Diversification benefits of Turkey-based investors: evidence from top trading partners based on a multivariate-GARCH approach

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Received 4 November 2021
Revised 9 March 2022
Accepted 14 April 2022

Abstract

Purpose – The aim of this study is to measure portfolio diversification benefits of the Turkey-based equity investors into top trading partner countries. Portfolio diversification benefits are analyzed from the viewpoint of two types of investors in Turkey: conventional equities investors and Islamic equity investors.

Design/methodology/approach – In order to evaluate the time-varying correlations of the trading partner country's stock index returns with the Turkish stock index returns, the multivariate-generalized autoregressive conditional heteroskedasticity–dynamic conditional correlation (GARCH-DCC) is applied based on daily data covering 13 years' period between January 22, 2008 and January 22, 2021.

Findings – The results revealed that the US stock indices provide the most diversified benefit for both conventional and Islamic Turkey-based equity investors. In general, Islamic indices exhibit relatively lower correlation with trading partners than conventional indices. Turkey and Russia are recorded as the most volatile indices.

Originality/value – The diversification potential in trading partners for Turkey-based Islamic equity investors has not been studied yet. This study is to fill in this gap in the literature and to give fruitful insights to both conventional and Islamic investors.

Keywords MGARCH DCC, Participation index, Islamic index, Islamic finance, Trading partner, Turkey

Paper type Research paper

1. Introduction

The maximized or at least stable return with nominal risk is the main goal of all individual and institutional investors. Portfolio selection and investment diversification are the basic strategies to alleviate market risk (Markowitz, 1959). Diversification can be possible by composing different types of assets in portfolio such as commodities, derivatives, real estate, private equity/hedge funds etc. within the local market. However, international diversification provides a special avenue in terms of return and risk.

With considerably rapid growth of the Islamic finance industry including Islamic capital markets as a result of wealth accumulation in oil producing Muslim countries, additionally growing interest from the West after 2008 global financial crisis, Islamic investment has become a significant segment for diversifying investments. The Islamic financial market is estimated to be around $2.2 trillion, and expected to grow 10 to 12% per annum (Standard & Poor's (S&P) Global Ratings, 2021). Although there are a vast number of studies on the correlation of conventional asset returns, studies on Islamic asset returns have been remained relatively limited. Recent studies suggest that investors get partial insulation or safer heaven by Islamic investments due to its filtering criteria. In other words, firms which are highly leveraged or whose main business is interest related or whose ratio of non-liquid assets to

Journal of Economic and Administrative Sciences

1026-4116
DOI 10.1108/JEAS-11-2021-0226

total assets is out of tolerable level are kept out of the index. Therefore, this study aims to contribute to the Islamic finance literature by exploring the comovements of the trading partner country's stock index returns with the Turkish stock index returns.

Due to recent events (i.e. Brexit, Turkish coupe, depreciation of Turkish Lira day by day, Arab spring, the Syrian war, instability in the Middle East, F35/S400 crisis with the USA and capital flight), Turkey has seen consequential effects regarding economy, tourism and European Union membership. The need for diversification among domestic investors has led us to delve into Turkey-based investors' international diversification potential. Additionally, the World Islamic Banking Competitiveness Report 2016 reported that Turkey has significant influence in the global growth of the Islamic financial services industry.

Turkey sees volatility with high interest, high inflation and currency exchange rate fluctuations. Through this, Turkish investors value diversification to minimize their risk while optimizing portfolios. International diversification is especially vital for investors who restrict their investment to only a subset of investments based on their limited preferences (i.e. social, sector and religious/ethics); this follows the disadvantage of investing in limited sectors' assets (i.e. technology, energy, consumption and service) (Bauer *et al.*, 2006).

The purpose of the paper is to identify the diversification benefits of Turkish-based investors with domestic assets and international assets among Turkey's top eight trading partners. We observe Islamic equity investments, as well as their conventional counterparts. Our study makes an original contribution to the literature as there are a limited number of studies highlighting diversification opportunities at international level using a multivariate-generalized autoregressive conditional heteroskedasticity–dynamic conditionl correclation (GARCH DCC) method for Turkey-based Islamic investors.

The rest of the paper after the introduction is organized in the following manner. We discuss the relevant literature that pertains to our hypotheses and methodology. We, then, delve into our expectations, data description and testing procedure. We analyze our results from which we conclude.

2. Literature review

2.1 Review of the literature from methodological perspective

Measuring comovements among stock market returns has implications for market players and academicians in terms of portfolio diversification issue; as others before us, we used Engle's (2002) pathbreaking work, the multivariate-GARCH (MGARCH DCC) model. It was introduced as a new class of estimator to overcome the limitation associated with the Bollerslev's (1988) constant conditional correlation (CCC) model, which is the constant conditional correlation estimator. As it functions as a substantial tool in a variety of financial fields including asset pricing, portfolio selection and risk management, MGARCH DCC has a wide range of application (Saiti *et al.*, 2014).

One strand of the empirical literature utilizing the MGARCH DCC method is comparative studies between Islamic and conventional stock indices. The underlying motivation of such studies is generally to check hedging capacity of Islamic indices. In this manner, Rizvi and Arshad (2014) revealed that Islamic equity can offer partial insulation during crises. Kamil *et al.* (2014) analyzed Dow Jones 23 sector indices, of which 16 are *Shariah* compliant and seven are conventional, covering 1997–2013 period by using efficient frontiers, time varying maximum Sharpe ratio, DCC in an MGARCH framework and revealed that Islamic investment universe is not poor in terms of diversification opportunities at international level. It can even outperform the conventional one under certain circumstances. El Mehdi and Mghaieth (2017) studied DCC between Islamic and conventional stock indices, and the findings revealed that Islamic indices in a conventional stock portfolio increase the risk-adjusted performance of the resulting portfolio. Trabelsi and Naifar (2017) also found

supportive results that portfolios including Islamic stock indexes perform better than a benchmark portfolio in turmoil periods. Ali *et al.* (2021) performed a comparative study by using MGARCH DCC between Islamic equity and socially responsible investment (SRI) equity. There exists a hedging potential between the two, especially in shorter investment horizon. Ahmad *et al.* (2018) found that during the global financial crisis (2008) period, the Dow Jones Islamic Market World Index (DJIMI) shows the patterns of decoupling from conventional benchmark indices, which suggests that Islamic equity index may act as an effective hedging instrument during the crisis period. On the contrary, Yilmaz *et al.* (2015) implemented DCC and DECO on Dow Jones Islamic Market sector indexes and found that Islamic equity sectors are integrated as in the conventional system. The results do not support the decoupling hypothesis of Islamic indices from the mainstream indices. Saiti *et al.* (2020) explored that Islamic indices are less volatile than the Chinese conventional sectoral indices by deploying MGARCH-DCC.

Islamic equity and commodities were studied comparatively as another strand of literature. For example, by means of MGARCH DCC and the filter of Kalman models, Mezghani and Boujelbène (2018) studied the relationship of oil and Gulf Cooperation Council (GCC) Islamic and Conventional stock markets and displayed to find the existence of contagion. Similarly, Abdulkarim *et al.* (2020) investigated volatility linkages between crude oil and African Islamic indices by employing maximum overlap discrete wavelet transformation (MODWT), continuous wavelet transform (CWT) and multivariate-GARCH-DCC techniques. From their results, investors holding the Tunisian and the Egyptian Islamic indices with oil can get maximum diversification benefit in long term periods.

Diversification potential among Islamic indices cross countries has been a focus of interest by academic world to orient Islamic equity investors into investment alternatives at international level. For Malaysia, Hakim and Masih (2014) used MGARCH DCC together with wavelet transform to catch time-varying correlation and time scales, respectively. The study revealed potential gain is possible from portfolio diversification both at international and domestic sectoral level. Another case study for Malaysia is the one by Najeeb *et al.* (2015) which determined international portfolio diversification opportunities for investors having heterogeneous investment horizons. Rahim and Masih (2014) also adopted MGARCH DCC to detect diversification benefits for Moroccan Islamic investors during political uncertainty, which is Arab Spring. Rahim and Masih (2014) applied MGARCH DCC to evaluate diversification strategies for Malaysian Islamic stock investors with their top trading partner countries by taking into account time varying correlations and different investment horizons. There are also practical implications for Saudi Arabia–based invertors in the study by Ali *et al.* (2019) through MGARCH DCC and continuous wavelet transforms. It is explored that diversification is possible with major trading partners in short-term investment horizons, although the highest potential exists with India and the least is with China. Joyo and Lefen (2019) investigated time-varying correlation and volatilities of stock markets of Pakistan and its trading partners by employing MGARCH-DCC with student t-distribution, for the period of 2005–2018. The results revealed that it is not possible to diversify portfolios for Pakistani investors with its trading partners during the 2008 global financial crisis.

2.2 Review of the literature from empirical perspective

Integration and volatility spillover are important decisive factors in asset allocation of international investors in order to obtain an optimal portfolio with minimum unsystemic risk. In fact, high integration and existence of volatility spillover lower diversification potential since the market is not isolated and vulnerable to external shock (Bekaert and Harvey, 2000). Furthermore, extreme volatility means uncertainty for foreign investors, which is undesirable (Darrat and Benkato, Interdependence and volatility spillovers under market liberalization: The case of Istanbul stock exchange, 2003).

Çemrek and Polat (2021) processed multivariate GARCH models on daily stock index data between 2005 and 2011 from seven countries of high trade volume and seven countries of low trade volume with Turkey according to the results of trade facilitates transfer of volatility to Turkey. Gursoy and Govdere (2020) run multivariate value at risk-exponential general autoregressive conditional heteroskedastic (VAR-EGARCH) model mean equation on daily data between 2006 and 2017 period in order to detect return and volatility spillover from developed countries including the USA, the UK, Japan, Germany and France, to developing countries including Turkey, Brazil, India, Indonesia and South Africa. With the aid of Hafner and Herwartz (2006) variance causality test and the DCC multivariate GARCH method, Senol and Turkay (2020) tested volatility spillover between developed markets and emerging markets. Buriev *et al.* (2018) applied MGARCH-DCC and Wavelet methodologies to examine availability of diversification benefits for Turkey-based conventional investors in Middle East and North Africa (MENA) countries. According to the findings, the major trading partners of the country, especially Egypt, within the region do not offer diversification potential due to interconnectedness of the related markets for all investment horizons. Değirmenci and Abdioğlu (2017) analyzed stock market spillover between the USA, Canada, China, Japan, South Korea, Germany, Britain, Switzerland and Greece to the fragile eight countries. According to the results obtained by the E-GARCH model, there is volatility spillover from the developed markets to the fragile eights. In order to measure return and volatility spillover between Turkey, Germany, France and the UK, Demirgil and Gök (2014) used VAR-EGARCH model. In terms of both return and volatility, Germany is the dominant country in terms of volatility spillover. Depending on daily data between 1995 and 2007 and using ARCH and GARCH models, the research conducted by Yalama and Sevil (2008) indicated that Turkey stock index returns have higher return volatility compared to UK, Netherland, Germany, US, France equity markets. Yu and Hassan (2008) applied EGARCH and multivariate ARCH models with daily data between 1999 and 2005 and concluded that shocks originating from US equity market cause excessive volatility in Turkey within the period studied. By using DCC ARCH-M and GARCHM, Alemdar (2010) also supported this finding. On the contrary, AbouZaid (2011) emphasized that the Turkish stock market is not affected by US and UK markets by their study with the aid of multivariate E-GARCH. Return spillover among US, Germany, France, UK and Turkey equity markets are studied by Tastan (2005) by means of VAR-DCC MVGARCH models with daily data between 1990 and 2004. It is concluded that Turkey is under a significant volatility spillover particularly after the customs union agreement. In the study done by Darrat and Benkato (2003) using the Johansen-Juselius cointegration test and GARCH process, it is proved that Turkey is a receiver of volatility shocks from the USA and the UK. In general, all the studies highlighted that Turkey is integrated with and affected by volatility spillover originating from its trading partners.

Another strand of literature consists of the studies regarding Turkish Islamic equity market integration at international scale. The first study applying multivariate GARCH DCC approach in order to evaluate diversification potential of Islamic investment for US-based investors in financial turmoil is performed by Saiti *et al.* (2014). US-based investors may obtain less diversification benefits from having Islamic stock indexes in their investment portfolio than their conventional equivalents. A similar study was conducted by Majdoub and Mansour (2014) where Morgan Stanley Capital International (MSCI) Islamic indices are studied by means of multivariate GARCH Baba, Engle, Kraft and Kroner (BEKK), CCC, and DCC models to show a weak correlation between US and Islamic emerging equity markets. Gandapur (2020) analyzed volatility spillover from global volatility Index (VIX) to the equity market of selected Islamic countries through Autoregressive Moving Average (ARMA) GARCH, Glosten-Jagannathan-Runkle (GJR) GARCH, DCC and ADCC methods. The author

indicated that any movement in VIX has a negative impact on the Borsa Istanbul Stock Exchange's volatility. Furthermore, negative news causes more volatility than positive news.

As a separate class, studies comparing Islamic and conventional stock indices can be mentioned. Anas *et al.* (2020) processed wavelet and ADCC methodologies on daily data for a quite large sample consisting of 41 countries, including Turkey. A substantial positive correlation in short investment horizons is detected between Islamic and conventional equity returns, and therefore the decoupling hypothesis failed.

At country level, Erdogan *et al.* (2020) analyzed at how traditional and Islamic stock markets responded to the Covid-19 outbreak in Turkey. The researcher applied the DCC-GARCH method and empirically demonstrated that the Turkish Islamic stock markets are more resilient to the global Covid-19 outbreak than the conventional counterpart. Kahyaoğlu and Akkuş (2020) measured volatility spillover between Islamic and conventional indices, namely Participation-30 and Borsa Istanbul stock exchange (BIST)-30 relatively by using DECO and HYGARCH (hyperbolic general autoregressive conditional heteroskedastic) models. Findings revealed that correlation between the two is strong, meaning no room for hedging. Secme *et al.* (2016) analyzed performance of BIST-100 and Participation-30 indices in terms of volatility and return with the help of GARCH (1,1) and exponential general autoregressive conditional heteroskedastic (EGARCH) (1,1) methodologies.

As seen from above literature review, diversification potential in trading partners for Turkey-based Islamic equity investors has not been studied yet. This study is mainly inspired by and follows the work of Saiti *et al.* (2014) and Noordin and Saiti (2018), albeit from the perspective of Turkey-based Islamic investors to fill in this gap in the literature and to give fruitful insights to Turkey based conventional investors with actual data.

3. Research methodology

3.1 Multivariate GARCH-dynamic conditional correlation

The MGARCH-DCC model of Engle (2002) will be deployed to estimate time-varying volatilities and correlations amongst stock indices.

The model consists of two steps estimations. First, the conditional variances of each asset is estimated by means of the following univariate GARCH (X,Y) model:

$$h_{it} = \omega_i + \sum_{x=1}^{X_i} \alpha_{ix} r_{it-x}^2 + \sum_{y=1}^{Y_i} \beta_{iy} h_{it-y}, \text{ for } i = 1, 2, \ldots, \text{k}$$

where ω_i, α_{ix} and β_{iy} are non-negative and $\sum_{x=1}^{X_i} \alpha_{ix} + \sum_{y=1}^{Y_i} \beta_{iy} < 1$.

where α_{ix} denotes shocks to return X to a short-run persistence (the ARCH effects), β_{iy} is the contribution of shocks to return Y to a long-run persistence (the GARCH effects) and k represents the number of assets.

At the second step, the time-varying conditional correlation between index returns will be calculated by using the general equation of the DCC estimator as follows:

$$H_t = D_t R_t D_t$$

where H_t denotes multivariate conditional covariance matrix, D_t represents a $k \times k$ matrix of conditional time-varying standardized residuals (ε_t), which were generated from the univariate GARCH model at the first step.

$$D_t = diag\left(\sqrt{h_{11,t}}, \sqrt{h_{22,t}}, \ldots, \sqrt{h_{kk,t}}\right)$$

It is a symmetric positive definitive matrix having $\sqrt{h_{ii,t}}$ on its diagonals, $I = 1,2,\ldots k$.

R_t stands for the time-varying correlation matrix (off-diagonal elements).

$$R_t = Q_t^{*-1} Q_t Q_t^{*-1}$$

where, $Q_t = (q_{ij,t})$ is derived from

$$Q_t = (1 - \phi - \gamma)\overline{Q} + \gamma\, Q_{t-1} + \phi \sigma_{i,t-1}\sigma_{j,t-1}$$

the $k \times k$ symmetric positive definitive matrix,

where Q_t is a $k \times k$ *symmetric positive* definitive conditional (time-varying) covariance matrix of standardized residual $\left(\sigma_{it} = \frac{\varepsilon_{it}}{\sqrt{h_{it}}}\right)$, and $\overline{Q}$ is the unconditional correlations of $\sigma_{i,t}\sigma_{j,t}$. ϕ and γ are non-negative scalar parameters satisfying $\phi + \gamma < 1$. Q_t^* is the diagonal matrix consisting of the square root of the diagonal elements of Q_t:

$$Q_t^* = diag(\sqrt{q_{11}}, \sqrt{q_{22}}, \ldots, \sqrt{q_{kk}})$$

Hence, the conditional correlation of X and Y stock indices at time t can be calculated as follows:

$$\rho_{ij,t} = \frac{(1 - \phi - \gamma)\overline{q}_{ij} + \phi \sigma_{i,t-1}\ \sigma_{j,t-1} + \gamma q_{ij,t-1}}{\left[(1 - \phi - \gamma)\overline{q}_{ii} + \phi\sigma_{i,t-1}^2 + \gamma q_{ii,t-1}\right]^{1/2}\left[(1 - \phi - \gamma)\overline{q}_{jj} + \phi\sigma_{j,t-1}^2 + \gamma q_{jj,t-1}\right]^{1/2}}$$

where q_{ij} is the element on the ith line and jth columns on the matrix Q_t. (Bollerslev, 1988). By *the* Bollerslev's (1988) model, the conditional log likelihood of the parameters based on the Gaussian assumption can be summarized as follows:

$$L = -\frac{1}{2}\sum_{t=1}^{T}\left[\left(k\log(2\pi) + \log|D_t|^2 + \varepsilon_t' D_t^{-1} D_t^{-1}\varepsilon_t\right) + \left(\log|R_t| + \sigma_t' R_t^{-1}\sigma_t - \sigma_t'\sigma_t\right)\right]$$

where, k denotes the number of equations a, whereas T denotes the number of observations. In Step 1, only the volatility component (D_t) is maximized, i.e. the log likelihood is reduced to the sum of the log likelihood of the univariate GARCH model. On the other hand, in Step 2, the correlation component (R_t) is maximized (conditional on the estimated D_t) with the standardized residuals obtained from Step 1. The use of Gaussian assumption in holding for daily returns is a controversial issue as it results in an underestimation of portfolio risk. In fact, despite consistency under the two-step estimation of the likelihood approach (Engle and Sheppard, 2001), it could possibly be inefficient under Gaussianity (Pesaran and Pesaran, 2010).

3.2 Data

Our data uses daily time series closing prices from January 29, 2008, to January 22, 2021. We collect from Thomson-Reuters DataStream.

As the proxies for conventional and Islamic stock returns, the MSCI Turkey index returns and the MSCI Turkey Islamic index returns are used respectively since MSCI has the most tough criteria for companies to be included in its index (Majdoub and Mansour, 2014). The MSCI conventional and Islamic index returns of the top trading partners of Turkey namely, Germany, the UK, Italy, the USA, France, Spain, the Netherlands and Russia are taken into account to unveil potential diversification benefits for Turkey-based equity investors. The countries are chosen as they are the all available data. The list of variables is shown in Table 1.

Conventional stock indices	Symbol
Base index	
MSCI Turkey Index	TUC
International stock indices	
MSCI Germany Index	GEC
MSCI United Kingdom Index	UKC
MSCI Italy Index	ITC
MSCI United States Index	USC
MSCI France Index	FRC
MSCI Spain Index	SPC
MSCI Netherland Index	NEC
MSCI Russia Index	RUC
Islamic Stock Indices	Code
Base Index	
MSCI Turkey Index	TUI
International Stock Indices	
MSCI Germany Index	GEI
MSCI United Kingdom Index	UKI
MSCI Italy Index	ITI
MSCI United States Index	USI
MSCI France Index	FRI
MSCI Spain Index	SPI
MSCI Netherland Index	NEI
MSCI Russia Index	RUI

Table 1.
List of variables

4. Research results and discussion

The empirical results of this research are obtained by using two empirical tests. The first one is to compare the maximized log-likelihood (ML) estimates of the Gaussian DCC model and the student dynamic conditional correlation (t-DCC) model in order to show which model is relatively more significant (due to the space constrain we just reported the results of t-DCC model). We set $\mu_{t-1} = 0$ and thus apply the DCC models to the daily returns over the period under review since our primary interest is in volatility modeling and the estimation of correlations between the returns of stock indices. We do not find any instances of nonconvergence or serial correlation. We, then, plot the estimated conditional volatilities and correlations.

4.1 Should the Turkey-based conventional equity investors invest in top trading partners to gain international portfolio diversification benefits?

Initially, we examine conventional stock indices from Germany, the UK, Italy, the USA, France, Spain, the Netherlands and Russia to investigate potential diversification opportunities for Turkey-based conventional equity investors.

4.1.1 Maximum log-likelihood estimates of the t-DCC model on conventional index returns. It is found that the ML value obtained by the t-DCC model (105502.4) is higher than that obtained by the Gaussian model (104,518.7). Additionally, the estimated degrees of freedom for the t-normal distribution is 7.5096, which is below 30. Therefore, this result implies that the fat-tailed nature of conventional index returns of Turkey and its trading partners tends to be best captured by the t-distribution model. The ML estimates for the DCC model with underlying student-t distribution on conventional index return series of Turkey and its trading partners are acquired in Table 2. The estimated unconditional volatilities and

Parameter	Estimate	Standard error	*T*-Ratio [Prob]
lambda1_D_TUC	0.90039	0.014661	61.4121 [0.000]
lambda1_D_GEC	0.93718	0.0041501	225.8198 [0.000]
lambda1_D_UKC	0.93266	0.0058936	158.2499 [0.000]
lambda1_D_ITC	0.92309	0.0061572	149.9211 [0.000]
lambda1_D_USC	0.86614	0.011902	72.7722 [0.000]
lambda1_D_FRC	0.93009	0.0045875	202.7467 [0.000]
lambda1_D_SPC	0.92212	0.0061534	149.8554 [0.000]
lambda1_D_NEC	0.93698	0.0054394	172.2561 [0.000]
lambda1_D_RUC	0.92866	0.0071895	129.1685 [0.000]
lambda2_D_TUC	0.074042	0.0098261	7.5352 [0.000]
lambda2_D_GEC	0.053534	0.0033136	16.1558 [0.000]
lambda2_D_UKC	0.058724	0.0048799	12.0339 [0.000]
lambda2_D_ITC	0.061452	0.0045681	13.4524 [0.000]
lambda2_D_USC	0.12209	0.010480	11.6500 [0.000]
lambda2_D_FRC	0.059716	0.0036715	16.2647 [0.000]
lambda2_D_SPC	0.065370	0.0048709	13.4205 [0.000]
lambda2_D_NEC	0.054637	0.0044446	12.2928 [0.000]
lambda2_D_RUC	0.064898	0.0062906	10.3167 [0.000]
Note(s): Delta1	0.96989	0.0020817	465.9224 [0.000]
Delta2 0.015217	0.8216E-3	18.5219 [0.000]	
df 7.5096	0.28412	26.4307 [0.000]	
ML = 105502.4			
df is the degrees of freedom of the multivariate *t* distribution			

Table 2.
Results of multivariate GARCH with underlying t-Distribution on the conventional index return series

correlations of conventional stock index returns of Turkey and its trading partners under the t-DCC model are revealed in Table 3.

Since the t-DCC model has been selected as the most suitable model for conventional stock indices, Tables 2 and 3 are used in the following discussion. The volatility parameters observed under the t-DCC model are highly significant, with the estimates of $\lambda_{1i}, i = 1, 2, 3, 4, 5, 6, 7, 8$ and 9 being very close to one, implying a gradual volatility decay (Table 4). This implies that after a market shock, the riskiness associated with the returns will gradually be canceled out. Furthermore, we note that the number of lambda1 and lambda 2 for all stock indices (for example, Lambda 1_GE + Lambda2_GE = 0.991334) is less than 1 or unity. This means that the shock to the returns volatilities is temporary; in other words, not the Integrated Generalized Auto Regressive Conditional Heteroskedasticity (IGARCH). This phenomenon has a significant implication: it implies that investors and portfolio managers have a higher risk of losing their money, although they will make a profit in the short term. Speculators and short-term investors, on the other hand, will profit from such market conditions.

The unconditional volatilities of conventional index returns are represented by the on diagonals in Table 4. The index is said to be less volatile if the unconditional volatility is close to zero. On the other hand, unconditional volatility close to one means that the index is more volatile. In Table 4, the unconditional volatilities of conventional indices are listed in an increasing order.

Conventional stock indices have low unconditional volatilities, ranging from 0.013077 to 0.023213. It is also observed that conventional stock indices have nearly same degree of volatility. It is noteworthy to say that Turkish conventional stock indices are the second most volatile one after Russia.

In Table 3, the off-diagonal elements represent the unconditional correlation between Turkish conventional index returns and conventional index returns of its trading partners. Accordingly, Table 5 shows the unconditional correlations in an increasing

Table 3. Estimated unconditional volatility matrix

Matrix	D_TUC	D_GEC	D_UKC	D_ITC	D_USC	D_FRC	D_SPC	D_NEC	D_RUC
D_TUC	0.021985	0.55433	0.54675	0.50580	0.37091	0.55183	0.51561	0.54828	0.52071
D_GEC	0.55433	0.016123	0.86597	0.87875	0.60338	0.94921	0.85707	0.91243	0.62342
D_UKC	0.54675	0.86597	0.014834	0.82346	0.57966	0.89851	0.81810	0.87069	0.64546
D_ITC	0.50580	0.87875	0.82346	0.018862	0.53806	0.91598	0.90967	0.87222	0.57845
D_USC	0.37091	0.60338	0.57966	0.53806	0.013077	0.58834	0.53717	0.58850	0.43217
D_FRC	0.55183	0.94921	0.89851	0.91598	0.58834	0.016381	0.90758	0.94092	0.63084
D_SPC	0.51561	0.85707	0.81810	0.90967	0.53717	0.90758	0.018338	0.85679	0.55716
D_NEC	0.54828	0.91243	0.87069	0.87222	0.58850	0.94092	0.85679	0.014918	0.61091
D_RUC	0.52071	0.62342	0.64546	0.57845	0.43217	0.63084	0.55716	0.61091	0.023213

order. It is found that the unconditional correlations of Turkey with its trading partners, except the USA, are at more or less the same level, ranging from +0.505 to +0.554. The relatively higher correlation between index returns between Turkish and European trading partners' markets may be explained by market spillover effects resulting from high trade level and numerous trade agreements between Turkey and the European Union, such as the European Union–Turkey Customs Union. Especially, Germany has been the top trading partner and covers almost 10% of the Turkey's total trade in 2020. In the same way, Russia as being one of the main trading partners, with 8% share in total import volume of Turkey in 2020, shows high correlation with Turkey. The lowest unconditional correlation exists between US conventional equity market and Turkish conventional equity market, at +0.370. This suggests that Turkish conventional equity investors would benefit from greater diversification if they invested in the US market instead of other trading partners.

4.1.2 Conditional volatilities of coventional index returns. The dynamic conditional volatilities for each conventional stock index return are shown in Figure 1. According to our findings, the conditional volatilities of the conventional stock indices follow nearly the same path. This finding is parallel with the findings of Çemrek and Polat (2021) that volatility transfer is mainly due to high trade volume between the markets. The lowest conditional volatility is witnessed on the MSCI US stock index returns; whereas the highest volatilities are recorded by the MSCI Russia and Turkey. Both findings are in compliance with the prior findings on unconditional volatilities in Table 8. Within the time interval of the study, the conditional volatilities increased to the highest level during the global financial crisis of 2008. The second highest peak and convergence of volatility is reached in March, 2020 due to the current pandemic. In both cases, there was also a substantial convergence of volatility among all stock index returns during the crisis periods which may be disadvantageous to investors and portfolio managers because it limits portfolio

Table 4. Unconditional volatilities of conventional index return series

No	Conventional index	Unconditional volatility
1	US	0.013077
2	UK	0.014834
3	Netherland	0.014918
4	Germany	0.016123
5	France	0.016381
6	Spain	0.018338
7	Italy	0.018862
8	Turkey	0.021985
9	Russia	0.023213

Table 5. Unconditional correlations between conventional index returns of Turkey and trading partners

Conventional index	Unconditional correlation
US	0.37091
Italy	0.50580
Spain	0.51561
Russia	0.52071
UK	0.54675
Netherland	0.54828
France	0.55183
Germany	0.55433

diversification options due to such great level of financial integration of the markets. At the end of 2011, there was an apparent increase in the volatility of conventional stock indices, which can be related to the European sovereign debt crisis. This came consequentially from the balance of payment crisis in Greece, Portugal, Ireland, Spain, and Cyprus. At the end of 2014, the Russian equity market recorded a high returns volatility due to the political tension with Ukraine. Additionally, the Italian equity market affected by a significant returns volatility around 2016. It seems to be due to political unrest after Prime Minister Matteo Renzi's resignation following a "no" result in Italy's historic constitutional referendum. On the other hand, The Turkish equity market spotted a substantial volatility increase in 2013 due to Gezi protests and in 2018 due to currency crisis.

4.1.3 Conditional correlations of conventional index returns. Lastly, we plot the conditional correlations of Turkey's trading partners' conventional stock index returns with Turkey conventional index returns in Figure 2. The plot indicates that the return correlations of the Turkish conventional stock index with its trading partners, except US, seems to move quite

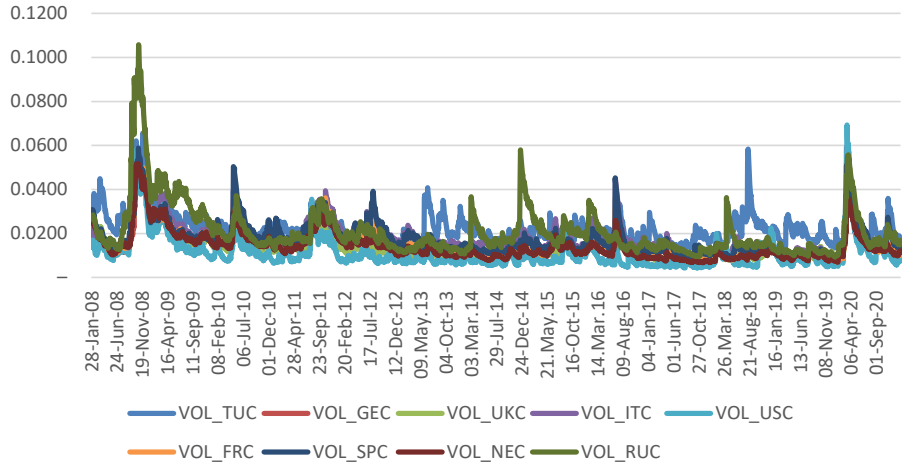

Figure 1.
Conditional volatilities of conventioanal indices

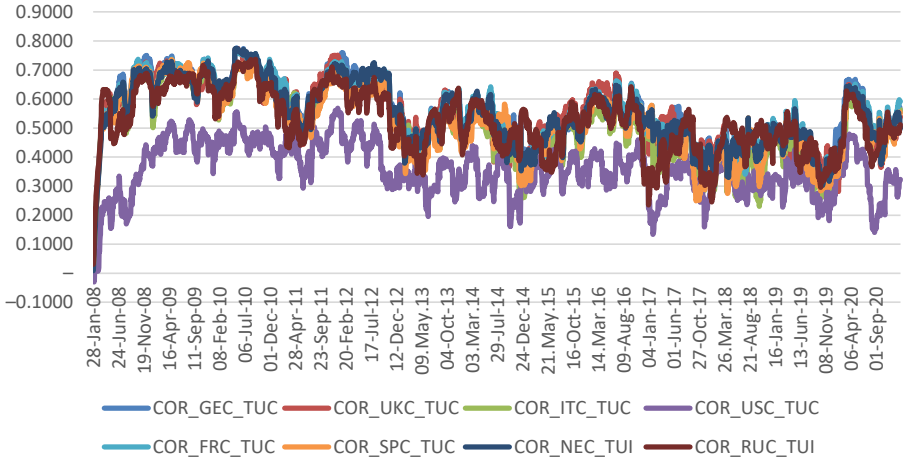

Figure 2.
Conditional correlations between conventional indices of Turkey and trading partners

closely together, especially during turmoil times including the 2008 global financial crisis and the pandemic shock. Moreover, the plot confirms the previous results of the unconditional correlations in Table 8, showing that the Turkish Islamic stock index has more or less same level of correlation with the Germany, France, Netherland, UK, Russia, Spain, Italy conventional market returns and is less correlated to the US conventional stock index returns. From here, it can be suggested that if the Turkey-based conventional equity investors were to invest their assets internationally, they should include the US conventional stock index in their portfolio in order to gain more diversification benefits as compared to other trading partners conventional stock indices.

4.2 Should the Turkey-based Islamic equity investors invest in top trading to gain international portfolio diversification benefits?

In the second part of the study, we explore how useful Islamic stock indices of Germany, United Kingdom, Italy, United States, France, Spain, Netherlands, and Russia in providing portfolio diversification opportunities from the perspective of the Turkey based Islamic equity investors.

4.2.1 Maximum log-likelihood estimates of t-DCC model on Islamic index returns. We discovered that the ML value obtained by the t-DCC model (101,120.0) is higher than that obtained by the Gaussian model (104,518.7). Besides, the estimated degrees of freedom for the t-normal distribution is 7.5242, which is below 30. Therefore, this result implies that the fat-tailed nature of Islamic index returns of Turkey and its trading partners tends to be best captured by the t-distribution model.

The ML estimates for DCC model with underlying student-t distribution on Islamic index return series of Turkey and its trading partners are acquired in Table 6. The estimated unconditional volatilities and correlations of Islamic stock index returns of Turkey and its trading partners under the t-DCC model are revealed in Table 7.

Table 6.
Results of multivariate GARCH with underlying *t*-distribution on the Islamic index return series

Parameter	Estimate	Standard error	*T*-ratio [Prob]
lambda1_D_TUI	0.89210	0.017854	49.9671 [0.000]
lambda1_D_GEI	0.94585	0.0043285	218.5196 [0.000]
lambda1_D_UKI	0.94237	0.0052895	178.1592 [0.000]
lambda1_D_ITI	0.94240	0.0059586	158.1582 [0.000]
lambda1_D_USI	0.86958	0.011963	72.6917 [0.000]
lambda1_D_FRI	0.94638	0.0046181	204.9263 [0.000]
lambda1_D_SPI	0.93199	0.0080621	115.6024 [0.000]
lambda1_D_NEI	0.94649	0.0056335	168.0132 [0.000]
lambda1_D_RUI	0.92999	0.0072257	128.7059 [0.000]
lambda2_D_TUI	0.078449	0.011550	6.7924 [0.000]
lambda2_D_GEI	0.045118	0.0033633	13.4145 [0.000]
lambda2_D_UKI	0.048356	0.0041878	11.5468 [0.000]
lambda2_D_ITI	0.046304	0.0044506	10.4039 [0.000]
lambda2_D_USCI	0.11729	0.010319	11.3659 [0.000]
lambda2_D_FRI	0.044494	0.0035762	12.4416 [0.000]
lambda2_D_SPI	0.055593	0.0062011	8.9651 [0.000]
lambda2_D_NEI	0.044307	0.0043388	10.2119 [0.000]
lambda2_D_RUI	0.063033	0.0062370	10.1062 [0.000]
Note(s): delta1	0.97714	0.0015975	611.6789 [0.000]
delta2	0.010989	0.6336E-3	17.3429 [0.000]
df	7.5242	0.27980	26.8918 [0.000]
ML = 101120.0			
df is the degrees of freedom of the multivariate *t* distribution			

Matrix	D_TUI	D_GEI	D_UKI	D_ITI	D_USI	D_FRI	D_SPI	D_NEI	D_RUI
D_TUI	0.021400	0.46559	0.44352	0.43297	0.30226	0.47748	0.42678	0.44743	0.45907
D_GEI	0.46559	0.016351	0.83155	0.84820	0.57191	0.93635	0.82297	0.86038	0.57797
D_UKI	0.44352	0.83155	0.016331	0.84923	0.58930	0.87027	0.75598	0.77330	0.62444
D_ITCI	0.43297	0.84820	0.84923	0.019661	0.54393	0.88640	0.77403	0.76026	0.59859
D_USI	0.30226	0.57191	0.58930	0.54393	0.012438	0.59292	0.52075	0.55661	0.41638
D_FRI	0.47748	0.93635	0.87027	0.88640	0.59292	0.016185	0.84175	0.87129	0.60409
D_SPI	0.42678	0.82297	0.75598	0.77403	0.52075	0.84175	0.017292	0.76052	0.50722
D_NEI	0.44743	0.86038	0.77330	0.76026	0.55661	0.87129	0.76052	0.014949	0.53519
D_RUI	0.45907	0.57797	0.62444	0.59859	0.41638	0.60409	0.50722	0.53519	0.023801

Table 7.
Estimated unconditional volatility matrix

Since it is determined that the t-DCC model is the most suitable model for the Islamic stock indices, the following discussion is based on Table 6 and Table 7. The volatility parameters observed under t-DCC model are highly significant, with the estimates of λ_{1i}, $i = 1, 2, 3, 4, 5, 6, 7, 8, 9$ being very close to one, implying a gradual volatility decay, as can be seen in Table 7. This indicates that after a market shock, the riskiness associated with the returns may gradually cancel out. In addition, the sum of lambda1 and lambda2 for all Islamic stock indices (e.g. lambda_1GEI + lambda_2GEI = 0.98703) is equal to or less than 1. This suggests that after a market shock, the riskiness associated with the returns will gradually cancel out. In other words, the shock to the returns volatilities is temporary, not the Integrated Generalized Auto Regressive Conditional Heteroskedasticity (IGARCH). Investors and portfolio managers have a higher risk of losing their money, even though they will make a profit in the short term. Speculators and short-term investors, on the other hand, will profit from such market conditions.

The unconditional volatilities of the Islamic index returns are represented by the on-diagonals in Table 7. The index is said to be less volatile if the unconditional volatility is close to zero. On the other hand, unconditional volatility close to one means that the index is more volatile. In Table 8, the unconditional volatilities of Islamic indices are listed in an increasing order.

Islamic stock indices have low unconditional volatilities, varying between 0.012438 and 0.023801. However, they are nearly at the same level of volatility with that the returns of conventional stock indices in general. This contradicts with the claim that Islamic stock indices are more stable than conventional ones due to being more conservative in leverage levels. It is not surprising that the MSCI US Islamic index returns, like the conventional one, is the least volatile market in the group. It is noteworthy to say that Turkish Islamic stock indices are the second most volatile one after Russia, like the conventional ones.

Table 8. Unconditional volatilities of Islamic indices

Islamic index	Unconditional volatility
US	0.012438
Netherland	0.014949
France	0.016185
UK	0.016331
Germany	0.016351
Spain	0.017292
Italy	0.019661
Turkey	0.0214
Russia	0.023801

Table 9. Unconditional correlations between Islamic indices of Turkey and trading partners

Islamic index	Unconditional correlation
US	0.30226
Spain	0.42678
Italy	0.43297
UK	0.44352
Netherland	0.44743
Russia	0.45907
Germany	0.46559
France	0.47748

In Table 8, on the other hand, the off-diagonal elements represent the unconditional correlations between the Turkish Islamic index returns and Islamic index returns of its trading partners, which are listed in Table 9 in an increasing order. It is observed that the MSCI France Islamic index has the highest unconditional correlation with the MSCI Turkey Islamic index, being estimated at +0.47748 whereas the MSCI US Islamic index has the lowest unconditional correlation with the MSCI Turkey Islamic index. As a result, this finding indicates that Turkish Islamic equity investors would benefit from greater diversification if they invested in the US market instead of other trading partners.

4.2.2 Conditional volatilities of the islamic stock indices. The dynamic conditional volatilities for each conventional stock index return are shown in Figure 3. According to our findings, the conditional volatilities of the conventional stock indices follow nearly the same path. The lowest conditional volatility is witnessed on the MSCI US stock index returns; whereas the highest volatilities are recorded by the MSCI Russia and Turkey. Both findings are in compliance with the prior findings on unconditional volatilities in Table 8. Within the time interval of the study, the conditional volatilities increased to the highest level during the global financial crisis of 2008. Not surprisingly, the current pandemic caused the second highest peak of volatility in March 2020. In both cases, there was also a substantial convergence of volatility among all stock index returns during the crisis periods, which may be disadvantageous to investors and portfolio managers because it limits portfolio diversification options due to such great level of financial integration of the markets. At the end of 2011, there was also an apparent increase in the volatility of conventional stock indices, which can be related to the European sovereign debt crisis. This can be traced to the balance of payment crisis of Greece, Portugal, Ireland, Spain and Cyprus. At the end of 2014, the Russian equity market recorded a high returns volatility due to political tension with Ukraine. The European equity markets witnessed high volatility by the end of 2016, as a response to the events within the same year including Brexit uncertainty, The European Central Bank monetary policy decisions to battle deflation in Eurozone, the US presidential election and Prime Minister Matteo Renzi's resignation following a "no" result in Italy's historic constitutional referendum (Li, 2020). On the other hand, The Turkish equity market spotted a substantial volatility increase in 2013 due to Gezi protests and in 2018 due to currency crisis.

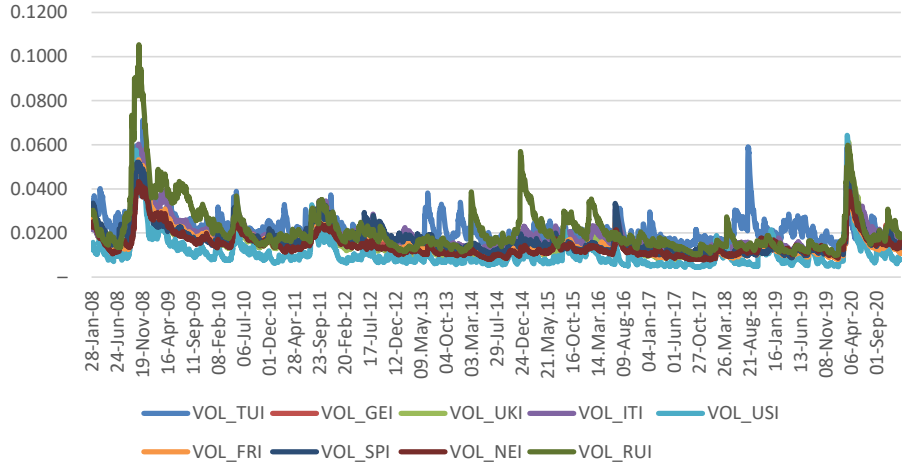

Figure 3.
Conditional volatilities of Islamic indices

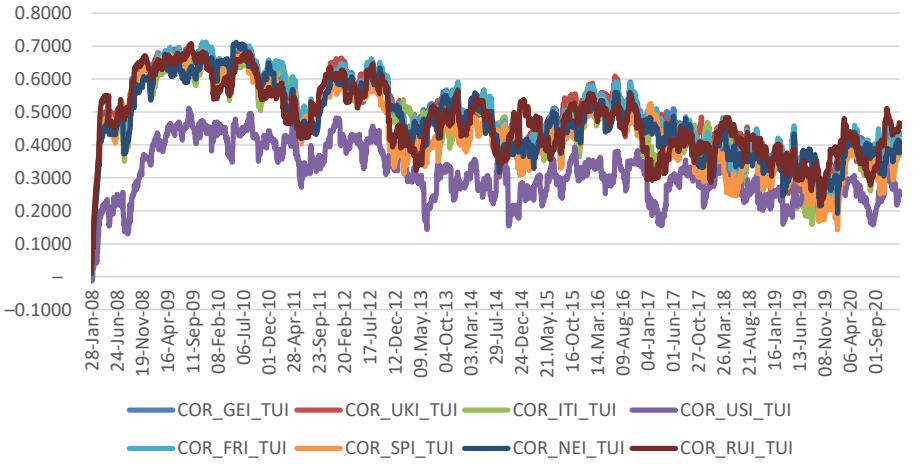

Figure 4.
Conditional correlations of Islamic indices of Turkey and trading partners

4.2.3 Conditional correlations of Islamic Indices. The conditional correlations of Turkey's trading partners' Islamic stock index return with the MSCI Turkey Islamic index returns are shown in Figure 4. The plot indicates that the return correlations of the Turkish Islamic stock index with its trading partners, except the USA, seems to move quite closely together, especially during turmoil times including the 2008 global financial crisis and Covid-19 outbreak. Moreover, the graph confirms the previous results of the unconditional correlations in Table 9, showing that the Turkish Islamic stock index has more or less the same level of correlation with the Germany, France, the Netherlands, the UK, Russia, Spain and Italy. The Islamic market returns is less correlated to the US Islamic stock index returns. From here, it can be suggested that if the Turkey-based Islamic equity investors were to invest their assets internationally; they should include the US Islamic stock index in their portfolio in order to gain more diversification benefits as compared to other trading partners Islamic stock indices.

5. Conclusion

This research aims to help Turkish equity investors identify potential portfolio diversification benefits by examining DCCs between Turkish stock index returns and the returns of the major trading partner countries. The study is undertaken from two perspectives: Turkey-based conventional equity investors and Turkey-based Islamic equity investors. The multivariate GARCH-DCC is used to evaluate the time-varying links between major trading partners' stock index returns.

The t-distribution model appears to fit better for capturing the fat-tailed nature of the distribution of both conventional and Islamic stock index returns, according to ML tests. The time-varying conditional volatility parameters of conventional and Islamic MSCI stock indices are found to be highly significant under the t-DCC model. This indicates that the shocks to the returns volatilities are not permanent, meaning that the riskiness associated with the stock returns may gradually diminish.

Furthermore, the analysis discovered that the most significant increases in conditional volatilities of both conventional and Islamic MSCI stock index returns occurred during the global financial crisis of 2008 and Covid-19 outbreak. In both cases, there seems a high level of convergence between worldwide stock markets, indicating a high level of market integration that may reduce diversification benefits for international investors.

The Turkish and Russian conventional and Islamic indices are recorded as the most volatile indices amongst the countries in the scope of this study. Contradicting to the claim that *Shariah* screening (the prohibition of usury, excessive uncertainty and gambling) makes Islamic equities offer Less risk, it is witnessed that Islamic stock indices follow a similar volatility path with its conventional counterparts. On the contrary, the same is not valid regarding correlations. It is observed that Islamic indices indicate less correlation compared to conventional indices with trading partners. The time-varying conditional volatility parameters of conventional and Islamic MSCI stock indices provided that the lowest correlation exists between the USA and Turkey. This implies that both the conventional and Islamic MSCI indices of the USA provide more diversification benefits compared to Germany, France, the Netherlands, the UK, Spain, Italy and Russia.

There are numerous significant implications for the Turkey-based equity investors, fund managers and policy makers in this study. The findings of this paper may have several significant implications for the Turkey-based equity investors and fund managers looking to better understand return correlations between the Turkish stock index and the world's largest stock market indices in order to increase risk-adjusted returns through portfolio diversification. The findings on market shocks and the level of the Turkish market's interaction with cross-border markets may provide some beneficial insights into creating efficient macroeconomic stabilization strategies to avert a contagion effect in the domestic economy. Furthermore, the findings of the time-varying comovements between these market returns may provide some useful information about the exchange rate risks that multinational firms face, thereby supporting their managers in developing their own internal control and risk management policies.

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