.

The error terms obtained from the VECM which shows long term causality is given in the above table. According to results, no long-term causality has been identified from the SBKU to the SBABBI and SBGIMS. The reason for that the error correction term is either positive in contrast to the theory or is not statistically significant in the system. On the other hand, since the coefficient of ECT is negative and statistically significant, the result shows that there is a long term causality from both SBABBI and SBGIMS to SBKU. In this case, we can say that 1unit deviation in the SBABBI will generate a deviation of 0.28 units in the SBKU and create an equilibrium in the long run. Likewise, 1unit deviation in the SBGIMS will generate a deviation of 0.14 units in the SBKU and create an equilibrium in the long run.

The vector error correction model shows that there is no short-term causality in both directions between the co-integrated series. However, the existence of long-term causality from the SBGIMS and the SBABBI to SBKU is statistically undeniable. One reason for that one-sided causality may be the relatively low market value of the underlying asset of International Sukuk Index (around $ 68 Billion) comparing with Asian Broad Bond Index (around $ 730 Billion) and Emerging Markets Government Bond Index (around $ 670 Billion). Therefore, it seems quite reasonable there is no long term causality from International Sukuk Index to others.

Conclusion

In this paper, the long-term relationship between FTSE International Sukuk Index and the other 8 different scale FTSE fixed-income indexes have been investigated. The determination of the integration also allows for inference to international diversification. According to the results of Engle-Granger and Johansen cointegration analysis, it is observed that the International Sukuk Index is only cointegrated with 2 of the international FTSE indexes. The fact that Engle-Granger and Johansen cointegration techniques both give the same result strengthens the consistency of the findings. In respect of international diversification, it can be concluded that the International Sukuk Index can highly provide international diversification benefits for international fixed income market investors since it is not highly integrated with others. We also have employed the VECM model to explore the degree, direction of the relationship. According to the vector error correction model, neither unilateral nor bilateral short-term causality is detected among the co-integrated index pairs. On the other hand, long-term casualty is realized only from the Asian Broad Bond Index and the Emerging Markets Government Bond Index to the International Sukuk Index. This result is assumed to be because of the relatively low market value of the International Sukuk Index. For this reason, a fluctuation in the International

Sukuk Index does not affect the other cointegrated series, but it is affected by the fluctuation of the others in the opposite scenario. As a result of the empirical study, it has been determined that the sukuk can potentially provide a diversification benefit for conventional fixed income portfolios.

As a result, international sukuk markets can provide a useful diversification alternative for conventional fixed-income investors. Supporting the findings with portfolio-based optimization techniques can provide promising results for future studies.

References

Abu-Alkheil, Ahmad, Walayet A. Khan, Bhavik Parikh and Sunil K. Mohanty (2017), "Dynamic Co-integration and Portfolio Diversification of Islamic and Conventional Indices: Global Evidence", *Quarterly Review of Economics and Finance*, 66: 212–224.

Alexander, Carol (2001), *Market Models: A Guide to Financial Data Analysis* (New Jersey: Wiley)

Aloui, Chaker, Shawkat Hammoudeh and Hela Ben Hamida (2015), "Co-movement between Sharia Stocks and Sukuk in the GCC Markets: A Time-Frequency Analysis", *Journal of International Financial Markets, Institutions and Money*, 34: 69–79.

Arribas, Ivan, Francisco Pérez and Emili Tortosa-Ausina (2011), "A Network Perspective on International Banking Integration", *Journal of Policy Modeling*, 33: 831-851.

Asutay, Mehmet and Amira Hakim (2018), "Exploring International Economic Integration through Sukuk Market Connectivity: A Network Perspective", *Research in International Business and Finance,* 46: 77–94.

Bhuiyan, Rubaiyat Ahsan, Maya Puspa Rahman, Buerhan Saiti and Gairuzazmi Mat Ghani (2018), "Financial Integration Between Sukuk and Bond Indices of Emerging Markets: Insights from Wavelet Coherence and Multivariate-GARCH Analysis", *Borsa Istanbul Review,* 18(3): 218–230.

Bhuiyan, Rubaiyat Ahsan, Maya Puspa Rahman, Buerhan Saiti and Gairuzazmi Mat Ghani (2019), "Does the Malaysian Sovereign Sukuk Market Offer Portfolio Diversification Opportunities for Global Fixed-income Investors? Evidence from Wavelet Coherence and Multivariate-GARCH Analyses", *The North American Journal of Economics and Finance,* 47: 675-687.

Brooks, Chris (2014), *Introductory Econometrics for Finance*, Second Edition (Cambridge: Cambridge University Press)

Engle, Robert Fry and Clive William John Granger (1987), "Co-Integration and Error Correction: Representation, Estimation, and Testing", *Econometrica,* 55(2): 251–276.

Făt, Codruta Maria and Eva Dezsi (2012), "A Factor Analysis Approach of International Portfolio Diversification: Does It Pay Off?", *Procedia Economics and Finance*, 3(12): 648–653.

Gilmore, Claire and Ginette McManus (2001), "International Portfolio Diversification: US and Central European Equity Markets", *Emerging Markets Review*, 3(1): 69-83.

Guidi, Francesco and Mehmet Uğur (2014), "An Analysis of South-Eastern European Stock Markets: Evidence on Cointegration and Portfolio Diversification Benefits", *Journal of International Financial Markets, Institutions and Money,* 30(1): 119–136.

Hassan, Mohammad Kabir, Andrea Paltrinieri, Alberto Dreassi, Stefano Miani and Alex Sclip (2018), "The Determinants of Co-movement Dynamics Between Sukuk and Conventional Bonds", *The Quarterly Review of Economics and Finance*, 68*:* 73–84.

IIFM (2019), "IIFM Sukuk Report July 2019 8th edition", https://islamicmarkets.com/publications/iifm-sukuk-report-2019-8th-edition (08.05.2020)

Johansen, Soren (1988), "Statistical Analysis of Cointegration Vectors", *Journal of Economic Dynamics and Control,* 12(2–3): 231–254.

MacKinnon, James G. (2010), "Critical Values for Cointegration Tests", (Queen's Economics Department Working Paper), URL: https://www.econstor.eu/bitstream/10419/67744/1/616664753.pdf (08.05.2020)

Markowitz, Harry Max (1952), "Portfolio Selection", *The Journal of Finance,* 7(1): 77–91.

Markowitz, Harry Max (1959), *Portfolio Selection: Efficient Diversification of Investments* (Connecticut: Yale University Press)

Naifar, Nader (2016), "Modeling Dependence Structure between Stock Market Volatility and Sukuk Yields: A Nonlinear Study in the Case of Saudi Arabia", *Borsa Istanbul Review,* 16(3): 157-166.

Naifar, Nader, Mourad Mroua and Slah Bahloul (2017), "Do Regional and Global Uncertainty Factors Affect Differently the Conventional Bonds and Sukuk? New Evidence", *Pacific-Basin Finance Journal,* 41: 157-166.

Okuyan, Hasan Aydın and Devran Deniz (2017), "Portföy Yönetiminde Uluslararası Çeşitlendirme Üzerine Uygulamalı Bir Çalışma", *Hacettepe University IIBF journal,* 35(2): 71-92.

Oloko, Tirimisiyu (2018), "Portfolio Diversification between Developed and Developing Stock Markets: The Case of US and UK Investors in Nigeria", *Research in International Business and Finance,* 45: 219-232.

Omet, Ghassan (2015), "The International Diversification of Investment Portfolios", *Dirasat: Administrative Sciences,* 23(2): 185-190.

Rahim, Adam Mohammad and Mansur Masih (2016), "Portfolio Diversification Benefits of Islamic Investors with Their Major Trading Partners: Evidence from Malaysia Based on MGARCH-DCC and Wavelet Approaches", *Economic Modelling,* 54: 425–438.

Sclip, Alex, Alberto Dreassi, Stefano Miani and Andrea Paltrinieri (2016), "Dynamic Correlations and Volatility Linkages between Stocks and Sukuk: Evidence from International Markets", *Review of Financial Economics,* 31: 34–44.

Solnik, Bruno (1974), "Why Not Diversify Internationally Rather Than Domestically?", *Financial Analysts Journal*, 30(4): 48-54.

Yiğiter, Şule Yüksel and Bilal Akkaynak (2017), "Modern Portföy Teorisi: Alternatif Yatırım Araçları İle Bir Uygulama", *Kahramanmaraş Sütçü İmam University Social Science Journal,* 14(2): 285-300.

Yunus, Nafeesa (2013), "Contagion in International Financial Markets: A Recursive Cointegration Approach", *Journal of Multinational Financial Management*, 23(4): 327–337.