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THE EXTENT OF SPILLOVERS FROM SECTORIAL INDICES TO THE BORSA ISTANBUL SUSTAINABILITY INDEX: EVIDENCE FROM VARIOUS QUANTILES

SEKTÖREL ENDEKSLERDEN BORSA İSTANBUL SÜRDÜRÜLEBİLİRLİK ENDEKSİNE YAYILMA ETKİLERİNİN BÜYÜKLÜĞÜ: FARKLI KANTİLLERDEN KANITLAR

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Abstract: *In this study, the return spillovers from sectorial indices to the BIST Sustainability Index (SRD) are investigated to present evidence for equity markets from a sectorial perspective. The aim of the study is to present compelling evidence for equity markets, taking a sectorial perspective into account. By examining the contributions from each sector, an attempt is made to shed light on the extent of their influence and provide empirical evidence to assist policy makers in formulating incentives and measures necessary for fostering future and more sustainable markets. Empirical analyses are conducted through a Quantile VAR analysis* at a given conditional quantile. *In this regard, 22 sectors from Borsa Istanbul are examined, and evidence is presented from three quantiles: extreme lower, median, and extreme upper quantiles. The major contributors to the return spillovers in these quantiles are found as ILTM and BANK sectors. Nevertheless, the GMYO sector comes to the fore and replaces the role of the BANK sector in the median quantile. Finally, results suggest that systematic risk is another rigorous element in transmitting returns toward the SRD index, especially during high market volatility led by the BANK sector. Thus, it is concluded that policies that mitigate the systematic risk exposure in the banking sector may enhance the stability of the SRD index.*

Keywords: *Sustainability, Emerging Markets, Borsa Istanbul Sectors, Quantile Connectedness.*

JEL: G10, C32, Q50

Öz: Bu çalışmada, sektörel endekslerden BIST Sürdürülebilirlik Endeksi'ne (SRD) olan getiri yayılmaları sektörel bir bakış açısıyla incelenerek hisse senedi piyasaları üzerindeki etkileri değerlendirilmektedir. Amaç, hisse senedi piyasalarına yönelik ikna edici kanıtlar sunmak ve sektörel perspektifi dikkate almaktır. Her sektörün katkıları incelenerek, etkilerinin boyutunu ortaya koymak ve politika yapıcılara, gelecekte daha sürdürülebilir piyasaların oluşturulması için gerekli teşvik ve önlemleri belirlemede yardımcı olacak ampirik kanıtlar sağlamak hedeflenmektedir. Ampirik analizler, belirli koşullu kantillerde, Kantil Vektor Otoregresyon kullanılarak gerçekleştirilmiştir. Bu kapsamda, Borsa İstanbul'dan 22 sektör incelenmiş ve üç farklı kantilden – aşırı düşük, medyan ve aşırı yüksek kantiller – elde edilen bulgular sunulmuştur. Bu kantillerde getiri yayılmalarına en fazla katkı sağlayan sektörlerin ILTM ve BANK olduğu tespit edilmiştir. Bununla birlikte, medyan kantilde GMYO sektörü öne çıkarak BANK sektörünün yerini almaktadır. Sonuçlar, özellikle BANK sektörünün öncülük ettiği yüksek piyasa oynaklığı dönemlerinde, sistematik riskin, getirilerin SRD endeksine aktarılmasında bir başka önemli unsur olduğunu

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göstermektedir. Bu nedenle, bankacılık sektöründeki sistematik riski azaltan politikaların SRD endeksinin istikrarını artırabileceği sonucuna varılmıştır.

Anahtar Kelimeler: Sürdürülebilirlik, Gelişmekte Olan Piyasalar, Borsa İstanbul Sektörleri, Kantil Bağlantısallığı

1. Introduction

Climate change, global warming, increasing need for energy, the pressure on natural resources, poverty and inequality together with increasing population have become the most crucial concerns of both non-governmental organizations and authorities in recent decades. Using renewable energy sources, preference for low emission and climate resistant investments are only a few of the ways to reduce the negative influence of such global issues on human life and ecosystem. With the help of a global transformation process, it is desired to create a more livable and sustainable world for future generations. Accordingly, from a business perspective, firms are expected to adopt good corporate governance standards. It is no longer sufficient for them to produce only goods and services for gaining financial success. Instead, as corporate citizens, they are expected to act responsibly to both human beings and the environment. Sustainability, which emerged as an indispensable concept in this transformation and change process, generated noteworthy interest at academic and business levels globally.

According to Scoones (2010), the term sustainability is one of the buzziest words of the recent years. He argues that anything can be defined as sustainable from resource management to business, cities to economies and so on. This multifaceted concept as a key debate of global importance has gained popularity after the late 1980s with the Brundtland report entitled as 'Our Common Future' by the United Nations. In this report, sustainable development with its guiding principles is defined as "meeting the needs of the present without compromising the ability of future generations to meet their own needs" (UN, 1987). It is also highlighted in the report that it should be perceived as a global objective even it may be possible for countries to imply their own policies due to their economic, social and ecological differences. By the end of 2015, the United Nations established 2030 Agenda for Sustainable Development consisting of 17 Sustainable Development Goals (SDGs). These goals are adopted by world leaders to guide all countries in mobilizing their endeavor to end poverty, fight against inequalities and struggle with climate change for the coming 15 years (United Nations, n.d.). It can be stated that global awareness of sustainability has increased with the help of 2030 Agenda of Sustainable Development. It is not only in the programs of countries, but businesses are also aware of its strategic importance. According to Dana et al. (2021) both businesses and academics around the world agree on the benefits of sustainable development.

Sustainability is claimed as a priority business approach in today's environment that takes into consideration how a company operates on environmental, social and governance (ESG) issues (Borsa İstanbul, 2020). Similarly, corporate sustainability is identified as the adaptation and management of environmental, social and economic issues in companies together with the corporate governance principles in order to create value in the long run. As in many areas of social and business life, sustainability concept in the finance field has also been one of the highlights of the recent decades. Following the increase in awareness and actions of companies and governmental authorities with respect to the concept and also increase in sensitivity of investors toward a more sustainable future led to the formation of sustainability indices in the world. These indices are used as an indicator to measure sustainability performance of the companies and also as a guide for investors or any stakeholders who are interested in sustainable investments.

To expedite the transition toward corporate sustainability and enhance awareness at both corporate and public levels, the BIST Sustainability Index was introduced at the end of 2014. The index which consists of firms with high corporate sustainability performance, has objective of providing information to investors related with the sustainable policies of companies and also providing a guide for firms in their decision-making process with respect to ESG factors. The index acts as a mirror that reflects the views, sensitivity and actions of companies related with significant sustainable concepts as climate changes, natural resources, global warming, pollution, poverty, inequality, health and many other similar global concerns. Companies may have a chance to improve themselves through recognizing the index as a tool in comparing their sustainability performance with the performance of other players. As a result, with the help of index, it is possible for companies to benefit from increasing awareness and reputation which in turn may provide competitive advantage and attract new capital for them (Borsa İstanbul, n.d.,a). Furthermore, The Sustainability Guide for Companies by Borsa Istanbul (2020) explains that investors and any interested parties in the finance area are increasingly using information related with the sustainability and ESG performance of the companies in their financing decisions. While sustainability and ESG issues are important for any business, the mentioned issues are more critical for companies operating in industries that are sensitive to environmental and social risks, cause pollution and use intensive natural resources as production inputs. Additionally, it is also expected from the companies operating in the industries as agriculture, chemical and pharmaceutical, energy, textile, oil and gas, forestry and paper, construction, transportation, food and beverage, mining and metals to integrate ESG policies into their strategies.

If any of the business helps to develop a sustainable future, where the interests of different parties are aligned for the benefits of all human beings and the planet, it is possible for these companies to be rewarded for their socially responsible behaviors. Corporations striving to achieve these goals should be encouraged and supported. In this regard, identifying sectors, specifically the companies, which show weak, moderate, or high performance is important for policymakers to measure the effectiveness of incentives and policies imposed. On the other hand, corporations that develop initiatives in the field of sustainability may also wish to assess the social value of these endeavors. From the finance standpoint, the best and most effective way of this performance measurement is the equity market analysis, as the ultimate goal of each company is to maximize firm value. To that end, in this study, it is employed stock prices in order to investigate the sustainability performance of sectorial indices in Borsa Istanbul. Since Borsa Istanbul is an emerging market, considering the sharp and rapid price developments, it is utilized the Quantile Connectedness methodology of Ando et al. (2018) and Chatziantoniou et al. (2021) that allows us to examine the connectedness of sectorial indices and sustainability index in both extremely high and extremely low return levels. The findings may provide valuable insights for companies, governmental authorities, and policymakers in stimulating weakly contributed industries, promoting environmentally friendly practices, and raising awareness.

The remainder of the study proceeds as follows: section two is devoted to literature review related with sustainability performance of companies from different regions, countries and sectors around the world. Section three introduces the econometric background of the methodology employed. Empirical findings and discussions on these results are populated in section four. Finally, section five presents the conclusion and policy implications.

2. Literature Review

While the importance of sustainability activities in many areas of life has increased in recent decades, the players also in the financial markets have not been indifferent to this popular concept. As the investors' sensitivity towards a sustainable future has increased; the awareness and actions of companies and authorities towards the concept have increased and become more visible, too. Consequently, sustainability indices as S&P Dow Jones Sustainability Indices (S&P DJSI); Morgan Stanley Capital International Environmental, Social and Governance Indices (MSCI-ESGI) and many other global and local indices were developed and used as a proxy to evaluate sustainability performance of the companies with respect to economic, social, and environmental factors. These indices have been a reference for any investor or business that are interested in sustainable investments. Most of them cover the companies which are commonly pronounced with their leading or noteworthy roles in sustainable investments.

With the development of sustainability indices, studies investigating the impact of firms' sustainability activities on their corporate financial performance or stock returns has been widely discussed in sustainability literature. An increasing number of studies have been analyzing the reactions of investors and stock markets to the inclusion of any company's stock in the sustainability index at both national and international levels. While a group of studies focuses on the performance of stocks listed in sustainability indices, another group of studies investigates the returns of sustainability indices with the major stock market indices which are used as a proxy for benchmark index.

One of the pioneering studies testing the sustainability practices in financial markets was conducted by Luck and Pilotte (1993) for U.S. market. The study aims to investigate the performance of Domini 400 Social Index (DSI) which measures the performance of portfolios with social constraints. For a period covering twenty-nine months from May 1, 1990 to September 30, 1992; the evidence indicates that DSI outperforms the S&P 500 which is used as the benchmark index. However, it is concluded that socially responsible investments do not have a significant impact on this outcome; rather it is suggested that higher return of DSI comes from higher risk. Statman (2006) further compared the returns of four indices of socially responsible companies, namely; the Domini 400 Social Index, the Calvert Social Index, the Citizens Index, and the U.S. portion of the Dow Jones Sustainability Index with the return of S&P 500 index. The evidence demonstrates that the returns of all socially responsible indices were generally higher than the returns of S&P 500 index for the overall analysis period from May 1990 to April 2004, but not in every sub periods. However, the study of DiBartolomeo and Kurtz (1999) covering the timespan from

1990 to 1999 has found any significant difference in the returns of modified DSI portfolio, which is generated through optimization, and the benchmark index of S&P 500.

In the following years, studies started to be carried out in Europe and other world countries and regions besides the U.S. A global study covering the period from 1996 to 2005, evaluates the performance of eight FTSE4Good indices which include stocks from different areas of the world that meet certain social responsibility criteria. The evidence documents that for the whole analysis period, FTSE4Good indices experience higher returns when compared with their relevant benchmarks. But this outperformance is suggested to be mostly related with the differences between risk level of compared indices. When the risk is integrated into the analysis, both FTSE4Good and their benchmark indices are found to generate same level of risk which results statistically any significant difference in terms of financial performance of the selected indices (Collison et al, 2008). Moreover, Ortas et al (2014) compare the risk adjusted returns and systematic risk levels of two main sustainability indices in European context, namely; DJSI Euro Stoxx 600 and DJSI Stoxx 600 with their benchmarks for the timespan between 2001 and 2010. While the results with respect to risk adjusted returns show no significant difference between socially responsible equity indices and their benchmarks; in terms of risk, socially responsible equity indices have higher risk levels which is found to be worse in the periods of market downturns.

A recent study conducted by Karakaya and Kutlu (2022) for a daily dataset between 2015 to 2019 investigates the return and volatility spillover between global, regional and domestic sustainability indices. To represent these indices Dow Jones World Sustainability Index (DJSI World), Dow Jones European Sustainability Index (DJSI European) and BIST Sustainability Index (BISTSI) were used. The results show the impact of negative news to be more influential than the positive news for the returns of all selected sustainability indices. The findings regarding the conditional variances of indices indicate that while the movements of DJSI World and DJSI European follow a similar pattern; BISTSI differs from them. Similarly, while a stronger correlation between DJSI World and DJSI European is documented, it is found to be not strong with respect to correlation of BISTSI with other two. Additionally, the findings of study reveal one way return spillover from the more comprehensive indices to less inclusive ones as from DJSI World and DJSI European to BISTSI.

In the context of Turkey, Gök and Özdemir (2017) probes the performance of Borsa Istanbul Sustainability Index (BISTSI) against the benchmark index of BIST100 for daily dataset covering the period between November 4, 2014 and December 30, 2016. Even the major findings of the study show the return of sustainability index to be higher than benchmark index, it is documented to be statistically insignificant which makes the performance of two indices systematically indifferent from each other for the analysis period. However, results with respect to risk adjusted return and risk reveals to be higher for sustainability index in comparison to benchmark. Based on the estimation results for the conditional volatility, volatility persistence is found to be high for both of the indices. Furthermore, the findings indicate greater influence of negative shocks on volatility than positive ones. Consistent with the findings of the study, without considering personal values of the investors it is concluded by authors that sustainability index does not provide any financial incentives for them during the analysis period. A more comprehensive study covering the period between November

4, 2014 and October 31, 2018 conducted by Levent (2019) compares the performance of Borsa Istanbul Sustainability Index with benchmark indices of BIST100, BIST All, BIST All-100 and BIST Corporate Governance Index also supports the findings of Gök and Özdemir (2017). While sustainability index is found to be more volatile than two market indices namely, BIST All and BIST All-100; the average return of it is not found to be significantly different from all the selected benchmark indices.

An industry specific study for Turkey by Altınay (2017) aims to examine the performance of selected four banks before and after their inclusion in to the BIST Sustainability Index. However, no significant difference was detected regarding the mean values of stocks of the selected banks before and after. Another industry specific study conducted by Gök and Gökşen (2020) examines how the stock returns are affected by the announcement of inclusion of banks to the Borsa Istanbul Sustainability Index (XUSRD). Based on the event study methodology, eight banks which were included in Borsa Istanbul Sustainability Index for the period between November, 2014 and October, 2019 were analyzed. The evidence reveals that investors react positively to the announcements of inclusion to the index. While the average abnormal returns were detected to be generally negative before the announcements of the inclusion to the index, it was positive after the announcements.

A more recent industry specific study by Açıkgöz (2022) investigates the influence of sustainability reporting on market risk and return volatility spillovers of two sectors; namely, food and energy. The results of the study, where the comparison of risk and return volatility of the selected sectors is compared within their mentioned industries, indicate that market risk is higher for the companies exhibiting high level of sustainability activities than the risk of the industry they are in. It is claimed that this finding may be due to the weak form of market efficiency, low financial literacy and market shallowness in Turkish financial markets. As a result, the evidence shows that the companies in Turkey with socially responsible activities do not have a competitive advantage in the market.

Iqbal et al. (2022) analyze asymmetric time- and frequency-spillovers among global sustainable investments, finding significant regional variations and stronger contagion effects during crises. Their results highlight the role of economic uncertainties and market volatilities in shaping sustainable investment dynamics, offering insights for socially responsible investors and portfolio diversification.

Kilic et al. (2022) analyze the comovements between ESG and conventional stock returns in 19 developing and 19 developed countries, finding that ESG stocks move in-phase with conventional stocks in developing markets but out-of-phase in developed markets. Their results suggest that ESG investments offer limited diversification benefits in developing countries but significant portfolio gains in developed ones.

Tiwari et al. (2023) analyze risk transmission between green bonds, Islamic stocks, and other asset classes, finding that green bonds pose a long-run systemic risk to Islamic stocks. Their results highlight weaker integration between green bonds and major indices during market volatility, emphasizing green bonds' role as a distinct investment asset.

Liu et al. (2023) investigate the relationship between sustainability and financial stability in China, finding that ESG investment reduces return and volatility spillover effects across major financial markets. Their results suggest that promoting ESG investment can enhance long-term market stability by limiting short-term speculation.

Bhuttaa et al. (2024) analyze the mean and volatility spillover from the ESG market to G7 stock markets using the ARMA-GARCH model, finding that while spillovers exist, mean volatility does not, indicating market efficiency. The study offers insights for investors and policymakers on cross-market correlations.

As the related literature review reveals, while most of the studies compare the return of sustainability indices with their benchmarks in different countries, studies addressing the sustainability performance of various sectors around the world are relatively limited in number. Very few studies have investigated spillover effects involving sustainability indices at a sectoral level, especially in an emerging market context. To the best of available knowledge, no previous study has specifically examined quantile-based spillovers from sector indices to a sustainability index in a market like Borsa Istanbul.

With a modest contribution towards filling this gap, the findings may provide information for companies, authorities, policy makers and any interested groups.

3. Methodology

The methodology of Ando et al. (2018) and Chatziantoniou et al. (2021) is employed as the empirical model. Ando et al. (2018) introduce a connectedness analysis based on the Diebold and Yilmaz (2009, 2014) framework, enabling the spillover analysis of variables at a given conditional quantile, $\tau \in (0, 1)$. In brief, the choice of QVAR is motivated by its ability to capture asymmetric spillovers across different market conditions, which alternative approaches cannot do as effectively. The authors utilize a factor structure to identify the common and distinguishing components in the error process. In calculating connectedness components (to, from, net and TCI), The following autoregressive model of order p, QVAR, is considered (p).

$$y_t = \mu(\tau) + \sum_{j=1}^{p} \Phi_j(\tau) y_{t-1} + e_t(\tau) \tag{1}$$

where τ is between 0 and 1. y_t and y_{t-j} are $k \times 1$ dimensional endogenous vectors. $\mu(\tau)$ represents a $k \times 1$ dimensional conditional mean vector, $\Phi_j(\tau)$ is $k \times k$ dimensional QVAR coefficient matrix. Finally, $e_t(\tau)$ indicates the $k \times 1$ dimensional error vector, which possesses a $k \times k$ dimensional variance-covariance matrix of $\sum \tau$. In demonstrating the effect a shock in variable j owns on variable *i*, the authors apply the GFEVD (H-step ahead Generalized Forecast Error Variance Decomposition) of Pesaran and Shin (1998) and Koop et al. (1996).

$$\psi_{ij}^{g}(H) = \frac{\Sigma(\tau)_{ii}^{-1} \sum_{h=0}^{H-1} \left(e_i' \Psi_h(\tau) \Sigma(\tau) e_j\right)^2}{\sum_{h=0}^{H-1} (e_i' \Psi_h(\tau) \Sigma(\tau) \Psi_h(\tau)' e_i)} \qquad \tilde{\psi}_{ij}^{g}(H) = \frac{\psi_{ij}^{g}(H)}{\sum_{j=1}^{k} \emptyset_{ij}^{g}(H)} \tag{2}$$

where $e_i$demonstrates a zero vector with unity at the ith position. Through the normalization applied here, the following equalities are obtained:

$$\sum_{j=1}^{k} \tilde{\psi}_{ij}^{g}(H) = 1 \quad \text{and} \quad \sum_{i,j=1}^{k} \tilde{\psi}_{ij}^{g}(H) = k \tag{3}$$

At this stage, to calculate total directional connectedness TO others, which provides the information of the overall effect variable i owns on the rest of the variables j, it is calculated:

$$C_{i\to j}^{g}(H) = \sum_{j=1, i\neq j}^{k} \tilde{\psi}_{ji}^{g}(H) \tag{4}$$

Likewise, to quantify the total directional connectedness FROM others, namely, the effect of shocking the rest of the variables j on variable i, The process below is applied.

$$C_{i\leftarrow j}^{g}(H) = \sum_{j=1, i\neq j}^{k} \tilde{\psi}_{ij}^{g}(H) \tag{5}$$

The difference below gives us the net total directional connectedness, the net impact of variable i on the network explored.

$$C_{i}^{g}(H) = C_{i\to j}^{g}(H) - C_{i\leftarrow j}^{g}(H) \tag{6}$$

Finally, in order to attain the adjusted version of the TOTAL connectedness index represented by TCI, the equation below is executed.

$$TCI\ (H) = \frac{\sum_{i,j=1, i\neq j}^{k} \tilde{\psi}_{ij}^{g}(H)}{k-1} \tag{7}$$

TCI ranges between 0 and 1 and indicates the extent of market risk. Higher values depict a more significant degree of network connectedness.

4. Empirical Analysis

As an economic motivation, firms strive to maximize their profit while serving the needs of human beings. However, in the long run, the ignorance of sustainable development objectives would bring about insufficient natural resources to operate for them. Thus, applying policies that positively impact the environment would offer a safer and healthier planet for humanity and all stakeholders to carry out objectives regarding profitability and creating value. Taking this fact into account, this study explores the connectedness between the sectorial equity indices of Borsa Istanbul and its Sustainability Index (SRD). Identifying the extent of connectedness might be important for the companies in each sector and policymakers. As sustainability objectives are the common interest of all stakeholders, results might be considered by various market participants. For instance, given that the objective is to determine the degree of each sector's connection to the sustainability index, both government agencies and policymakers can benefit from the results to stimulate sectors with weak contributions, promote environment-friendly practices, and raise awareness. Econometric analysis has been executed through the Quantile Connectedness methodology of Ando et al. (2018) and Chatziantoniou et al. (2021) using R software.

Consistent with this objective, the empirical section of the study tests the pairwise connectedness between the Borsa Istanbul Sustainability Index (SRD) and sectorial indices. The analysis covers the period from 18.08.2017 to 13.01.2023, using log and dividend-adjusted returns obtained from the Matriks Inc. database. The sectors utilized are as follows Banks (Bank), Informatics Technology (BLSM), Electricity (XELKT), Leasing Factoring (FINK), Food Beverage (GIDA), Real Est. Inv. Trusts (GMYO), Telecommunication (ILTM), Construction (INSA), Wood Paper Printing (KAGT), Chem. Petrol Plastic (KMYA), Mining (MADN), Basic Metal (MANA), Metal Products Mach. (MESY), Insurance (SGRT), Sports (SPOR), Nonmetal Min. Product (TAST), W. And Retail Trade (TCRT), Textile Leather (TEKS), Tourism (TRZM), Transportation (ULAS), Sustainability (SRD), Technology (TEK), Investment Trusts (YORT).

Table 1. Descriptive Statistics

	BANK	BLSM	ELKT	FINK	GIDA	GMYO	ILTM	INSA
Mean	0.0007	0.0016	0.0018	0.0012	0.0011	0.0012	0.0013	0.0017
Std. Dev.	0.0242	0.0201	0.0183	0.0312	0.0162	0.0171	0.0171	0.0198
Skewness	-0.2130	-0.8774	-0.6600	-0.5778	-1.0418	-1.0827	-0.9825	-0.0553
Kurtosis	5.8717	8.6509	6.8475	9.6375	7.8373	8.6906	8.0738	6.8835
Jarque- Bera	476.2*	1978*	934.8*	2565*	1567*	2095*	1673*	853.8*
ERS	-8.597*	-14.79*	-14.01*	-13.74*	-11.48*	-10.67*	-6.98*	-15.70*

	KAGT	KMYA	MADN	MANA	MESY	SGRT	SPOR	TAST
Mean	0.0016	0.0018	0.0019	0.0016	0.0016	0.0013	0.0008	0.0014
Std. Dev.	0.0195	0.0181	0.0278	0.0214	0.0177	0.0136	0.0299	0.0177
Skewness	-0.8005	-0.6266	-0.1387	-0.1695	-0.8854	-0.6460	-0.4201	-0.9596
Kurtosis	7.5103	7.0751	4.6351	4.9523	7.5434	9.4093	8.6993	8.1984
Jarque-Bera	1294*	1027*	155*	222*	1344*	2415*	1875*	1735*
ERS	-9.70*	-12.19*	-11.21*	-4.87*	-10.17*	-13.80*	-12.14*	-12.96*

	TCRT	TEKS	TRZM	ULAS	SRD	TEK	YORT
Mean	0.0011	0.0018	0.0015	0.0020	0.0012	0.0012	0.0015
Std. Dev.	0.0166	0.0188	0.0243	0.0262	0.0167	0.0216	0.0192
Skewness	-0.6023	-1.2624	-0.5971	-0.1988	-0.8543	-0.7401	-0.6075
Kurtosis	7.6728	8.8145	6.2630	5.0214	7.6860	8.1047	10.950
Jarque-Bera	1316*	2270*	682.1*	240*	1406*	1596*	3654*
ERS	-16.97*	-10.28*	-9.467*	-10.82*	-7.21*	-14.77*	-9.125*

* denotes significance at the 1% level.

Table 1 populates the results of descriptive statistics for each variable. As seen, all return series have positive values around zero. As an indicator of the variability, standard deviation statistics show that the extent of return fluctuations is close to each other. The highest values are observed in FINK and SPOR indices. Number of the constituents in these sectors can account for this observation. As these two sectors contain a relatively smaller number of companies index volatilities appear to be higher due to the lessened benefits of diversification. According to the skewness and kurtosis statistics, all indices exhibit departures from the normal distribution. The negative skewness values show that all indices are skewed to the left, meaning the frequency of above-mean returns is greater than the below-mean returns. For each variable, the kurtosis statistics is greater than the reference number of three in the normal distribution. This result indicates leptokurtic probability distributions containing fat tails due to the high probability of extreme events. The departures from normality are confirmed by the statistically significant Jerque-Bera test statistics at the 1% level. Finally, the ERS model of Stock et al. (1996) is employed for the unit root test. This model can be considered as the modified version of the conventional Augmented Dickey-Fuller methodology. As the authors discussed, this test is quite robust even under the small sample size and in the presence of unknown mean and trends of the variables. The results depict that each return series is stationary at the 1% significance level. The quantile approach mitigates structural break concerns by separately analyzing stable vs. turbulent periods (through the median vs. extreme quantiles). For instance, if there was a market crash in the sample, its effect on connectedness is reflected in the 5% quantile outcomes (which largely represent “crisis” conditions). Therefore, the results already account for the influence of such extreme events on spillovers.

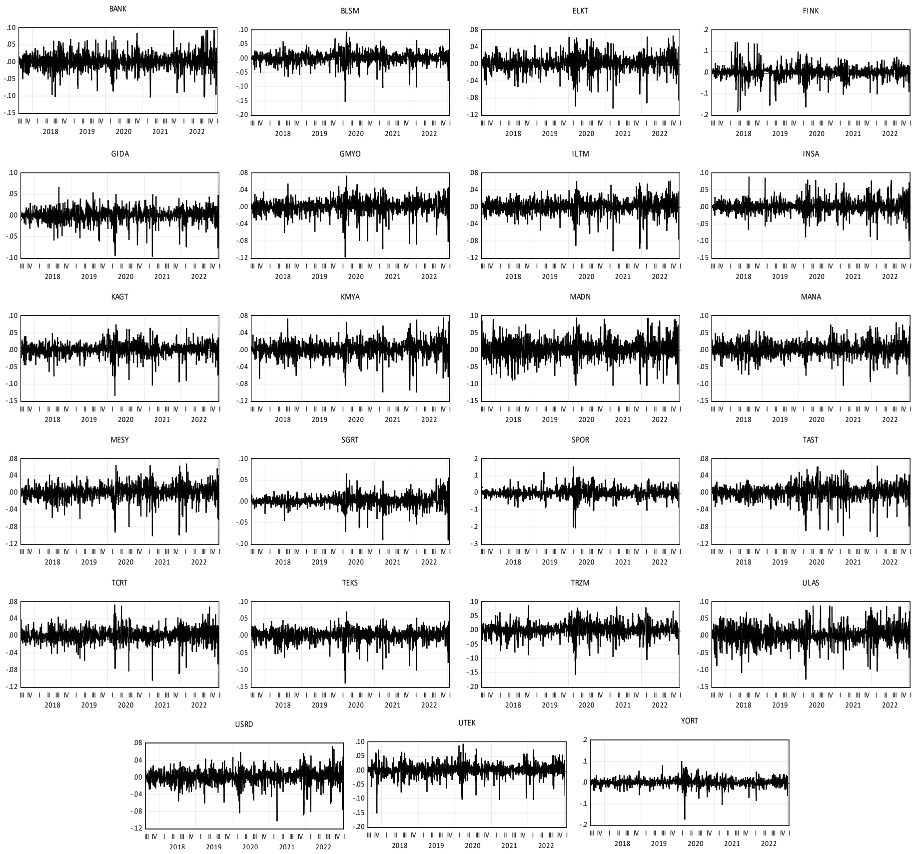

Figure 1. Return Series of the Variables

Following the discussion of descriptive statistics, Figure 1 presents the return series of variables. Consistent with the previous discussions, it is observed that while other variables mostly fluctuate between -0.05 and 0.05, FINK and SPOR indices occasionally display significantly larger deviations that exceed 0.10 on both sides. Focusing on the pandemic period, it seems that the largest relative falls occur in the returns of BLSM, KAGT, SPOR, TEKS, TRZM, ULAS, and YORT indices. Other sector indices display even larger drops at other times of the analysis period. The Russia-Ukraine war period is also considered as another critical event in this time interval. A visual investigation does not detect any pattern in index returns that can be attributed to this event. However, it is apparent that the fluctuation of returns and, thus, uncertainty in asset prices of the two sectors catch attention. There is considerably increased variation in the returns of INSA and MADN variables toward the end of 2022 and the beginning of 2023.

In Table 2, The results of the connectedness analysis are presented. To account for varying market conditions, the connectedness between SRD and sectorial indices is explored under three quantiles: extreme lower quantile (τ=0.05), median quantile (τ=0.50), and extreme upper quantile (τ=0.95). These quantiles correspond to extremely low return periods, typically observed in bear markets, tranquil periods, and extremely high return periods during bull markets. The results of pairwise connectedness, which explore the interactions between SRD and each index separately, are also presented. In the table, FROM shows the total directional spillovers received from other variables, while TO indicates the total directional spillovers transmitted to other variables. Therefore, NET represents the difference between TO and FROM. Positive (negative) values indicate that the variable is the net transmitter (receiver) of return spillovers. In the execution of the methodology (see Figures 2, 3, and 4), a 200-day window size and a ten-day forecast horizon are utilized.

The results in Table 2 show that, among all sectors, the highest and lowest contributions to the returns of SRD in median quantile come from the GMYO (45.76%) and ILTM (45.19%); and SPOR (13.12%), and YORT (20.75%) sectors, respectively. When the same comparison is made for the extreme lower quantile, it is observed that ILTM (48.68%) and BANKS (47.61%) have the highest contributions, while GMYO (34.85%) and SPOR (39.81%) have the lowest. On the other hand, the highest and lowest contributions in extreme upper quantile stem from ILTM (48.42%) and BANKS (47.48%); and FINK (40.30%) and INSA (40.91%) sectors, respectively. The main reason behind these findings can be attributed to the composition of shares in BANK and ILTM sectors. It is evidence that both sectors incorporate companies that possess high scores in sustainability requirements unlike the case of SPOR, YORT and FINK sectors that have minimum number of constituents in complying with sustainability requirements. Likewise, as GMYO incorporates only one company in meeting sustainability requirements it has relatively less contribution to SRD in lower quantile. On the other hand, GMYO illustrates an unexpected performance in the median quantile. This result might be related to relatively smoother market conditions. Overall findings show that the main reason regarding the extent of sectorial contributions to the SRD is composition of indices, namely, number of companies that comply with the sustainability criteria. When comparing the results across the three different quantiles, it is evident that out of 22 sectors, only GMYO exhibits a higher spillover impact in the median quantile than its counterparts. This finding may show that this sector returns become more persistent, robust and influential during normal market conditions, especially, than that of cycles of economic downturn.

Table 2. Connectedness Analysis Results in Various Quantiles

		USRD	BANKS	FROM		USRD	BLSM	FROM		USRD	ELKT	FROM		USRD	FINK	FROM
Extreme Lower Quantile	**USRD**	52.39	47.61	47.61	**USRD**	55.19	44.81	44.81	**USRD**	54.45	45.55	45.55	**USRD**	58.68	41.32	41.32
	BANKS	46.91	53.09	46.91	**BLSM**	44.74	55.26	44.74	**ELKT**	45.24	54.76	45.24	**FINK**	41.91	58.09	41.91
	TO	46.91	47.61	94.52	**TO**	44.74	44.81	89.54	**TO**	45.24	45.55	90.78	**TO**	41.91	41.32	83.23
Median Quantile	**USRD**	58.79	41.21	41.21	**USRD**	69.51	30.49	30.49	**USRD**	68.1	31.9	31.9	**FINK**	81.81	18.19	18.19
	BANKS	41.33	58.67	41.33	**BLSM**	30.58	69.42	30.58	**ELKT**	31.92	68.08	31.92	**ELKT**	17.97	82.03	17.97
	TO	41.33	41.21	82.54	**TO**	30.58	30.49	61.07	**TO**	31.92	31.9	63.82	**TO**	17.97	18.19	36.16
Extreme Upper Quantile	**USRD**	52.52	47.48	47.48	**USRD**	56.17	43.83	43.83	**USRD**	55.6	44.4	44.4	**FINK**	59.7	40.3	40.3
	BANKS	47.08	52.92	47.08	**BLSM**	43.62	56.38	43.62	**ELKT**	45.05	54.95	45.05	**ELKT**	39.98	60.02	39.98
	TO	47.08	47.48	94.56	**TO**	43.62	43.83	87.45	**TO**	45.05	44.4	89.46	**TO**	39.98	40.3	80.28

		USRD	GIDA	FROM		USRD	GMYO	FROM		USRD	ILTM	FROM		USRD	INSA	FROM
Extreme Lower Quantile	**USRD**	54.57	45.43	45.43	**USRD**	65.15	34.85	34.85	**USRD**	51.32	48.68	48.68	**USRD**	58.69	41.31	41.31
	GIDA	46.11	53.89	46.11	**GMYO**	34.62	65.38	34.62	**ILTM**	48.59	51.41	48.59	**INSA**	41.25	58.75	41.25
	TO	46.11	45.43	91.55	**TO**	34.62	34.85	69.47	**TO**	48.59	48.68	97.27	**TO**	41.25	41.31	82.56
Median Quantile	**USRD**	68.08	31.92	31.92	**USRD**	54.24	45.76	45.76	**USRD**	54.81	45.19	45.19	**USRD**	81.1	18.9	18.9
	GIDA	32.23	67.77	32.23	**GMYO**	45.37	54.63	45.37	**ILTM**	45.24	54.76	45.24	**INSA**	18.62	81.38	18.62
	TO	32.23	31.92	64.15	**TO**	45.37	45.76	91.13	**TO**	45.24	45.19	90.43	**TO**	18.62	18.9	37.52
Extreme Upper Quantile	**USRD**	55.72	44.28	44.28	**USRD**	54.9	45.1	45.1	**USRD**	51.58	48.42	48.42	**USRD**	59.09	40.91	40.91
	GIDA	44.44	55.56	44.44	**GMYO**	45	55	45	**ILTM**	48.37	51.63	48.37	**INSA**	40.92	59.08	40.92
	TO	44.44	44.28	88.73	**TO**	45	45.1	90.09	**TO**	48.37	48.42	96.79	**TO**	40.92	40.91	81.82

		USRD	KAGT	FROM		USRD	KMYA	FROM		USRD	MADN	FROM		USRD	MANA	FROM
Extreme Lower Quantile	**USRD**	55.48	44.52	44.52	**USRD**	55.63	44.37	44.37	**USRD**	57.28	42.72	42.72	**USRD**	54.18	45.82	45.82
	KAGT	43.99	56.01	43.99	**KMYA**	46.55	53.45	46.55	**MADN**	42.92	57.08	42.92	**MANA**	46.02	53.98	46.02
	TO	43.99	44.52	88.51	**TO**	46.55	44.37	90.92	**TO**	42.92	42.72	85.64	**TO**	46.02	45.82	91.85
Median Quantile	**USRD**	70.2	29.8	29.8	**USRD**	64.78	35.22	35.22	**USRD**	77.77	22.23	22.23	**USRD**	65.45	34.55	34.55
	KAGT	29.43	70.57	29.43	**KMYA**	35.42	64.58	35.42	**MADN**	22.28	77.72	22.28	**MANA**	34.89	65.11	34.89
	TO	29.43	29.8	59.23	**TO**	35.42	35.22	70.64	**TO**	22.28	22.23	44.51	**TO**	34.89	34.55	69.43
Extreme Upper Quantile	**USRD**	56.12	43.88	43.88	**USRD**	54.31	45.69	45.69	**USRD**	58.21	41.79	41.79	**USRD**	54.49	45.51	45.51
	KAGT	44.21	55.79	44.21	**KMYA**	45.74	54.26	45.74	**MADN**	41.4	58.6	41.4	**MANA**	45.37	54.63	45.37
	TO	44.21	43.88	88.08	**TO**	45.69	91.43	45.74	**TO**	41.79	83.19	41.4	**TO**	45.51	90.88	45.37

Table 2. Connectedness Analysis Results in Various Quantiles (continuing)

		USRD	MESY	FROM		USRD	SGRT	FROM		USRD	SPOR	FROM		USRD	TAST	FROM
Extreme Lower Quantile	**USRD**	53.3	46.7	46.7	USRD	57.86	42.14	42.14	USRD	60.19	39.81	39.81	USRD	54.55	45.45	45.45
	MESY	46.8	53.2	46.8	SGRT	42.37	57.63	42.37	SPOR	40.37	59.63	40.37	TAST	45.93	54.07	45.93
	TO	46.8	46.7	93.5	TO	42.37	42.14	84.51	TO	40.37	39.81	80.18	TO	45.93	45.45	91.37
Median Quantile	**USRD**	62.29	37.71	37.71	USRD	76.57	23.43	23.43	USRD	86.88	13.12	13.12	USRD	65.49	34.51	34.51
	MESY	37.46	62.54	37.46	SGRT	23.33	76.67	23.33	SPOR	13.08	86.92	13.08	TAST	34.59	65.41	34.59
	TO	37.46	37.71	75.16	TO	23.33	23.43	46.75	TO	13.08	13.12	26.2	TO	34.59	34.51	69.1
Extreme Upper Quantile	**USRD**	53.91	46.09	46.09	USRD	57.86	42.14	42.14	USRD	60.96	39.04	39.04	USRD	54.61	45.39	45.39
	MESY	46.25	53.75	46.25	SGRT	42.37	57.63	42.37	SPOR	38.71	61.29	38.71	TAST	45.48	54.52	45.48
	TO	46.25	46.09	92.34	TO	42.37	42.14	84.51	TO	38.71	39.04	77.76	TO	45.48	45.39	90.87

		USRD	TCRT	FROM		USRD	TEKS	FROM		USRD	TRZM	FROM		USRD	ULAS	FROM
Extreme Lower Quantile	**USRD**	56.52	43.48	43.48	USRD	54.76	45.24	45.24	USRD	56.27	43.73	43.73	USRD	54.32	45.68	45.68
	TCRT	43.09	56.91	43.09	TEKS	45.43	54.57	45.43	TRZM	43.94	56.06	43.94	ULAS	45.67	54.33	45.67
	TO	43.09	43.48	86.58	TO	45.43	45.24	90.67	TO	43.94	43.73	87.67	TO	45.67	45.68	91.36
Median Quantile	**USRD**	76.61	23.39	23.39	USRD	67.34	32.66	32.66	USRD	77.53	22.47	22.47	USRD	65.61	34.39	34.39
	TCRT	23.81	76.19	23.81	TEKS	32.92	67.08	32.92	TRZM	22.23	77.77	22.23	ULAS	34.33	65.67	34.33
	TO	23.81	23.39	47.21	TO	32.92	32.66	65.58	TO	22.23	22.47	44.7	TO	34.33	34.39	68.71
Extreme Upper Quantile	**USRD**	57.87	42.13	42.13	USRD	55.24	44.76	44.76	USRD	58.17	41.83	41.83	USRD	54.88	45.12	45.12
	TCRT	42.42	57.58	42.42	TEKS	44.72	55.28	44.72	TRZM	41.97	58.03	41.97	ULAS	45.14	54.86	45.14
	TO	42.42	42.13	84.55	TO	44.72	44.76	89.48	TO	41.97	41.83	83.8	TO	45.14	45.12	90.26

		USRD	TEK	FROM		USRD	YORT	FROM
Extreme Lower Quantile	**USRD**	54.13	45.87	45.87	USRD	58.21	41.79	41.79
	TEK	46.56	53.44	46.56	YORT	42.36	57.64	42.36
	TO	46.56	45.87	92.43	TO	42.36	41.79	84.15
Median Quantile	**USRD**	64.64	35.36	35.36	USRD	79.25	20.75	20.75
	TEK	35.37	64.63	35.37	YORT	20.82	79.18	20.82
	TO	35.37	35.36	70.72	TO	20.82	20.75	41.57
Extreme Upper Quantile	**USRD**	54.65	45.35	45.35	USRD	58.18	41.82	41.82
	TEK	44.87	55.13	44.87	YORT	41.76	58.24	41.76
	TO	44.87	45.35	90.22	TO	41.76	41.82	83.58

Following the examination of received and transmitted spillovers below in Figure 2, The net directional spillovers in the extreme lower quantile (0.05) are presented. Similar to the previous discussion, the pairwise spillovers are also examined. In each figure, the net spillovers transmitted or received are shown above and below the zero line. Any value above zero indicates that sectorial indices are the transmitters of spillovers. Likewise, values below zero illustrate the return spillovers received by the sectorial indices from SRD. Unlike the previous discussion, this analysis allows us to observe time-varying dynamics of the spillovers and their response to market developments, such as two critical events that occurred in the analysis period: the COVID-19 pandemic and the Russia-Ukraine war.

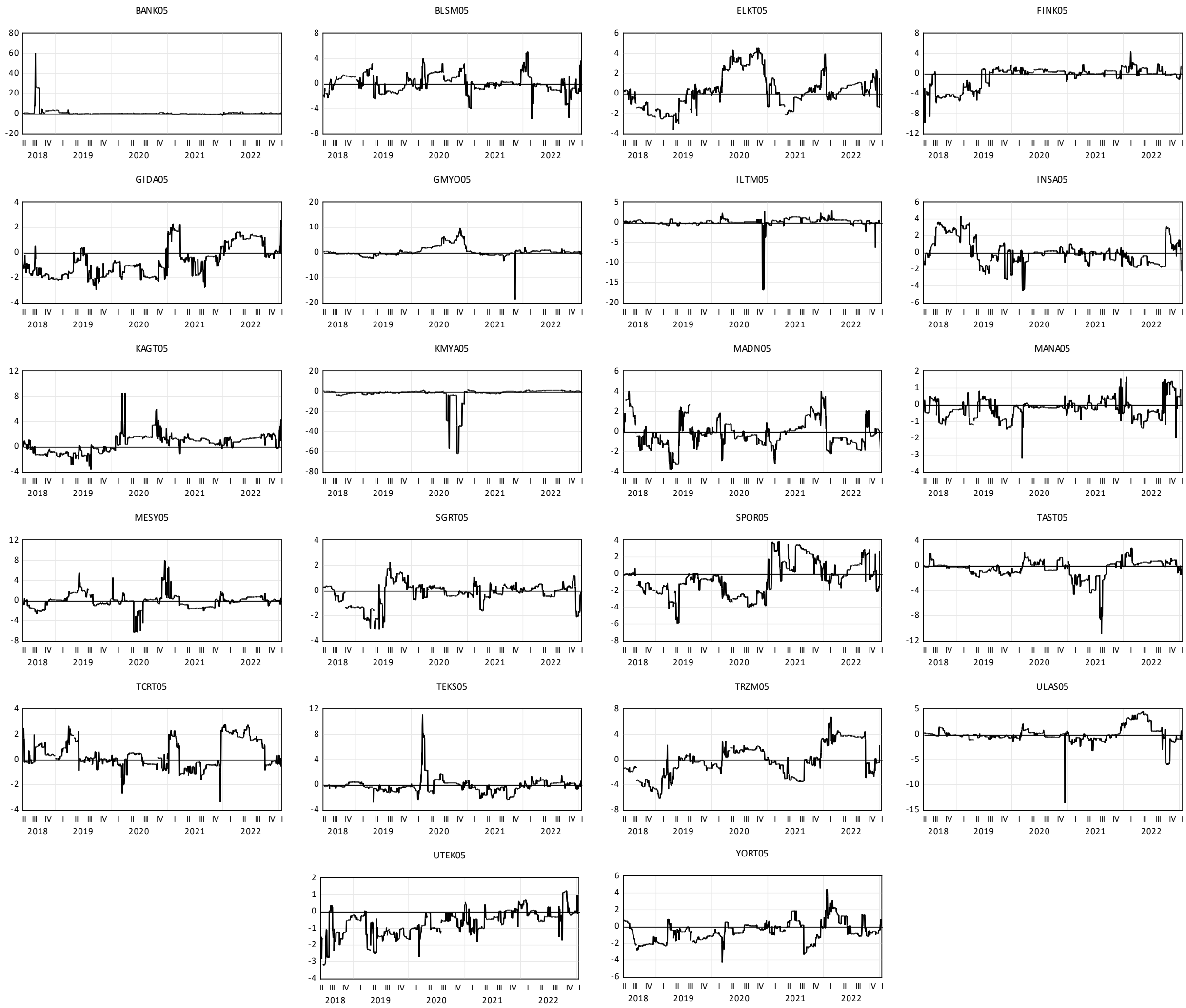

Figure 2. Net Total Directional Connectedness in Extreme Lower Quantile ($\tau = 0.05$)

According to the net directional spillover results, in extreme lower quantile, return transmissions to SRD from BANKS and TEKS display a spike approximately in Q3-

2018 and the beginning of 2020, respectively. For instance, in the case of BANKS, the index hits its extreme value (60) and, till the beginning of 2019, displays substantially high levels. This finding might be related to political risk stemming from the cabinet reshuffle that occurred at the beginning of Q3-2018. The increase in CDS spreads from 211 basis points to 539 between May and September also confirms the political risk. Based on this observation, it can be concluded that political risk is fairly priced and reflected in the banking sector. Similar behavior is observed in ILTM, KMYA, and ULAS sectors. However, these sectors, unlike the BANKS and TEKS, become the receiver of extreme negative returns from SRD around the end of 2020. There is no significant news impact in the markets during this period when the relevant indices are receivers of return spillover from the SRD. Apart from these sectors mentioned above, the rest illustrate relatively stable fluctuations in transmitting and receiving return spillovers. Occasionally each index appears to be a receiver or transmitter of returns. No particular pattern is observed across the variables, especially during COVID-19 and the Russia-Ukraine war, with some exceptions. For instance, ELKT and KAGT variables turn into a transmitter of returns along with the emergence of the pandemic and remain in this status over the year. This observation can be attributed to the recession expectation in the economy during the pandemic. It appears that idiosyncratic risks came to the fore due to the pandemic and the ELKT and KAGT sectors turned it into a transmitter. TEK and YORT are the receivers of return spillovers in this period.

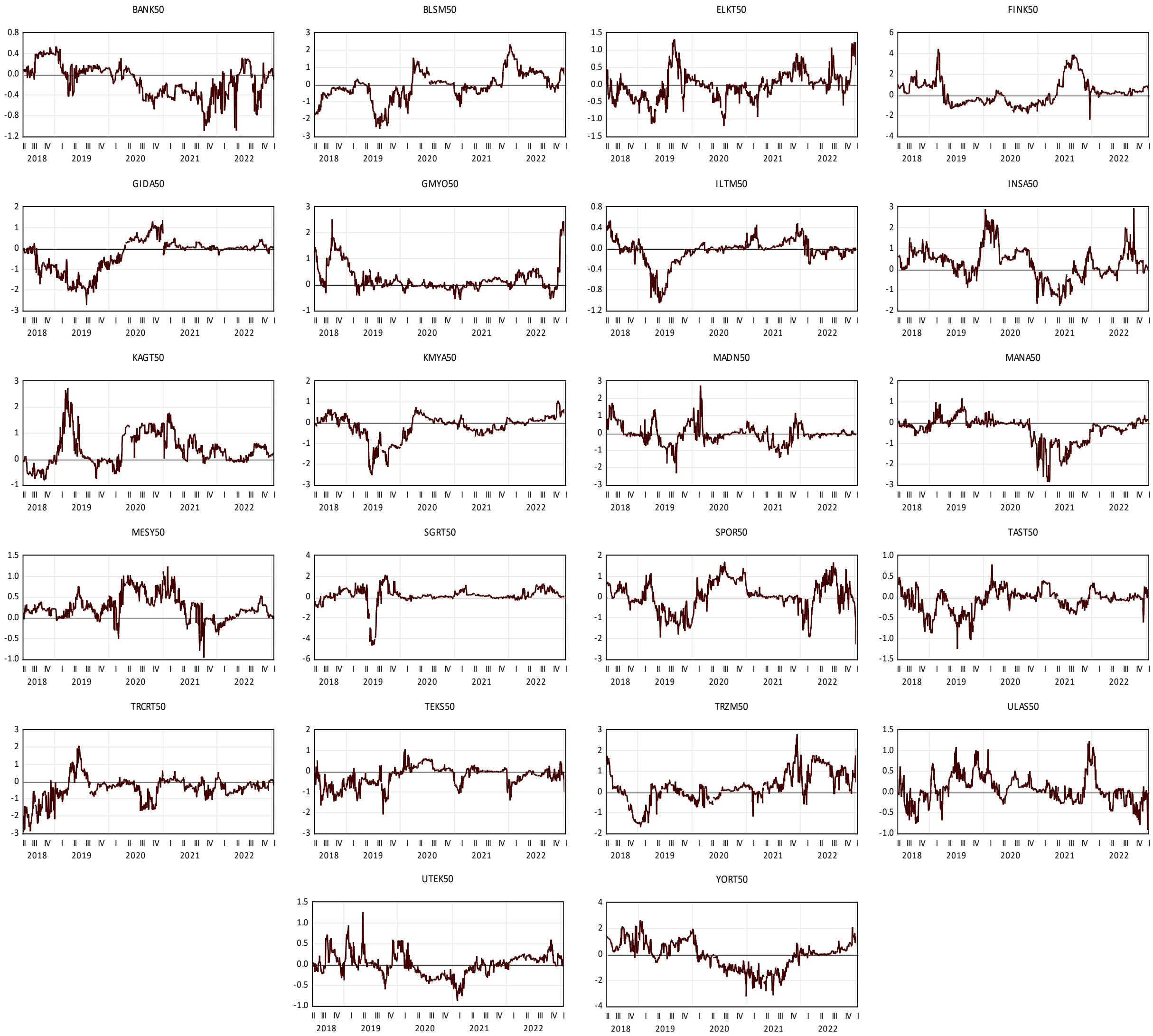

Figure 3. Net Total Directional Connectedness in Median Quantile ($\tau = 0.50$)

Figure 3 presents the time-varying return spillovers in the median quantile. As discussed above, values above (below) zero display return spillovers from sectorial indices (SRD) to SRD (sectorial indices). Unlike the previous discussions, in the median quantile, no outliers are observed in the transmission of returns; thus, the range of the spillovers appears to be significantly smaller. FINK and SGRT illustrate the highest fluctuation in spillovers. The impact of the pandemic on transmitting or receiving returns seems to vary across the sectors. For instance, BANKS, TEK and YORT values shifted to the negative side in emergence with the pandemic. While the spillovers from INSA and MADN changed their course and started getting weaker, they remain on the positive side. On the other hand, KAGT and MESY appear to be transmitting more robust returns along with the beginning of the pandemic. The two sectors with the highest weight in the sustainability index , BANK and MESY display an inconsistent pattern. Although the BANK is the receiver and MESY is the transmitter of returns. This finding may indicate that the degree of compliance with sustainability principles does not provide sufficient information regarding the direction of spillover in the median quantile, namely, during the smooth and consistent price movements.

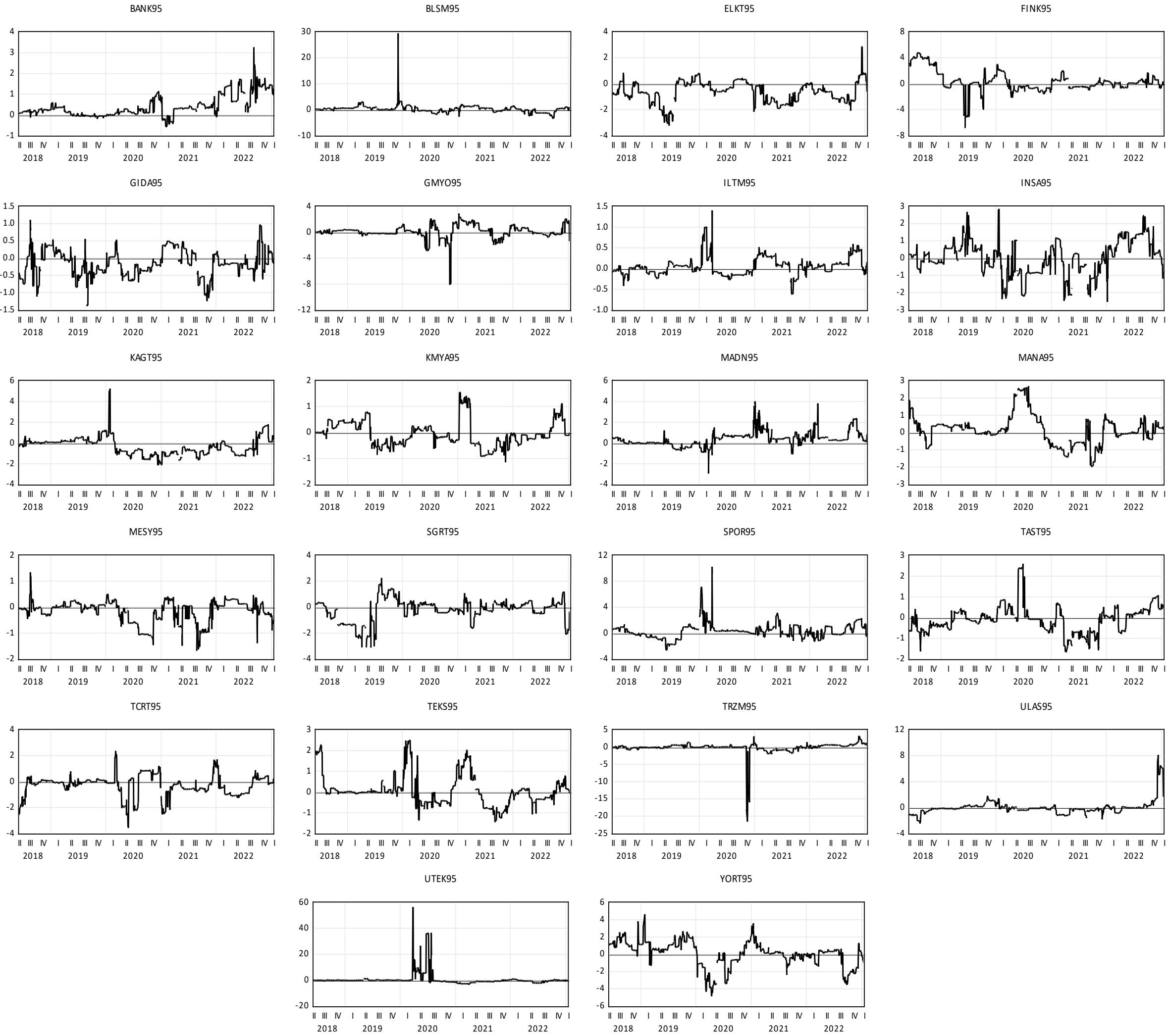

Figure 4. Net Total Directional Connectedness in Extreme Upper Quantile ($\tau = 0.95$)

Finally, the same analysis is executed for the extreme upper quantile, which corresponds to high returns. As observed in the extreme lower quantile, some spikes in the return transmissions from sectorial indices to SRD are also monitored here. The largest jumps in positive (transmitted) and negative (received) sides are listed as follows: TEK, BLSM, and SPOR; and TRZM and GMYO, respectively. In the case of TEK and SPOR, persistent positive return spillovers are seen in the first and second quarters of 2020, which might be associated with the plummet in global equity markets due to the emergence of the COVID-19 pandemic. This finding also demonstrates the positive decoupling of BLSM and TEK from other sectors during the pandemic. While the spillover index values fluctuate above and below zero across the years in most sectorial indices, stable and persistent positive values are observed in the BANKS sector. The index points gain strength over the years and reach their highest in 2022. Since every constituent of this sector is listed under the SRD index, this result aligns with the theoretical expectations.

However, this rationale does not apply to ILTM and MESY. Therefore, it can be concluded that, in addition to technical reasons, the systematic risk component also plays a significant role in the transmission of returns from sectorial indices to SRD in Borsa Istanbul. Due to the technical and economic facts, the banking sector incorporates a relatively high portion of the systematic risk in the Turkish stock market. The size and depth of the Turkish stock market are considerably smaller than that of developed economies and firms that need capital primarily utilize the debt market rather than its counterpart, the equity market, and it induces a high connectedness between the banking sector and any other segments of the economy. This fact inflates the pose of the banking sector to systematic risk more than other sectors, and it appears that this reality plays a significant role in the findings.

5. Conclusion

Sustainability and its pillars interest various market participants and policymakers since it offers optimum use of natural resources and the preservation of the environment for future generations. In light of these facts, this study explores the return spillovers from the sectorial equity indices of Borsa Istanbul to the BIST Sustainability Index. To consider price developments and the extent of negative and positive returns, the empirical analysis is executed through the Quantile Spillover analysis, which allows for measuring return spillovers across different levels of returns. In this regard, the study focuses on three quantiles: extreme lower returns (lower quantile, τ=0.05), median returns (median quantile, τ=0.50), and extreme upper returns (higher quantile, τ=0.95). The empirical analysis is conducted for the period from 18.08.2017 to 13.01.2023 to account for various market developments on both a local and global scale. The sectors examined are as follows: Banks (BANK), Informatics Technology (BLSM), Electricity (XELKT), Leasing Factoring (FINK), Food and Beverage (GIDA), Real Estate Investment Trusts (GMYO), Telecommunication (ILTM), Construction (INSA), Wood Paper Printing (KAGT), Chemical Petroleum Plastic (KMYA), Mining (MADN), Basic Metal (MANA), Metal Products and Machinery (MESY), Insurance (SGRT), Sports (SPOR), Nonmetal Mining Product (TAST), Wholesale and Retail Trade (TCRT), Textile and Leather (TEKS), Tourism (TRZM), Transportation (ULAS), Sustainability (SRD), Technology (TEK), and Investment Trusts (YORT).

The results show that spillovers spike in both lower and higher quantiles across each sector. Out of the 22 sectors, the BANK and ILTM sectors dominate most of the spillovers in all examined quantiles. Specifically, the BANK and ILTM sectors propagate higher spillovers toward the sustainability index in lower and higher quantiles, while GMYO stands out in the median quantile and replaces the BANK sector's role. Besides the median quantile, GMYO also exhibits very high spillovers in the extreme upper quantile. While this result aligns with the findings from other sectors, the case of the median quantile requires further discussion regarding the factors driving these spillovers.

Considering the substantial weight of BANK and ILTM companies in the SRD index, the spillovers from BANK and ILTM to the sustainability index are more justifiable. However, this technical dependence cannot explain the high spillovers from GMYO to the SRD index, as the number of companies meeting sustainability requirements in this sector is relatively low. Therefore, this finding is attributed to the role of the GMYO sector in the Turkish economy. Its driving influence on economic growth and its organic connections with other sectors enhance its impact on the equity market, leading to high return spillovers, even during smoother market conditions. The significant return spillovers observed in the median quantile, which are even higher than those of the BANK sector, indicate that GMYO has the potential to impact the sustainability index during tranquil market phases, which are less prone to sentiment-driven influences and speculation.

On the other hand, these discussions do not apply to the construction sector (INSA). However, it is known that, unlike INSA, GMYO is an investment platform linked to the real estate market, and its engagement with the financial markets predates its listing on the stock exchange. This distinction makes GMYO more sensitive to market developments in the transmission of returns to the sustainability index, unlike the INSA sector.

As the lower and higher quantiles correspond to extremely low and high returns, reflecting considerably higher market volatility, the findings in these quantiles can be linked to relatively risky market conditions. As discussed earlier, in both quantiles, BANK and ILTM variables dominate and exhibit considerable spillovers to the SRD index. It should be noted that both sectors are represented in the SRD index by a substantial number of companies. However, as in the case of GMYO, this technical dependence may not fully explain the magnitude of these spillovers. In this context, it is proposed that the reason behind these return transmissions may be the systematic risks to which these sectors, particularly banking, are exposed. Since financing operations in the Turkish economy are primarily governed by the debt market, a greater volume of bank operations increases the banking sector's exposure to systemic risk. Therefore, risks propagated across sectors inevitably impact the banking sector due to its technical and financial interconnectedness. Consequently, it can be concluded that systematic risk likely plays a significant role in the spillovers from the BANK sector to the SRD. In other words the BANK sector plays a dominant role in transmitting shocks to the sustainability index under stress. This is explicitly connected to the concept of systematic risk: since banking is a highly interconnected sector, turmoil there can affect the entire market, including sustainability-oriented stocks. The findings indicate that a reduction in the volatility of the Turkish banking sector may help mitigate the rapid and abrupt price changes in the Borsa Istanbul sustainability index. Thus, it is suggested that financial regulators closely monitor and manage systemic risk in the banking sector as a means to protect the sustainability index's stability. This could involve encouraging banks to adopt stronger risk controls or maintain adequate capital buffers, especially since their distress can spill over to even the most sustainability-focused stocks. Alternatively, sectorial incentives and a rise in market volume and depth might be helpful. Likewise, for investors, it is recommended considering the sectoral sources of risk identified by this study when constructing ESG portfolios – e.g., hedging or underweighting sectors that contribute heavily to downside spillovers (like banking during vulnerable periods) and not assuming that a sustainability index is insulated from traditional sector risks.

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