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VOLATILITY TRANSMISSION BETWEEN US ECONOMIC POLICY UNCERTAINTY AND BIST (BORSA ISTANBUL) MAJOR SECTOR INDICES

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ABSTRACT

The significant effects of global economic policy uncertainties on world markets have been revealed in the related literature recently. The primary purpose of this study is to examine the volatility interaction (the causality in variance relationship) between uncertainty in US economic policies and BIST (Borsa Istanbul) major sector indices (financial, industrial, and technology indices). To satisfy this purpose, the causality in variance approach proposed by Hafner and Herwartz (2006) is utilized. The findings of the implemented volatility model show that the US economic policy uncertainty and BIST (Borsa Istanbul) major sector indices are strongly influenced by long-term volatility. According to the main findings of the causality invariance test, it is observed that there are significant and robust volatility transmissions from the US economic policy uncertainty to the BIST significant sector returns (financial, industrial, and technology sector returns). The test findings indicate that the BIST significant sector returns are quite sensitive to shocks in the US economic policy uncertainty. The results of the analysis present considerable implications for market participants in terms of developing effective economic policies and constructing optimal portfolios.

Keywords:

Volatility Interaction

US Economic Policy Uncertainty

BIST Major Sector Indices

JEL Codes:

C58, D81, G11

ABD EKONOMİ POLİTİKALARINDAKİ BELİRSİZLİK VE BIST (BORSA İSTANBUL) ANA SEKTÖR ENDEKSLERİ ARASINDAKİ VOLATİLİTE GEÇİŞKENLİĞİ

ÖZ

Son zamanlarda global ekonomi politikalarındaki belirsizliklerin dünya piyasaları üzerindeki önemli etkileri ilgili literatürde ortaya konmuştur. Bu çalışmanın temel amacı ABD ekonomi politikalarındaki belirsizlik ve BIST (Borsa İstanbul) ana sektör endeksleri (mali, sınai ve teknoloji endeksleri) arasındaki volatilite etkileşimini (varyansta nedensellik ilişkisini) incelemektir. Bu amacı gerçekleştirmek için, Hafner ve Herwartz (2006) tarafından önerilen varyansta nedensellik metodu kullanılmıştır. Uygulanan volatilite modelinin bulguları, ABD ekonomi politikası belirsizlik ve BIST (Borsa İstanbul) ana sektör endekslerinin uzun vadeli volatiliteden güçlü bir şekilde etkilendiğini göstermektedir. Varyansta nedensellik testi ana bulgularına göre, ABD ekonomi politikası belirsizlik endeksinden BIST ana sektör endeksleri (mali, sınai ve teknoloji endeksleri) getirilerine doğru önemli ve güçlü volatilite geçişkenlikleri olduğu gözlemlenmiştir. Test bulguları BIST ana sektör endeks getirilerinin ABD ekonomi politikası belirsizliğindeki şoklara oldukça duyarlı olduğunu göstermektedir. Analiz sonuçları etkin ekonomi politikaları geliştirme ve optimum portföyler oluşturma açısından piyasa katılımcıları için dikkate değer çıkarımlar sunmaktadır.

Anahtar Kelimeler:

Volatilite Etkileşimi

ABD Ekonomi Politikası Belirsizliği

BIST Ana Sektör Endeksleri

JEL Kodları:

C58, D81, G11

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1. INTRODUCTION

Global investors should try to understand the risk-return behaviour of assets in developed and/or emerging markets as they are deciding to invest in global markets. Dynamic interactions between global markets have increased drastically during the last decades, along with increased financial liberalization of countries. These interactions have resulted in that the developed (low-risk markets) and emerging (high-risk markets) markets are being similarly influenced by shocks in international markets. Macroeconomic uncertainty is a potential factor that affects the asset allocations of international investors. In this respect, one of the most critical factors affecting investors' risk appetite in international markets is the uncertainty in the economic policies of developed countries (e.g. USA), which plays a crucial role in determining the relations between asset markets (Baker et al., 2016). In consideration of all the above information, it is essential to examine how assets in global markets are affected by US economic policy uncertainty, especially when examining the investment potential of risky emerging markets.

It is tough to measure the risks arising from uncertainty. The main reason for this is the difficulty in evaluating the probabilities of possible events (Ellsberg, 1961). As Ellsberg (1961) emphasizes, individuals' decisions are strongly influenced by both the source and degree of uncertainty. People are inclined to avoid ambiguous conditions due to less knowledge of the occurrence probabilities of these conditions. The primary reason behind this avoidance is that it is almost impossible to assess the possible conditions (Knight, 1921) accurately. The impact of uncertainty on financial markets has been a matter of scholarly concern in recent times since global portfolio structures are seriously affected by macroeconomic uncertainty. To hedge uncertainty in global economic conditions, dynamic learning strategies should be taken into consideration by market participants (Xia, 2001). Following the bad news, the adverse effect of uncertain conditions on asset returns has a significant impact on the asset allocations of investors (Zhang, 2006). In particular, emerging market portfolios, including risky assets, are expected to be more strongly affected by uncertainty shocks in global economies.

There are several sources of uncertainties in global markets. Among these sources, recent studies indicate that uncertainties in global economic policies have essential effects on macroeconomic indicators (Baker et al., 2016; Caggiano et al., 2020). Given the leading role of the US markets on the asset price discovery process, it could be argued that the uncertainties in the US economic policies are of critical importance on the business and economic conditions of other countries. Various studies have revealed significant evidence to support this claim (see Caggiano et al., 2020). Due to the potential effects of the uncertainties in US economic policies on the real activity of other countries, it is inevitable to see the reflections of these effects on the financial markets. The effects of uncertainty shocks in US economic policies are significant for investors trading especially in risky markets (e.g. the stock markets of emerging economies). The fragile economies of developing countries make their markets more vulnerable to these uncertainty shocks. In this respect, a better understanding of the movements of emerging markets requires the consideration of uncertainty shocks in US economic policies.

Traditional finance theories claim that higher returns with less risk can be achieved by constructing diversified portfolios, including weakly correlated assets (Markowitz, 1952). On a global scale, to create these diversified portfolios, global investors concentrate on reducing systematic risks that cannot be eliminated in the domestic markets and on obtaining substantial returns with this diversification strategy (Solnik, 1974). However, with increasing globalization, it has become quite difficult to find markets with low correlations and to create portfolios with low risk and high return in these markets (Aloui et al., 2011). Due to the leading role of the US economy affecting world markets, the risks and uncertainties in the US economy are considered necessary, especially for emerging countries that need to have a hot money flow from abroad. During recession periods, when uncertainty increases in global economies, the significant increases in the volatility of risky markets (such as stock markets) of high-risk developing countries are observed (Bloom, 2014). When considering this fact, uncertainties in US economic policies are expected to alter the hedging strategies of investors significantly, and hence their portfolio structures across global markets. Based on this expectation, to invest in a risky emerging market

(e.g. Turkish stock market), the impact of US economic policy uncertainty on this market should be investigated.

To invest in a particular stock market, it is crucial to evaluate the investment potential of assets with different risk characteristics within that market. Taking into account the various fundamental characteristics of assets, some indices consisting of assets traded in developed and/or developing economies have been constructed. Among these indices, some of the most important ones are major sector indices (e.g. industrial, financial, and technology indices). In this regard, in global stock markets, the performance of sector indices attracts great attention of investors. Major sector indices offer excellent opportunities to diversify international portfolios depending on their different risk characteristics. To correctly evaluate these opportunities, it is necessary to examine whether significant sector indices are affected by uncertainties in the global economy (e.g. US economic policy uncertainty).

There are a few studies on the link between the global economic policy uncertainty and BIST sector indices (e.g. Korkmaz and Güngör, 2018; Sadeghzadeh and Aksu, 2020; Tiryaki and Tiryaki, 2019). More specifically, there has been no study examining volatility transmissions between the US economic policy uncertainty and BIST primary sector indices. To fill an information gap in the related literature, the primary purpose of this study is to investigate whether volatility spillovers exist from the US economic policy uncertainty to the significant sector indices (financial, industrial, and technology sector indices) in the Turkish stock market. To this end, the causality-in-variance test proposed by Hafner and Herwartz (2006) is utilized due to its various superiorities over other similar methods. The results of the analyses provide implications about how increasing globalization influences BIST major sector indices via the changes in the US economic policy uncertainty.

2. LITERATURE REVIEW

To assess the investment potential of the Turkish stock market, various studies applying different approaches have been conducted. Some of these studies focus on indices including a significant portion of the assets in the Turkish stock market and

hence these indices represent the aggregate market (e.g. Kocaarslan et al., 2017; Küçükkaya, 2009). This study, instead of using an index representing the aggregate market, as mentioned in the introduction, uses the major sector indices consisting of assets with different risk characteristics (financial, industrial, and technology indices). The financial sector index returns are strongly influenced by the developments in the global markets because financial institutions provide the primary source of funding across global markets (Akkaya and Sarı, 2019). A similar effect can be observed in the industrial sector index due to the critical role of fluctuations in global markets on export and import dynamics (Eyüboğlu and Eyüboğlu, 2016). Also, the returns of technology stocks are significantly affected by the excessive reactions of investors in times of high volatility and uncertainty (Barberis et al., 1998; Barberis and Thaler, 2003; Wilkens et al., 2004). In light of this information, this study examines the sensitivity of the leading sector indices in the Turkish stock market to the uncertainty in US economic policies.

Several studies in the literature have concentrated on the volatility transmissions between major sector indices in the Turkish stock market. Using Exponential Generalized Autoregressive Conditional Heteroskedastic (EGARCH) model, Duran and Şahin (2006) obtain the conditional variances of leading sector indices. Then, utilizing Vector Autoregressive (VAR) model, they find volatility interactions between these indices. Tokat (2010) investigates volatility transmissions between industrial, technology, financial, and service sector indices by employing a multivariate GARCH model and daily data. The findings of this study show significant volatility spillovers between service & technology sector indices and between industrial & financial sector indices. Kamışlı et al. (2016) use the causality invariance test proposed by Hafner ve Herwartz (2006) and demonstrate that there is a volatility spillover effect from the industrial sector index to service and financial sector indices. They also find evidence of one-way volatility spillover effect from the service sector index to the financial sector index. Kamışlı and Sevil (2018) employ the dynamic conditional correlation (DCC-GARCH) model and focus on relations between sub-sector indices. Their results indicate that essential developments in global markets have a significant impact on volatility transmissions between sub-

sector indices. Kocaarslan (2020) utilizes the causality invariance test, as in the study of Kamışlı et al. (2016), and finds volatility spillover effect from technology index to other major sector indices (financial, service and industrial sector indices).

The other strand of the related literature focuses on the cointegrating and causality relationships between major sector indices in the Turkish stock market. Berument et al. (2005) use various models suggested by Engle and Granger (1987) and Johansen (1988) and find no evidence of the cointegrating relationship between BIST Industrial, BIST Service ve BIST Financial indices. Yüksel and Güleryüz (2010) examine asymmetric and symmetric cointegration relations between BIST100, BIST financial, BIST service, BIST technology ve BIST industrial indices using the threshold autoregressive (TAR) and momentum-TAR models proposed by Enders and Siklos (2001) and the Engle-Granger (1987) cointegration method. Their results show that there is no statistically significant relation between BIST financial, BIST service, BIST industrial, and BIST technology indices in the short- and long-term. Eyüboğlu and Eyüboğlu (2019) investigate the relationships between BIST Technology, BIST Financial, BIST Service ve BIST Industrial indices by using the Johansen (1988) cointegration and Granger (1969) causality tests. In that study, they use both weekly and daily data and concentrate on the period between 2014-2017. The findings of their analysis indicate no cointegrating and causality relationships between these indices. Overall assessment on the cointegrating and causality relationships between the significant sector indices in the Turkish stock market suggests that there are diversification opportunities across BIST sector indices.

As mentioned above, this study aims to examine volatility transmissions between the US economic policy uncertainty and the primary sector indices (financial, industrial, and technology sector indices) in the Turkish stock market. Korkmaz and Güngör (2018) investigate the impact of global economic policy uncertainty on some sector indices in the Turkish stock market. Their analysis reveals the considerable impact of global economic policy uncertainty on BIST-Electric, BIST-Plastic, BIST-Petroleum, BIST-Chemical, and BIST-Metal indices. Using the autoregressive distributed lag (ARDL) model and a nonlinear extension of this model (NARDL), Sadeghzadeh and Aksu (2020) find an asymmetric relationship between

global economic policy uncertainty and BIST100 index and this relationship points out the adverse impact of an increase in global economic policy uncertainty on the assets in the Turkish stock market. Tiryaki and Tiryaki (2019) show the negative impacts of US economic policy uncertainty on the Turkish stock returns in the long-run utilizing the ARDL model. As seen in the related studies above, there has been no study investigating the causality invariance (volatility transmission) between US economic policy uncertainty and BIST primary sector indices (financial, industrial, and technology sector indices). This study aims to fill this vital gap in the relevant literature.

3. DATA SOURCES AND CHARACTERISTICS

The used data set contains the daily closing prices of the three major sector indices (financial, industrial, and technology sector indices) in the Turkish stock market and the daily changes in the US economic policy uncertainty. The sector indices data are sourced from the "investing.com" web site. To track the changes in the US economic policy uncertainty, this study uses the US economic policy uncertainty index developed by Baker et al. (2016)[2]. The sample period ranges from January 4, 2011, to April 30, 2020. This study focuses on the post-crisis period due to the changing investor perceptions (the observed lower risk avoidance) after the global economic crisis (2008) (Hoffmann et al., 2013). In our empirical examination, the first differences of the logarithm of the related indices are used for the returns of the three major sector indices and the changes in the US economic policy uncertainty.

Table 1 presents the descriptive statistics of the related indices. The obtained statistics show excess kurtosis for the used data set. According to the Jarque–Bera statistics (rejecting the null hypothesis of normality), the user data are not normally distributed. Also, the statistics indicate that the US economic policy uncertainty index has a higher standard deviation (hence higher volatility) than the returns of the three major sector indices in the Turkish stock market.

[2] The US economic policy uncertainty index is publicly available on https://www.policyuncertainty.com/

Table 1. Descriptive Statistics of the Data

	DLFIN	DLIND	DLTEC	DLEPU
Mean	3.16E-05	3.74E-04	0.000839	0.000416
Median	0.000379	0.001239	0.001265	-0.008427
Maximum	0.148959	0.063099	0.093636	3.215618
Minimum	-0.127754	-0.11401	-0.151518	-3.370102
Std. Dev.	0.017605	0.012523	0.018344	0.51339
Skewness	-0.309148	-1.132208	-0.657574	0.050067
Kurtosis	8.639505	11.02332	9.78602	5.660199
Jarque-Bera	3150.2350	6802.4340	4676.4360	693.6094
Probability	0.0000	0.0000	0.0000	0.0000

Note: Table 1 reports the descriptive statistics of the data. L and D represent the log operators and first difference, respectively. DLFIN, DLIND, DLTEC, and DLEPU refer to the daily returns of the three major sector indexes (BIST Financial, BIST Industrial, and BIST Technology) and the changes in the US economic policy uncertainty index, respectively.

Figure 1 indicates the evolution of the returns of the three major sector indices and the changes in the US economic policy uncertainty over the used period. In this figure, the observed volatility clustering motivates the use of the GARCH approaches to examine the volatility spillovers between the three major sector indices in the Turkish stock market (BIST Financial, BIST Industrial, and BIST Technology indices) and US economic policy uncertainty.

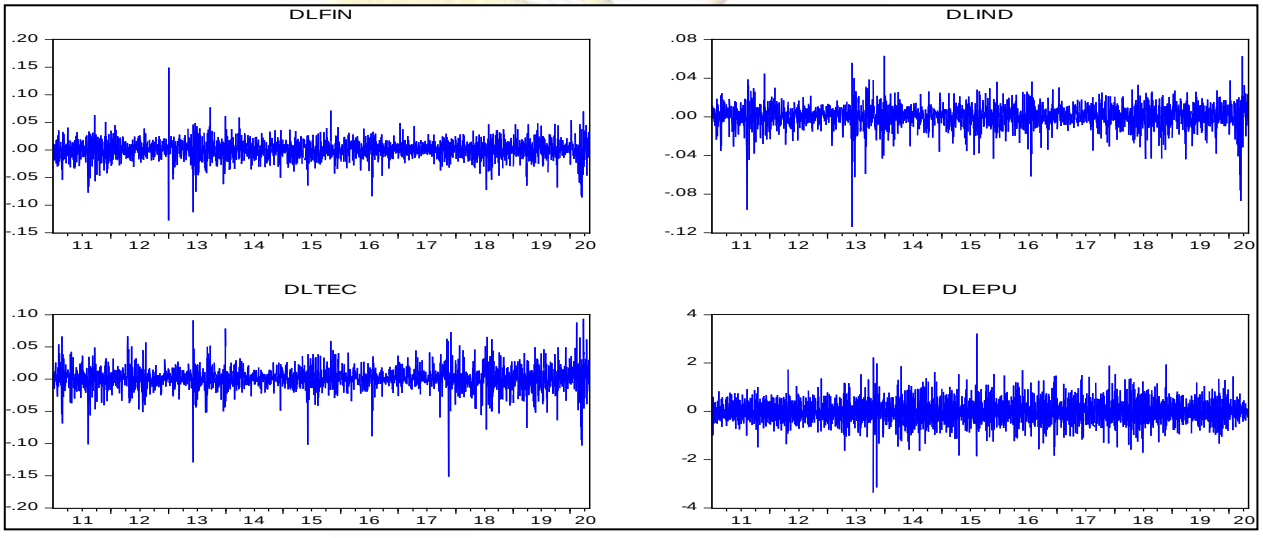

Figure 1. Evolution of the Changes of the Related Indices over the Test Period

Note: L and D represent the log operators and first difference, respectively. DLFIN, DLIND, DLTEC, and DLEPU refer to the daily returns of the three major sector indexes (BIST Financial, BIST Industrial, and BIST Technology) and the changes in the US economic policy uncertainty index, respectively.

The causality-in-variance analysis requires that all used variables should be stationary. To satisfy this stationarity requirement, this paper utilizes the Modified Augmented Dickey-Fuller (MADF) test (Kim and Perron, 2009). The MADF test is

carried out to account for a structural breakpoint. An intercept and both intercept and trend are considered in the test procedure. Table 2 presents the unit root test findings. The findings indicate that all variables are stationary.

Table 2. Unit Root Test Findings

		MADF Statistics		MADF Statistics
Variables				
DLFIN	Intercept	-51.56396***	Intercept	-51.55206***
DLIND		-32.15066***	and Trend	-32.14938***
DLTEC		-48.94481***		-49.02466***
DLEPU		-25.30075***		-25.31515***

Note: L and D represent the log operators and first difference, respectively. DLFIN, DLIND, DLTEC, and DLEPU refer to the daily returns of the three major sector indexes (BIST Financial, BIST Industrial, and BIST Technology) and the daily changes in US economic policy uncertainty index, respectively. MADF refers to the Modified Augmented Dickey-Fuller (MADF) unit root test. *** Significant at the 1% level.

4. ECONOMETRIC TECHNIQUE

The primary purpose of this paper is to examine the volatility linkages between the three major sector indices in the Turkish stock market (BIST Financial, BIST Industrial and BIST Technology indices) and US economic policy uncertainty index. This examination helps to understand better volatility transmission between assets in the Turkish stock market and US economic policy uncertainty. The critical role of US economic policies in international markets is of great importance for the investment decisions of investors. Depending on the uncertainty in US economic policies, the changing asset allocation decisions of global investors affect the risk characteristics of assets in emerging markets (e.g. Turkish stock market) over time.

The causality-in-variance (volatility spillover) analyses proposed by Hong (2001) and Cheung and Ng (1996) are grounded on the cross-correlation function principle. This paper utilizes the causality-in-variance test proposed by Hafner and Herwartz (2006). This analysis is built on the Lagrange Multiplier (LM) principle. The use of the causality-in-variance test eliminates various significant problems (e.g. a high-sensitivity to the order of leads and lags and significant oversizing in the presence of leptokurtic volatility process for small samples) that other volatility spillover tests have. In the first step of the analysis, the estimation of univariate GARCH models is conducted to describe the variations in the conditional variances

and means. A traditional GARCH model (Bollerslev, 1986) is employed for the conditional variances. The AR(1) autoregressive terms are considered to account for the effect of lagged information on the three major sector indices in the Turkish stock market (BIST Financial, BIST Industrial and BIST Technology indices) and US economic policy uncertainty index in the mean equation. This specification also may help to mitigate the serial correlation problem in time series. The specified mean and variance equations are shown as follows, respectively:

$$R_t = \mu + AR(1) + \varepsilon_t \quad (1)$$

$$\sigma_t^2 = \omega + \alpha\varepsilon_{t-1}^2 + \beta\sigma_{t-1}^2 \quad (2)$$

R_t represents the daily returns of the three major sector indices and the changes in US economic policy uncertainty index. AR(1) refers to the lagged index returns (the lagged returns of the three major sector indices and the lagged changes in the US economic policy uncertainty index). The α (ARCH parameter) shows the impact of previous shocks on current conditional variances while the β (GARCH parameter) shows the impact of previous conditional variances on current conditional variances. The sum of these parameters (β +α) points out the persistence of the variance series. To check for stationarity and stability, various constraints ($\alpha \geq 0$; $\alpha + \beta < 1$; $\omega > 0$; $\beta \geq 0$) should be met for the used model.

Second, the below null hypothesis of no causality in variance between the three major sector indices (financial, industrial, and technology indices) (series i) and US economic policy uncertainty index (series j) is tested.

$$H_0: \mathrm{Var}\left(\varepsilon_{it} \mid F_{t-1}^{(j)}\right) = \mathrm{Var}\left(\varepsilon_{it} \mid F_{t-1}\right) \; j = 1, \ldots, N, i \neq j, \quad (3)$$

where $F_t^{(j)} = F_t/\sigma(\varepsilon_{j\tau}, \tau \leq t)$ and ε_{it} refers to the residuals obtained from the GARCH models. To test the null hypothesis, the following equation is used:

$$\varepsilon_{it} = \xi_{it}\sqrt{\sigma_{it}^2(1 + z_{jt}'\pi)}, \; z_{jt} = (\varepsilon_{jt-1}^2, \sigma_{jt-1}^2)', \quad (4)$$

ξ_{it} and σ_{it}^2 refer to the standardized residuals and the conditional variance (conditional volatility) for the series i, respectively, while ε_{jt-1}^2 and σ_{jt-1}^2 refer to the squared standardized residuals and the conditional variance (conditional volatility)

for the series j, respectively. The null hypothesis of no causality invariance (H_0: $\pi = 0$) is tested against the alternative hypothesis (H_1: $\pi \neq 0$), stating the presence of the causality invariance. The score of the Gaussian log-likelihood function of ε_{it} is obtained by $x_{it}(\xi_{it-1}^2)/2$, where the derivatives refer to $x_{it} = \sigma_{it}^{-2}\,(\partial\sigma_{it}^2/\partial\theta_i)$, $\theta_i = (\omega_i, \alpha_i, \beta_i)'$. Hafner and Herwartz (2006) propose the below Lagrange-multiplier (LM) test to examine volatility linkages between the relevant variables.

$$\lambda_{LM} = \frac{1}{4T}\left(\sum_{t=1}^{T}\left(\xi_{it}^2 - 1\right) z'_{jt}\right) V(\theta_i)^{-1} \left(\sum_{t=1}^{T}\left(\xi_{it}^2 - 1\right) z_{jt}\right), \quad (5)$$

Where,

$$V(\theta_i) = \frac{K}{4T}\left(\sum_{t=1}^{T} z_{jt}\, z'_{jt} - \sum_{t=1}^{T} z_{jt}\, x'_{it} \left(\sum_{t=1}^{T} x_{it}\, x'_{it}\right)^{-1} \sum_{t=1}^{T} x_{it}\, z'_{jt}\right),$$

$$K = \frac{1}{T}\left(\sum_{t=1}^{T}\left(\xi_{it}^2 - 1\right)^2\right)$$

The asymptotic distribution of the test statistic λ_{LM} in Eq. (5) depends on the number of misspecification indicators in z_{jt}. The presence of two misspecification indicators in λ_{LM} equation necessitates that an asymptotic chi-square distribution with two degrees of freedom needs to be obtained for the applied model. The rejection of the null hypothesis indicates that there is a volatility transmission from series j to series i. One can apply a similar test procedure to uncover the volatility transmission from series i to series j.

5. EMPIRICAL FINDINGS

To correctly follow the test procedure, the estimates of univariate GARCH models are first conducted to describe the volatility characteristics of the three major sector indices in the Turkish stock market (BIST Financial, BIST Industrial, and BIST Technology indices) and US economic policy uncertainty index. Tables 3 and 4 reports the estimates of the GARCH (1,1) models, for the mean and variance equations, respectively. For a rigorous analysis, the testing of the stability conditions ($\alpha \geq 0$; $\alpha + \beta < 1$; $\omega > 0$; $\beta \geq 0$) is necessary. The presented findings in Table 4 suggest no stability problem concerning the used models. As seen in the reported findings for the mean equation in Table 3, a significant AR(1) term for US economic policy uncertainty means that lagged changes in US economic policy uncertainty negatively

affect its current changes. The significant parameters for the variance equations presented in Table 4 show the presence of conditional heteroscedasticity for the three major sector indices in the Turkish stock market (BIST Financial, BIST Industrial, and BIST Technology indices) and US economic policy uncertainty index. The higher long-run (GARCH) effects than the short-run (ARCH) effects show the strong effect of long-run volatility on the three major sector indices and US economic policy uncertainty index.

Table 3. Mean Equation Estimates

Independent Variables	Dependent Variables			
	DLFIN	DLIND	DLTEC	DLEPU
Constant	0.000363	0.000927***	0.000824	0.002995
AR(1)	-0.02305	0.028332	0.021935	-0.412022***

Note: Table 3 reports the mean equation estimates for the time series. L and D represent the log operators and first difference, respectively. DLFIN, DLIND, DLTEC, and DLEPU refer to the daily returns of the three major sector indexes (BIST Financial, BIST Industrial, and BIST Technology) and the daily changes in US economic policy uncertainty index, respectively. Dependent variables are the DLFIN, DLIND, DLTEC, and DLEPU. AR(1) term refers to the lagged changes independent variables. *** Significant at the 1% level.

Table 4. Variance Equation Estimates

Dependent Variables	Model	ω	α	β
DLFIN	GARCH(1,1)	2.73E-05***	0.077737***	0.832636***
DLIND	GARCH(1,1)	1.49E-05***	0.162447***	0.748609***
DLTEC	GARCH(1,1)	0.000219***	0.150000***	0.600000***
DLEPU	GARCH(1,1)	0.031907***	0.102134***	0.754145***

Note: Table 4 reports the variance equation estimates for the time series. β and α represent the GARCH and ARCH parameters, respectively. *** Significant at the 1% level.

The determined higher long-run volatility encourages one to test volatility transmission between the three major sector indices and US economic policy uncertainty index. Table 5 shows the LM test statistics (volatility spillover test results) to evaluate the volatility spillover effect from US economic policy uncertainty to the three significant sector returns (BIST Financial, BIST Industrial, and BIST Technology sector returns). The results reported in Table 5 show a significant one-way volatility spillover effect from US economic policy uncertainty to the three significant sector returns. These findings suggest the high vulnerability of the three major sector indices (BIST Financial, BIST Industrial, and BIST Technology) to fluctuations in US economic policy uncertainty.

Table 5. LM Test Statistics (Causality in Variance Test Results)

	DLFIN	DLIND	DLTEC	DLEPU
DLFIN				11.94759***
DLIND				7.827838**
DLTEC				10.11166***
DLEPU	3.97724	5.106299	3.274562	

Note: Table 5 reports volatility spillover (causality invariance) test results. L and D represent the log operators and first difference, respectively. DLFIN, DLIND, DLTEC, and DLEPU refer to the daily returns of the three major sector indexes (BIST Financial, BIST Industrial, and BIST Technology) and the daily changes in US economic policy uncertainty index, respectively. Significance shows Granger causality in variance running from column variable to row variable. ** Significant at the 5 percent level; ***significant at the 1 percent level.

6. DISCUSSION

As explained in the preceding sections, this paper aims to explore volatility spillovers between the three major sector indices in the Turkish stock market and US economic policy uncertainty. The primary motivation behind this investigation is that increasing US economic policy uncertainty may have a huge and negative impact on real global activity and hence on global financial markets during high volatile periods. The three major sector indices in the Turkish stock market ((BIST Financial, BIST Industrial, and BIST Technology indices) appear to be highly vulnerable to an increase in US economic policy uncertainty. This finding supports the view that intensified US economic policy uncertainty adversely affects the riskiness of investments in the Turkish stock market, regardless of the sector of investment. In other words, the attractiveness of assets in the Turkish stock market significantly changes depending on the fluctuations in US economic policy uncertainty.

Our findings indicate that there is a significant volatility spillover from uncertainty in the US economic policy to the BIST Financial sector index (the considerable effect of deep uncertainty in the US economic policy on the riskiness of the assets in the BIST Financial sector index). The stock performance of financial companies can be considered to be a critical indicator for the Turkish economy since stocks in BIST Financial sector index consist of a significant portion of the market capitalization of Borsa Istanbul (BIST). As mentioned above, US markets play a critical role in world markets. Therefore, it is inevitable that enhanced concerns about uncertainties in US economic policy can potentially have adverse effects on the real

activity in developing countries. When considering these facts, these adverse effects are expected to increase the riskiness of the stocks of the financial companies, which are greatly affected by the adverse developments in the real sector. Our results support this expectation.

This study also finds causality in variance running from US economic policy uncertainty to the BIST Industrial index. The performance of the industrial sector largely depends on the number of exports. Furthermore, the majority of industrial companies import a significant amount of the raw materials used in production. In this respect, an increase in the US economic policy uncertainty may potentially have a significant impact on the world economy via adverse effects on the world trade pattern. This economic transmission mechanism negatively influences the cash flows of industrial companies and thus, the risk level of the stocks of these companies. Based on the above arguments, it is not surprising that an increase in US economic policy uncertainty enhances the riskiness of the industrial sector stocks in the Turkish stock market.

As for the effect of US economic policy uncertainty on the BIST Technology index, a significant volatility spillover effect is observed from US economic policy uncertainty to the BIST Technology index. During high-uncertainty periods, the stocks of technology companies with high price/earnings ratios are seriously influenced by the possible cyclical developments in the overall economy. The reason behind this effect is the excessive reactions of investors due to changing expectations on the earnings of these companies (Sadorsky, 2003). Therefore, the high volatility of these stocks is frequently observed in tough times. In light of this information, the stocks of technology companies appear to be highly speculative investments with high-volatility in uncertain times. Accordingly, the level of US economic policy uncertainty is of enormous importance in determining the risk level of the technology stocks in the Turkish stock market.

7. CONCLUSION

Historically, many economies in the world have suffered from financial contagion from the US in times of economic crisis, as happened in the global financial

crisis (2008). Given the leading role of the US economy, it can be argued that global markets are strongly and negatively influenced by the US-based economic policy uncertainty. Thus, it is quite valuable to investigate the volatility spillover effect from US economic policy uncertainty to asset returns in global markets for determining optimal investment and hedging strategies. To fill an information gap in the relevant literature, this study aims to explore the extent to which US economic policy uncertainty shocks are transmitted to the three significant sector indices returns in the Turkish stock market. To satisfy this purpose, in this study, volatility transmissions between US economic policy uncertainty and the three major sector indices (BIST Industrial, BIST Technology, and BIST Financial indices) are uncovered by using a causality invariance test proposed by Hafner and Herwartz (2006).

The baseline results indicate that there is a significant one-way volatility spillover effect from US economic policy uncertainty to the three major sector indices in the Turkish stock market. From a perspective of investment strategies, it appears that deep uncertainty in US economic policy crucially increases the riskiness of assets in the Turkish stock market irrespective of the sector of investment. The findings imply that US economic policy uncertainty shocks strongly reduce the diversification capacity of investments in the Turkish stock market. This implication is of paramount importance for determining optimal risk management strategies in the Turkish market. Also, the findings have great importance in implementing sound economic policies. The increased US economic policy uncertainty negatively affects global macroeconomic performance through its adverse impacts on global investment, employment, and output growth, eventually which leads to increased stock price volatility in global markets (Baker et al., 2016). That is why economic policymakers in Turkey should foster timely and predictable policy responses to mitigate the adverse effects of US economic policy uncertainty shocks on the volatility of assets in the Turkish stock market.

Future studies might concentrate on other dimensions of economic policy uncertainty (e.g. monetary policy uncertainty and fiscal policy uncertainty) to investigate volatility transmissions between the related uncertainties and major sector indices in developed and/or developing markets. The volatility spillover

effects from economic policy uncertainty indices to some thematic indices in global markets might also be further investigated.

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