The Relationship Between the Indices of Volatility (VIX) and Sustainability (DJSEMUP): An ARDL Approach

Gizem Vergili[1] , Mehmet Sinan Celik[2]

Abstract: *This study aims to determine the cointegration relationship between Dow Jones Sustainability Emerging Markets Index (DJSEMUP) and the VIX Fear Index with monthly series between February 2013 and March 2020. This study, which examines the cointegration relationship between sustainability and volatility index from the perspective of emerging markets, is novel. First, unit root tests are utilized to understand the stationarity of the series. The unit root test results show that the VIX Index and DJSEMUP Index are not stationary at the same level. To this end, the ARDL (Autoregressive Distributed Lag) bounds test, which allows to detection of stationarity relationships at different levels, is applied to examine the cointegration relationship. The results show that there is a long-term relationship between the DJSEMUP Index and the VIX Index with a negative coefficient. As a result, long-term investors of companies included in the DJSEMUP Index can be recommended to invest by considering the VIX Index.*

1. Introduction

Sustainability means producing without endangering the lives of others today and in the future. It is a comprehensive concept and is mainly handled under environmental protection, economic growth, and social development. Sustainability and Corporate Sustainability Assessment (CSA) strategies focus on the companies' financial and specific materials regarding economic, social criteria, and environmental. The Brundtland Report (1987) mentioned sustainability for the first time as "sustainable development". This report identifies sustainable development as "*meeting the needs of the present without compromising the ability of future generations to meet their own needs*" (Brundtland Report, 1987: 24). So, sustainability consists of these three subsets; economic, social, and environmental criteria. The concept of sustainability states that not only is economic growth vital, but preventing the unconscious use of natural resources has brought a new perspective emphasizing that social welfare should be achieved in a respectful way to the environment (Diez-Canamero et al., 2020: 4). While all stakeholders must adopt the concept of sustainability, it imposes excellent duties and responsibilities, especially on companies. Companies set different goals and continue their activities in line with these goals. Companies cannot be considered independent of the society in their operating regions. While they affect the community in many ways, they are affected by the society in many respects.

1   Asst. Prof., PhD., Burdur Mehmet Akif Ersoy University, Bucak Faculty of Business Administration, Department of Economics and Finance, Burdur, Turkiye, gizemvergili@mehmetakif.edu.tr
2   Res. Asst., PhD., Nigde Omer Halisdemir University, Faculty of Economics and Administrative Sciences, Department of Finance and Banking, Nigde, Turkiye, mehmetsinancelik@ohu.edu.tr (Corresponding Author)

In the past, while the ultimate goal of companies was profit maximization, this goal was later adopted as maximizing shareholder value and gained a different dimension with the "stakeholder theory" put forward by Freeman in 1984. According to the theory in question, while companies try to maximize shareholder value, they also affect the individuals and groups around them. It can be stated that they have social responsibilities towards the environment and society (Freeman, 1984: 53). International corporate responsibility reporting research began to be published by KPMG (Klynveld Peat Marwick Goerdeler) in 1993. When analysed in financial markets, the disclosure of sustainability reports is essential for sensitive investors and company stakeholders. Based on the announced reports, a sustainability index is prepared in the stock markets, guiding investors in this regard.

In terms of sustainability, a view creates a win-win situation for investors, as financial and social criteria in the investment process can increase the welfare of investors without compromising their values. Sustainable companies can be expected to perform better financially for reasons such as employee loyalty, better social performance, and acceptance of business reputation in the capital market. On the other hand, the opposing view argues that investment according to sustainability criteria will limit the investment universe, increasing the potential for higher volatility and decreased returns and leading to monitoring costs. Within the framework of socially responsible investment, hundreds of Sustainable mutual funds have been created in many countries. As of 2021, approximately $17.1 trillion in total assets in the USA are managed using sustainable, responsible and effective investment strategies (USSIF, 2021).

Sustainability in the business world requires that environmental, social, ethical and financial issues be harmonized with the corporate culture and addressed at the institutional level within a sustainable philosophy. The development of the perspective on sustainability undoubtedly affects the financial system. In this respect, sustainability indices are put into service by many world stock markets that encourage people who are sensitive to the environment and social issues to invest by increasing transparency, reducing information asymmetry and systematically evaluating the environmental, social and economic performance of businesses (Searchy & Elkhawas, 2012: 81).

The oldest sustainability index is the Dow Jones Sustainability Index (DJSI) which has been calculated since 1999. One of the newest created sustainability indexes is Borsa İstanbul Sustainability Index (XUSRD). Borsa İstanbul Sustainability Index has been the last sustainability index among developing countries and has grown quickly. Calculation dates started in other developing country stock markets; South Africa 2004, Brazil 2005, Indonesia 2009, Korea 2009, and Egypt 2010 (Temiz & Acar, 2018). The DJSEMUP Index, which constitutes the data set of the study, has also been calculated since February 2013. The sustainability index has particular importance for developing countries, and it can contribute to the planned development of companies in these countries while growing. Firms in emerging markets have understood effective sustainability management leads to competitive advantages. The DJSEMUP Index consists of firms located in Taiwan- ROC, Brazil, Thailand, India, Chinese, Chile, South Africa, Mexican, Colombia, Philippines, Malaysia, Russia, and Türkiye. 40.3% of the DJSEMUP Index consists of Taiwan, also known as the Republic of China; twenty-four companies are listed in the index. Nine companies are from Brazil, with a 14.2% market share of the Index. Thailand is the third country on the list, and its weight of shares is 13.9%. In DJSEMUP Index, among the emerging markets, Russia and Türkiye have 1% and 0.9%, respectively. As seen, Taiwan constitutes almost half of the index alone.

The number and weights of firms in the countries included in the sustainability index are also presented in Appendix (Table 1A). Today, stock markets, which help the deepening and development of financial markets, have become affected by many factors with the increase in economic globalization and the speed of capital movement. This expected behavior is influenced by the VIX "Fear" Index, which was introduced by Whaley (1993) 1993 as the volatility indicator of the market. The VIX Index is the trademark symbol denoting the Chicago Board Options Exchange (CBOE) Volatility Index. It is a popular scale computed by the CBOE's that measures the implied volatility in S&P 500 index options. Generally, investors take positions according to the VIX Index. This index also affects the policies of Central Banks (İskenderoğlu & Akdağ, 2018: 490). VIX Index volatility also affects stock market investors. The rise of the VIX Index generally causes a downward price trend in stock markets (Whaley, 2000: 32).

This study aims to investigate the long-run relationship between the DJSEMUP Index and the VIX Index. February 2013, when the DJSEMUP Index began to be calculated, was taken as the starting period, and March 2020 was taken as the ending period. The last analysis date is March 2020, and it is thought that excessive fluctuations during the pandemic period may deviate the analysis results. ARDL (Autoregressive Distributed Lag) bounds test was exploited to detect whether the cointegration relationship in the data set was arranged after the literature review on the subject and was found to be stationary at different levels.

In the literature, many studies analyse macroeconomic factors' effect on the volatility index. Studies in recent years focus on the sustainability or socially responsible investment index and volatility index in developed economies like the USA stock markets. Emerging markets perspective, there is no study about the cointegration relationship in the literature on the volatility index and sustainability index. This study aims to contribute to the relationship between the volatility index and sustainability index in an emerging market economy.

The study has been designed as follows: In the second section, a literature review of the VIX Index and stock markets are described, whereas the data and methodology are presented in the third section. In the fourth section, empirical results are discussed, concluding remarks and analysis suggestions are addressed in the last part.

2. Literature Review

The over-integration of economies through trade and investment has led to an increase in correlation between almost all markets, especially stock markets. A shock in the USA directly affects the investments flowing to developing countries and their markets with a domino effect. In general, the shock wave moves from developed countries to emerging markets. Therefore, the relation of the VIX Index with emerging markets is vital for investors and governments. In recent years, sustainability has been more crucial than before worldwide. A sustainable business strategy can help to lead the sustainability of companies. Investors also invest for the future in the stock market; the future passes through sustainability. For anyone who prefers to invest in social and environmental criteria and is willing to get more, the correct address seems like the DJSEMUP Index. Emerging markets which are riskier than developed market economies can offer higher returns to investors. There are several studies investigating the negative relationship between the stock markets and the VIX Index, and there are also studies investigating the relationship between VIX futures markets and VIX Index (Zhang, 2006; Sarwar, 2012; Wang, Tsai, & Lu, 2014; Kaya & Coşkun, 2015; Chandra & Thenmozhi, 2015; Kaya, 2015; Bantwa, 2017; Emna & Myriam, 2017). Some studies examine macroeconomic factors' effect on the volatility index (Chen & Clements, 2007; Onan, Salih, & Yasar, 2014; Prasad, Bakhshi, & Seetharaman, 2022). The sustainability and the VIX Index relations have been argued for a few years, especially in the USA stock markets. There is a lack of studies on the volatility index and sustainability index in an emerging market economy; hence, this is an attempt to fill it. This study hopes to meet the deficit in this topic. Firstly, in this study, the VIX Index and other stock markets and macroeconomic relations are given. After that, the relation between the VIX Index and sustainability and some social responsibility indices is investigated in the literature review.

Giot (2005) investigated the relationship between S&P100 and NASDAQ100 indices, VIX Index and Nasdaq Volatility Index (VXN). He explored this relationship using the linear regression method. The analysis of the study was carried out using data from 1994-2003. As a result of his research, NASDAQ100 and S&P100 indices and their related volatility indices have a negative and significant relationship. The VIX Index is used to explain the uncertainties of the markets and the changes in the markets. Chiang (2012) reviewed the interaction between S&P 500, NASDAQ100, VIX, and VXN Indices using the GARCH model. Chiang has reached that the VIX Fear Index strongly affects the S&P500 Index. From a different perspective, Sarwar (2012) analysed the relationship between S&P500 return, VIX, and BRIC countries' stock markets returns. The result of the study shows that the VIX Index have a negative relation with S&P returns and BRIC stock market returns. The VIX is a fear gauge for Unites States markets and the stock markets of China, Brazil and India. Mensi et al. (2014) use the quantile regression approach to analyse BRICS countries' stock markets between September 1997 and September 2013. The results show that the VIX negatively impacts the BRICS countries'

stock returns except for India when there is a bearish session in the stock markets. And also, the VIX Index has no impact on the BRICS countries' stock returns except for Brazil and India during the bullish session. In their study, Huang and Wang (2017) examined the investors' fear on investment decisions in the VIX Index and the Taiwan Stock Exchange, so the VIX is discussed from a different viewpoint. Huang and Wang analysed the study with regression analysis using daily data between 01.01.2007 and 31.12.2014. As a result of the study, herding behaviour in the Taiwan Stock Exchange increases with the VIX. They concluded that the changes in the VIX Index affect the investor's behavior. Emna and Myriam (2017) examined the relationship between the VIX Index and stock returns using the GJR-GARCH model and the Granger causality test. Analysis data are daily returns of Switzerland, England, Germany, and France for 5 years, covering 2010 and 2015. As a result, it has been determined that there is a two-way relationship between stock returns and the VIX Index for Switzerland, stock index changes have a leverage effect on the VIX Index for France, and there is a relationship between the VIX Index and stock returns for Germany. For England, no relationship was found between the VIX and stock returns. Sadeghzadeh (2018) examined the factors affecting Borsa İstanbul (BIST) 100 Index using monthly data between 2004-2018. The long and short-term analyses show that increases in the VIX Index cause a decrease in the BIST 100 Index. As a result, the volatility index can represent an adverse sign for investors who want to invest in BIST100 Index. Ji et al. (2018) analysed the causal relationship between the VIX Index and implied volatilities in the BRICS countries' equities on 16.03.2011-09.12.2016 and determined that the reason for the volatility was the VIX Index, even Brazil and China. Yang et al. (2018) analysed the effects of the VIX Index on the credit default swaps (CDS) of the G7 and BRICS countries with the data of 01.01.2009-02.12.2017 and determined the negative effect of the VIX Index both CDS of G7 countries and BRICS countries in the middle and long term. There are no significant results for the short term between the VIX and CDS of G7 and BRICS countries. Akdağ (2019) examined the effect of the VIX Index on various financial indicators. As a result, the VIX Index has been determined to impact BIST, Euro and US Dollar exchange rates, real sector confidence index, risk appetite index, industrial production index, purchasing managers index, and consumer confidence index. It has been determined that the VIX Index acts together with other variables in the long run. Another study conducted as country groups is Su's (2020) study. The volatility spread between G7 stock markets and the VIX Index was investigated using daily frequency data between 2003 and 2015, and the volatility from the VIX Index to France, Japan and England stock markets was determined in the study. The implied volatility of the VIX Index positively affects net volatility spillovers in Japan, the United Kingdom and France. Because the panic of investors increases, the volatility of stock markets increases too. In his study on the BRICS country group, Gürsoy (2020) looked at whether the VIX Index had an effect using the data between 2011 and 2020 and determined a two-way relationship between the VIX Index with stock markets of; Russia (RTSI) and South Africa (INVSAF40), and a one-way relationship with China (SSEC) and India (BSESN). In the study of Smales (2022), the effect of the VIX Index on the implied volatility of the G7 and BRICS countries was examined from January 2001 to December 2020. BRIC countries' data is not available before March 2011. So the BRIC countries are used as a sub-section in the study. US stock market volatility causes uncertainty in G7 and BRIC countries' stock markets. The VIX Index transmits fears to global markets, but there is no reverse effect from global markets to the VIX Index.

Some researchers examined the impact of volatility index and socially responsible investment indices in USA stock markets. López et al. (2019) analysed the effect of the VIX Index on the indices of the S&P500, the S&P500 Environmental & Socially Responsible between 2nd of January 2015 and 30thof December 2016. The companies listed in S&P500 and S&P500 Environmental & Socially Responsible react negatively to the VIX returns. Morales et al. (2019) investigated the data of the VIX Index and Socially Responsible Investing (SRI) Indices which constitutes the Dow Jones (DJ) Sustainability, Dow Jones Sustainability Index (DJSI) World USA subset, DJSI World excluding alcohol, gambling, tobacco and arms and finally MSCI KLD 400 Social. As a result, The VIX Index, which represents implied volatility, has a negative effect on the SRI indices mentioned. Shaikh (2022) analyses the relationship between sustainable investment and uncertainties in the stock market period between 2000-2017. The VIX Index is used as an equity market uncertainty. It is found that Dow Jones Sustainability Indices (DJSIUS) and the future volatility of the VIX Index have a negative relationship.

3. Data and Method

This study investigates the long-term relationship between the DJSEMUP Index, one of the first sustainability indices, and the VIX Index. Monthly series between February 2013 and March 2020 were used to reduce volatility of data instead of daily. In the literature it is shown that daily and monthly data are significantly similar in mean value, maximum value and minimum value. Monthly data are all approximate with daily data. Since the start date of the DJSEMUP Index is February 2013, it was chosen as the beginning of the data set. March 2020 has been set as the end of the analysis period, as excessive volatility during the pandemic period may distort the analysis. COVID-19 was declared as a pandemic by The World Health Organization (WHO) in March 2020. The DJSEMUP Index and the VIX Index data were attained from the "www.spglobal.com" and "investing" websites.

Firstly, the unit root tests should be carried out on stationarity in time series. Determining whether the series has a unit root is essential in time series analysis. In this study, Phillips-Perron (PP) and Augmented Dickey-Fuller (ADF) tests were applied to test the stationarity of the data set. The outcome of tests showed that the series are non-stationary at the same level. Because of this, checking the long-term relationship between The VIX Index and the DJSEMUP Index is possible with The ARDL bounds testing. The ARDL bounds testing approach is developed by Pesaran and Shin (1999) and Pesaran et al. (2001). There are several advantages of using the ARDL bounds testing approach. One of them it; the ARDL allows the detection of stationarity relationships at different levels, which was applied to ascertain the cointegration of the series. Cointegration is used to detect the steady-state equilibrium between the series The other advantage is the small sample and data sizes the ARDL is relatively more efficient than other cointegration tests. Using monthly data which are non-stationary at the same level make sense to use the ARDL Bounds Test. In the case of this study, choosing this approach also is appropriate with 84 observations. Finally, applying the ARDL in research help to obtain unbiased estimates of the long-run model (Harris & Sollis, 2003). From this point of view, the ARDL Bounds Testing is used to conduct the long-run relationships between series with different orders of integration. After testing the existence of cointegration with the F-test and comparing it with the critical value table of Pesaran et al. (2001). If the F- test statistic is above the upper bond, H_0 of no long-run relationship can be rejected, on the other hand F-test statistic is lower under the bond the H_0 can not be rejected. If the result of F-test statistic is between the upper and lower bond, Using the ARDL Bounds Testing Approach inappropriate

4. Empirical Results

Descriptive statistics of the VIX Index and DJSEMUP Index data are shown in Table 1 below.

Table 1. Descriptive Statistics of Variables

Variables	Observations	Mean	Std. Deviation	Minimum	Maximum
DJSEMUP	84	996.0101	102.6964	707.0133	1185.641
VIX	84	15.10905	3.502054	9.51	28.43

Since the Dow Jones Sustainability Emerging Markets Index consists of larger numbers than the VIX Index data set, the DJSEMUP Index data are used logarithmically.

Before analysing with series, the conventional unit root tests ADF (1981), and PP (1988) tests are utilized. Table 2 and Table 3 show the unit root test results of the VIX Index and DJSEMUP Index, respectively.

Table 2. Unit Root Test Results of DJSEMUP

	ADF	
DJSEMUP	**Intercept**	**Trend and Intercept**
Level	-2.019	-1.813
	(-3.471)	(2.588)
First	-4.426***	-4.560***
Difference	(-3.162)	(-2.588)
	PP	
DJSEMUP	**Intercept**	**Trend and Intercept**
Level	-10.381	-9.965
	(-17.262)	(-10.898)
First	-52.540***	-52.677***
Difference	(-17.248)	(-10.892)

Critical values are given in parentheses. ***; 0.01 represent significance level.

As seen in Table 2, DJSEMUP Index has a unit root, so it is not stationary at the level in both tests. So non-stationary data were made stationary at the I(1) level by taking the first difference.

Table 3. Unit Root Test Results of VIX Index

	ADF	
VIX	**Intercept**	**Trend and Intercept**
Level	-3.525 **	-3.548***
	(-3.161)	(-2.588)
	PP	
VIX	**Intercept**	**Trend and Intercept**
Level	-47.663***	-47.648**
	(-10.898)	(-17.262)

Critical values are given in parentheses. ***, **; 0.01 and 0.05 represent significance levels, respectively.

The unit root test results (ADF and PP) of the VIX Index show that the VIX Index data is stationary at the level in Table 3.

Table 4. Selection of Optimal Lag Length

Lag Lenght	FPE	AIC	HQ	SIC
0	0. 00012	-3.3556	-3.33093	-3.2938
1	0. 000091	-3.63061	-3.55658*	-3.44521
2	**0.000088***	**-3.65977***	-5.74559	-3.35077
3	0.000095	-3.58744	-2.02695	-3.15485

It is necessary to choose the optimal lag length by using the lag order selection model, which are Final Prediction Error Criteria (FPE), Akaike Information Criteria (AIC) Hannan Quinn Criteria (HQ), Schwarz Information Criteria (SIC). Estimating optimal lag length criterion, shown in Table 4, the maximum lag length is applied three (3) in checking analysis through Stata because the result did not change when the maximum lag length was bigger. As presented in Table 4, Final Prediction Error Criteria and Akaike Information Criteria values were considered to determine the optimal lag length as two (2). After the selection of the lag length criterion for the analysis of the relationship between the two series ARDL method is used to detect the relationship at different levels. The model was established as Equation 1.

$$\Delta DJSEMUP_t = c_0 + \sum_{i=1}^{m} c_{1i} DJSEMUP_{t-I} + \sum_{i=0}^{n} c_{2i} VIX_{t-I} + \varepsilon_I \qquad (1)$$

Error correction model results are presented in Table 5, and lag lengths are taken as two (2), which were chosen above.

Table 5. ARDL Results and Diagnostic Test of The Model

	Coefficient
ADJ (DJSEMUP)	-0.1190878
	(0.016)
LR (VIX)	-0.6322458
	(0.040)
SR	
	-0.0235 **(D1)**
	(0,039)
	0.009 **(LD)**
	(0.384)
	0.0132 **(L2D)**
	(0.002)
R^2: 0.8209	**R^2 (Adj):** 0.9378
DW: 2.036844	**F Statistic:** 6.037
X ^{2BG}: 0.2543	

P values are in parentheses. X ^{2BG}, DW denotes Breusch-Godfrey and Durbin Watson, respectively.

Null hypothesis which is "there is no long-term relationship" rejected with 0.016 probability value. It can be stated that there is a long-term relationship between the two series because the "ADJ" value is significant. When the ADJ speed of adjustment coefficient is examined, it can be stated that DJSEMUP Index reacts negatively 0.11 in a period. The LR-long run coefficient result shows the effect of the independent variable on the dependent. Adjusted R^2 is 0.93, which means the VIX Index, the independent variable of the model, can explain the dependent variable DJSEMUP Index. In the model, VIX Index affects DJSEMUP Index in the long term. Diagnostic test results at the bottom of Table 6 give information about no autocorrelation problem in the model.

Table 6. Bounds Test Results for Cointegration

		I(0) Lower Bound Critical value 5 %	I(1) Upper Bound Critical value 5 %
k*=1	**F-Statistic** 7.125	5.039	5.871
k*=1	**t-Statistic** 3.576	-2.887	-3.263

* denotes the number of the independent variable.

The CUSUM Square test is used to determine whether the regression coefficients are stable or not. If F and t statistics are higher than the critical values, indicating a long-term relationship. F and t statistics are higher than 5 % critical value upper bounds, which denotes a long-term equilibrium relationship between DJSEMUP Index and VIX Index. Also, the result of the CUSUM Square test plots for structural break has shown in Graph 1 that there is no breakage.

Graph 1. CUSUM Square Test
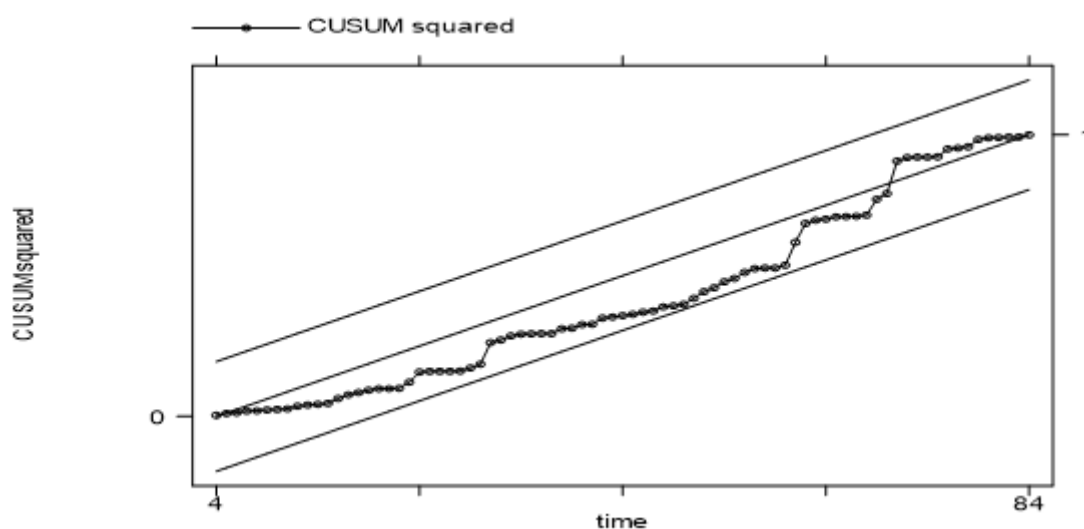
5. Conclusion

Investors also monitor many indicators that may affect their investments during the investment process. The VIX Index is one of these indicators to which investors constantly follow and attach importance. This study aims to check the relations between The VIX Index and the sustainability index of emerging markets, which is the DJSEMUP. February 2013, when it began to be calculated, was taken as the starting period, and March 2020 was taken as the DJSEMUP Index ending period. The World Health Organization declared the COVID-19 pandemic in 2020. COVID-19 caused deaths and illnesses worldwide and affected financial markets also rigorously. The study examines the long-run relationship between the DJSEMUP Index and the VIX Index. The results of the study indicate that there is a long-term equilibrium relationship between the indices. The long-term coefficient is negative, which means The VIX Index and the DJSEMUP Index have a long-term equilibrium relation. And the correlation between the series is negative. These results parallel the literature explaining the existence of a negative correlation of the VIX Index with stock markets (Sarwar, 2012; Wang et al., 2014; Kaya & Coşkun, 2015; Chandra & Thenmozhi, 2015; Kaya, 2015; Bantwa, 2017; Emna & Myriam, 2017). The high volatility causes a higher VIX Index, pushing investors to act more hesitantly in their decisions. When the fear in the financial markets gets higher, it is expected to affect the Sustainability Index negatively. In this study sustainability index indicator is the DJSEMUP Index, so emerging markets react more than developed markets. And negative effect fits with the literature review.

Emerging markets represent returns for investors with high risk. The importance of the DJSEMUP Index, which indexes companies that act in the light of rising corporate governance principles in their economic, environmental and social activities to create long-term value in emerging markets, attracts more attention for investors who want to spread the risk. As a result, long-term investors of companies included in the DJSEMUP Index can be recommended to invest by considering the VIX Index.

Choosing the end date of March 2020 can be described as the limitations of this study. Future researchers can compare the pandemic and pre-pandemic periods when the VIX Index was highly volatile. Moreover, researchers can examine the relationship between the sustainability indices calculated in developing countries and the VIX Index one by one for further studies. By classifying country groups, it can be determined which group is affected by the VIX Index and to what extent.

Declarations and Disclosures

References

Akdağ, S. (2019). VIX korku endeksinin finansal göstergeler üzerindeki etkisi: Türkiye örneği. *Hitit Üniversitesi Sosyal Bilimler Enstitüsü Dergisi,* 12(1), 235-256.

Bantwa, A. (2017). A study on India volatility Index (VIX) and its performance as risk management tool in Indian stock market (2017). *Paripex - Indian Journal of Research*, 6(1), 248-251.

Chandra, A., & Thenmozhi, M. (2015). On asymmetric relationship of India volatility index (India VIX) with stock market return and risk management. *Decision,* 42, 33-55. https://doi.org/10.1007/s40622-014-0070-0

Chiang, S. M. (2012). The relationships between implied volatility indexes and spot indexes. *Procedia - Social and Behavioral Sciences*, 57, 231-235.

Chen, E. J., & Clements, A. (2007). S&P500 implied volatility and monetary policy announcements. *Finance Research Letters*, 4(4), 227-232.

Diez-Cañamero, B., Bishara, T., Otegi-Olaso, J. R., Minguez, R., & Fernández, J. M. (2020). Measurement of corporate social responsibility: A review of corporate sustainability indexes, rankings and ratings. *Sustainability,* 12(5), 2153. https://doi.org/10.3390/su12052153

Dow Jones Sustainability Emerging Market Index Data (2021). https://www.spglobal.com/spdji/en/indices/esg/dow-jones-sustainability-emerging-markets index/#overview (Access Date: 10.10.2021).

Emna, R., & Myriam, C. (2017). Dynamics of the relationship between implied volatility indices and stock prices indices: The case of European stock markets. *Asian Economic and Financial Review,* 7(1), 52-62.

Freeman, R. E. (1984). *Strategic management: A stakeholder approach.* Marshfield, MA, USA: Pitman Publishing Inc.

Harris, R., & Sollis, R. (2003). *Applied time series modelling and forecasting*. Wiley.

Huang, T. C., & Wang, K. Y. (2017). Investors' fear and heading behavior: Evidence from the Taiwan stock market. *Emerging Markets Finance and Trade*, 53(10), 2259-2278.

Giot, P. (2005). Relationships between implied volatility indices and stock index returns. *Journal of Portfolio Management,* 31(3), 92-100.

Gürsoy, S. (2020). Investigation of the relationship between VIX index and BRICS countries stock markets: An econometric application. *Mehmet Akif Ersoy Üniversitesi Uygulamalı Bilimler Dergisi,* 4(2), 397-413.

İskenderoğlu, Ö., & Akdağ, S. (2018). VIX korku endeksi ile çeşitli ülkelerin hisse senedi endeks getirileri arasında bir nedensellik analizi. Bildiriler kiyabı (ss. 489-505), 2. International Economic Research and Financial Markets Congress, 12-13-14 Nisan 2018, Cappadocia, Türkiye.

Kaya, A., & Çoşkun, A. (2015). VIX endeksi menkul kıymet piyasalarının bir nedeni midir? Borsa İstanbul örneği. *Cumhuriyet Üniversitesi İktisadi ve İdari Bilimler Dergisi*, 16(1), 175-186.

Kaya, E. (2015). Borsa İstanbul (BIST) 100 endeksi ile zımni volatilite (VIX) endeksi arasındaki eş-bütünleşme ve Granger nedensellik. *KMÜ Sosyal ve Ekonomik Araştırmalar Dergisi,* 17 (28), 1-6.

KPMG (2020). The KPMG survey of sustainability reporting 2020. Available online: https://assets.kpmg/content/dam/kpmg/xx/pdf/2020/11/the-time-has-come.pdf (Access Date: 29.12.2021).

Ji, Q., Bouri, E., & Roubaud, D. (2018). Dynamic network of implied volatility transmission among us equities, strategic commodities, and BRICS equities. *International Review of Financial Analysis*, 57, 1-12.

López-Cabarcos, M. Á., Pérez-Pico, A. M., & López-Pérez, M. L. (2019). Does social network sentiment influence S&P500 environmental & socially responsible index? *Sustainability,* 11(2), 320. https://www.mdpi.com/2071-1050/11/2/320 (Access date: 26.11.2022).

Mensi, W., Hammoudeh, S., Reboredo, J. C., & Nguyen, D. K. (2014). Do global factors impact BRICS stock markets? A quantile regression approach. *Emerging Markets Review,* 19, 1-17.

Morales, L., Soler-Domínguez, A., & Hanly, J. (2019). The power of ethical investment in the context of political uncertainty. *Journal of Applied Economics*, 22(1), 554-580.

Onan, M., Salih, A., & Yasar, B. (2014). Impact of macroeconomic announcements on implied volatility slope of SPX options and VIX. *Finance Research Letters,* 11(4), 454-462.

Pesaran, M. H., & Shin, Y. (1999). An autodistributed lag modeling approach to cointegration analysis. In S. Strom (ed.), *Econometrics and economic theory in the 20th century: The Ragnar Frisch centennial symposium*. Cambridge: Cambridge University Press.

Pesaran, M. H., Shin, Y., & Smith, R. (2001). Bound testing approaches to the analysis of level relationship. *Journal of Applied Econometrics,* 16*, 289-326.*

Prasad, A., Bakhshi, P., & Sheetharaman, A. (2022). The impact of the US macroeconomic variables on The CBOE VIX index*. Journal of Risk and Financial Management,* 15(3), 126. https://doi.org/10.3390/jrfm15030126

Sadeghzadeh, K. (2018). Borsanın psikolojik faktörlere duyarlılığı: Oynaklık endeksi (VIX) ve tüketici güven endeksi (TGE) ile BIST100 endeksi arasındaki ilişkiler. *Cumhuriyet Üniversitesi İktisadi ve İdari Bilimler Dergisi*, 19(2), 253-238.

Sarwar, G. (2012). Is VIX an investor fear gauge in BRIC equity markets? *Journal of Multinational Financial Management*, 22(3), 55-65.

Searchy, C., & Elkhawas, D. (2012). Corporate sustainability ratings: An investigation into how corporations use to Dow Jones sustainability index. *Journal of Cleaner Production*, 35, 79-92.

Shaikh, I. (2022). On the relationship between policy uncertainty and sustainable investing. *Journal of Modelling in Management,* 17(4), 1504-1523. https://doi.org/10.1108/JM2-12-2020-0320

Smales, L. A. (2022). Spreading the fear: The central role of CBOE VIX in global stock market uncertainty. *Global Finance Journal*, 51, 100679. https://doi.org/10.1016/j.gfj.2021.100679

Su, X. (2020). Dynamic behaviors and contributing factors of volatility spillovers across G7 stock markets. *The North American Journal of Economics and Finance*, 53, 101218.

Temiz, H., & Acar, M. (2018). Sürdürülebilirlik endeksinde işlem gören firmaların finansal performansı: Olay çalışması örneği, *Hitit Üniversitesi Sosyal Bilimler Enstitüsü Dergisi,* 11(3), 1971-1987. https://doi.org/10.17218/hititsosbil.441200

The Brundtland Report (1987). World commission on environment and development (WCED). Our common future. Available Online: https://www.are.admin.ch/are/en/home/media/publications/sustainable-development/brundtland-report.html (Access Date: 30.09.2021).

USSIF-The Forum for Sustainable and Responsible Investment. Available Online: https://www.ussif.org/blog_home.asp?Display=155 (Access Date:26.11.2022).

Wang, Y. C., Tsai, J. J., & Lu, W. (2014). The impact of volatility index on China's stock market. *Journal of Business & Economics,* 6(1), 23-46.

Whaley, R. E. (1993). Derivatives on market volatility: hedging tools long overdue. *The Journal of Derivatives,* 1(1), 71-84.

Whaley, R. E., (2000). The investor fear gauge. *The Journal of Portfolio Management,* 26(3), 12-17.

Zhang J. E., & Zhu, Y. (2006). VIX futures. *Journal of Futures Markets: Futures, Options, and Other Derivative Products,* 26(6), 521-531.

Yang, L., Yang, L., & Hamori, S. (2018). Determinants of dependence structures of sovereign credit default swap spreads between G7 and BRICS countries. *International Review of Financial Analysis*, 59, 19-34.

Appendix

Table 1A. Dow Jones Emerging Markets Sustainability Index (DJSEMUP)

Country	Number of Companies	Market Values	Index Weights
Taiwan, ROC	24	777,008.27	40.3%
Brazil	9	110,006,22	14.2%
Thailand	22	225,754.94	13.9%
India	11	152,865.06	11.3%
Chinese	3	39,207.01	5.6%
Chile	7	44,507.65	2.8%
South Africa	6	17,098.59	2.6%
Mexican	5	18,849.29	2.3%
Colombia	6	20,753.76	2.1%
Philippines	2	21,599.01	1.5%
Malaysia	1	13,665.90	1.4%
Russia	1	10,243.31	1.0%
Türkiye	3	14,382.30	0.9%
Source: www.spglobal.com, Country/Region Breakdown.			

This Page Intentionally Left Blank