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THE EFFECTS OF GLOBAL RISK INDICATORS ON THE MSCI EMERGING MARKETS INDEX

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Abstract

The rising uncertainty in financial markets in the last 40 years has led to the creation of new financial indices that will enable these uncertainties to be defined and measured. For this purpose, the first volatility index created was the VIX Index as an indicator of uncertainty in the stock markets, which was followed by the OVX Index as an indicator of uncertainty in the oil markets and the GVZ Index as an indicator of uncertainty in the gold markets. These volatility indices are also called "global risk indicators". The MSCI (Morgan Stanley Capital International) Emerging Markets Index, which is the dependent variable of the study, is an index that is frequently followed by fund and portfolio managers in international markets and used as a benchmark. Therefore, in this study, the relationship between the MSCI EM Index and the global risk indicators for the period 28.03.2011-25.03.2022 was examined by the Toda-Yamamoto Causality Test. Afterwards, impulse-response and variance decomposition tests were applied to the variables. As a result of the study, causality relationships from global risk indicators to the MSCI EM Index were determined.

JEL classification: C58, F30, F37
Keywords: MSCI Emerging Markets Index, global risk indicators, VIX Index, OVX Index, GVZ Index, Toda-Yamamoto Causality Test

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Introduction

The increase in uncertainty in financial markets around the world after the Second World War, the rapid developments in Germany and Japan in the 1960s, and the rapid increase in the American budget deficits in these years began to threaten the gold-indexed US dollar (USD) and the fixed exchange rate regime. As a result of the depreciation of the US dollar, the pressures on the stable parity of the US dollar started to increase. The distrust in the dollar and the oil crises that started in the 1970s caused inflationary pressures. Increasing uncertainties in the markets caused interest rates to rise and fixed exchange rate systems came to an end, and exchange rates began to fluctuate. Efforts to reduce uncertainty, along with the rapid development of technology, increased the importance of futures markets and in 1973, the first call option written on stocks began to be traded on the Chicago Board Option Exchange (CBOE).

After the 1980s, with the effect of developing technology, the increase in uncertainties in the markets has also led to an increase in uncertainties about the future. Various volatility indices have been created in order to measure the uncertainties. The first uncertainty measure was calculated in 1993 to be an indicator for international markets. This first Volatility Index (VIX Index), which is also called the "fear index", was created by the CBOE in order to use the implicit volatility of stock index options. An increase in the VIX Index indicates that the markets have turned negative.

The VIX Index is calculated using the implied volatility of stock options that are written on the S&P 500 Index and have a maturity date of more than 23 days and less than 37 days. The main purpose is to estimate the predicted volatility for the average 30-day stock market. The VIX Index was followed by the OVX Index and the GVZ Index which measure the volatility in gold and oil prices.

The dependent variable of this study is the MSCI Emerging Markets Index (MSCI EM), while the independent variables are the VIX Index, the OVX Index and the GVZ Index. The MSCI EM Index, which started on January 1, 2001, is calculated with the weighted average of the stock market indices of 24 developing countries. The countries in the index, created by Morgan Stanley Capital International, are China, Taiwan, Mexico, India, South Korea, Peru, Thailand, United Arab Emirates, Pakistan, Brazil, Russia, Poland, Malaysia, Chile, Colombia, Qatar, Czech Republic, Egypt, Greece, Hungary, Indonesia, Philippines, South Africa and Turkey. The weights of these countries in the index are as follows: China 30.04%, Taiwan 16.15%, India 13.10%, South Korea 12.58%, Brazil 5.82%, and other countries 22.31% (MSCI Emerging Markets Index, 2021; Kaya & Yarbaşı, 2020).

In this study, the relationships between the MSCI EM Index, which consists of emerging market indices, and the VIX, OVX, and GVX volatility indices, which are important indicators in international markets and called "global risk indicators", was examined by using the Toda-Yamamoto Causality Test. The period of the analysis is between 28.03.2011 and 25.03.2022. Afterwards, variance decomposition analysis was carried out and impulse-response functions graphs were created to determine the shocks between the variables, and finally, results of the econometric analysis are discussed.

Literature review

In the literature, there are academic studies to explain the relationships between the MSCI EM Index, volatility indices and stock market indices. One of them is the study of Akar (2013). Akar (2013) investigated financial stability through the econometric analysis of the stock markets of the countries included in the MSCI EM index: Poland, Morocco, Russia, Czech Republic, Hungary, Russia, Turkey, Egypt and South Africa. The study conducted a Baur and Schulze (2009) Quantile Regression Test with the data belong to the 01.07.2002 -17.02.2011 period, and found evidence of financial stability only in Poland and Morocco among the examined countries. It was determined that other markets did not have financial stability.

Yıldız and Aksoy (2014) investigated whether portfolio diversification between BIST and emerging markets (MSCI) will be beneficial, in other words, whether there is cointegration between the markets. They conducted an Engle-Granger Cointegration analysis with the data belong to January 1990 - December 2011 period, and found a strong relationship between BIST and MSCI Index. Also, when all of the countries in the study are evaluated in general, it can be argued that it will not allow a good international portfolio diversification for Turkey.

Majdoub and Mansour (2014) examined the ccorrelations between the MSCI Islamic Index and five examples of emerging Islamic markets: Malaysia, Turkey, Pakistan, Qatar and Indonesia. They conducted multivariate GARCH BEKK, CCC, and DCC analyzes with the data belong to the January 2008 - January 2013 period. The results of the study show a weak correlation over time between the MSCI Islamic Index and emerging Islamic equity markets. However, it has been determined that there is no spread from the US market to the emerging Islamic stock markets.

Bayramoğlu and Abasız (2017) used VAR-EGARCH analysis method in their studies for the data between 12.03.2013 and 30.12.2016 with the aim of examining interaction and diffusion between MSCI Index and Emerging Market Index (Brazil, Mexico, Russia, Turkey). In the study, the volatility spread and variance change between the specified index returns were examined. According to the results of the analysis, MSCI Index has been determined as the leading index for each stock market index and for all markets.

Nageyev and Dinç (2018) tried to find an answer if gold can be used as a hedge in MSCI Turkey Stock Market Index and MSCI Participation Turkey Index, and applied the Wavelet Coherence analysis in their studies by using the data of 01.01.2010 - 04.04.2018 period. The findings show the hedge characteristic of gold. At the same time, gold demonstrates the safe harbor feature during periods of increased volatility. The findings are also decisive in ensuring the effectiveness of asset selection for those who invest in the Turkish market.

Öztürk (2018) investigated the relationship between MSCI EM Index and BIST 30 Index by applying the Johansen Cointegration Test for the data belong to January 2003 - July 2017 period. According to the results of the analysis, a significant long-term relationship was found between MSCI EM Index and BIST 30 Index, while no relationship could be found in the pre-crisis period.

The study of Kaya and Yarbaşı (2020), that used the data between 14.04.2003 and 31.12.2019 and conducted a Granger Causality analysis, examined the lead-lag relationship between MSCI EM Index and BIST 100 Index. As a result of the study, a bidirectional causality relationship has been determined between MSCI EM Index and BIST 100 Index.

Kamışlı and Esen (2020) examined the volatility relationship structure between Islamic Stock Index returns in the USA, India, Sri Lanka, England, Turkey, Japan, Malaysia and Kuwait in their study. They conducted an Engle and Sheppard (2001) conducted dynamic correlation analysis with the data belong to the 15.09.2008 - 06.06.2019 period. According to the results of the analysis, it has been determined that there is generally a dynamic volatility relationship between index returns, which is the subject of the study.

In the study of Gülhan (2020), the relationship between BIST 100 Index, VIX Index, dollar exchange rate, infectious diseases, Capital Markets Volatility Index, MSCI, Covid-19 and mortality rate were examined with the data belong to the 31.12.2019 - 28.05.2020 period. As a result of the analysis using Johansen Cointegration, Robust Least Squares and Error Correction Model, significant relationships were found in the short-run: A negative relationship between stock market index and mortality rate, dollar exchange rate and VIX Index; a positive relationship between infectious diseases, Capital Markets Volatility Index and MSCI. In the long-run, significant negative and positive relationships were found between stock market index and mortality rate and MSCI, respectively.

Büberkökü (2021) investigated the causality relationships between the VIX Index and MSCM EM and MSCM FM indices in the study where MSCI EM Index represents emerging market economies and MSCI FM Index represents developing countries. Toda-Yamamoto Causality Test, and Breitung and Candelon Frequency Domain Causality Test are conducted in the study with the data belong to the January 2007 - July 2021 period. According to the results of the analysis, no statistically significant relationship has been determined between the MSCI FM Index and the VIX Index. On the other hand, according to the results of Toda-Yamamoto Causality Test, there are one-way causality relationships both from MSCI EM and MSCI G7 indices to the VIX Index.

Data and methodology

In this study, which aims to describe the financial relationship between the MSCI EM Index, which is accepted as an emerging markets index, and global risk indicators, daily closing data for the period 28.03.2011 - 25.03.2022 were used.

The data set were obtained from Bloomberg Data Services. The abbreviations and variable names of the data used in the analysis are illustrated in Table 1.

Table 1: Variables of the study

Variables	Description of variables
MSCI EM	MSCI Emerging Markets Index
VIX	CBOE Volatility Index
OVX	CBOE Crude Oil Volatility Index
GVZ	CBOE/COMEX Gold Volatility Index

Source: Own elaboration.

Granger Causality Tests are frequently used methods in empirical analysis. Granger causality starts from the idea that the cause of the past cannot be the future or the present, and that if an event occurs before another event, the event that happened first may be the cause of the event that happened later. Based on this idea, Granger (1969) developed a test that analyzes whether the movements in one variable occur systematically before the movements of another variable (Hacker & Hatemi-J, 2006, p. 1489). Although the Granger Causality Test is highly applicable, it is a method that has some shortcomings. First of all, the variables to be tested for Granger causality must be stationary. If the series are not stationary, the F-test procedure will not be valid since the test statistics do not have a standard distribution (Gujarati, 2006).

In order to apply the Granger (1988) method, the non-stationary series must be integrated in the same order and there must be a cointegration relationship between the series. However, the method developed by Toda-Yamamoto (1995) allows the analysis of causality for integrated series of the same or different degrees, without the need for the existence of a cointegration relationship (Büyükakın et al., 2009). The Modified Wald (MWALD) Test developed by Toda-Yamamoto is a highly applicable test because it is based on the standard asymptotic distribution and does not require any pre-test (Çalışkan et al., 2017).

The standard Granger Causality Test is performed based on the estimation of a VAR (p) Model, with p being the optimal number of lags. The Toda-Yamamoto Causality Test is performed by estimating the VAR (p+d) Model, with the d series being the maximum degree of integration (Akçay, 2011). Therefore, it does not require testing for the existence of a cointegration relationship between the non-stationary series, and therefore estimating a VEC Model for the Toda-Yamamoto Causality Test predicts the VAR Model given in the equation.

The Toda-Yamamoto Causality Test is analyzed by the following two equations:

$$Y_t = \omega + \sum_{(i=1)}^{k} \alpha_{1i} X_{t-i} + \sum_{i=1}^{k} \beta_{1i} Y_{t-i} + \sum_{j=m+1}^{d\max} \delta_{1i} X_{t-i} + \sum_{j=m+1}^{d\max} \theta_{1i} Y_{t-i} + \varepsilon_{1t} \quad (1)$$

$$X_t = \partial + \sum_{(i=1)}^{k} \alpha_{2i} X_{t-i} + \sum_{i=1}^{k} \beta_{2i} Y_{t-i} + \sum_{j=m+1}^{d\max} \delta_{2i} X_{t-i} + \sum_{j=m+1}^{d\max} \theta_{2i} Y_{t-i} + \varepsilon_{2t} \quad (2)$$

The k in the equation shows the appropriate lag length and the dmax is the largest integration degree. The error terms $\mathcal{E}1_t$ and $\mathcal{E}2_t$ are assumed to have a zero mean and constant covariance matrix (Yenilmez & Erdem, 2018).

MWALD tests based on the VAR Model with the degrees of freedom to be estimated (k+dmax) showed that there was a $\chi 2$ distribution when the degrees of freedom were k and the maximum integration degrees were dmax. Toda-Yamamoto (1995) proved that the MWALD Test has an asymptotic $\chi 2$ distribution in a VAR order system to be estimated (k+dmax), by specifying the k lag lenght of the dmax series and the maximum degree of integration.

Empirical results

It will be useful to perform unit root tests before starting the analysis. Thus, it will be possible to decide whether the Granger Causality Test or the Toda-Yamamoto Causality Test can be applied. Before the unit root test, the statistical results of the study should be examined.

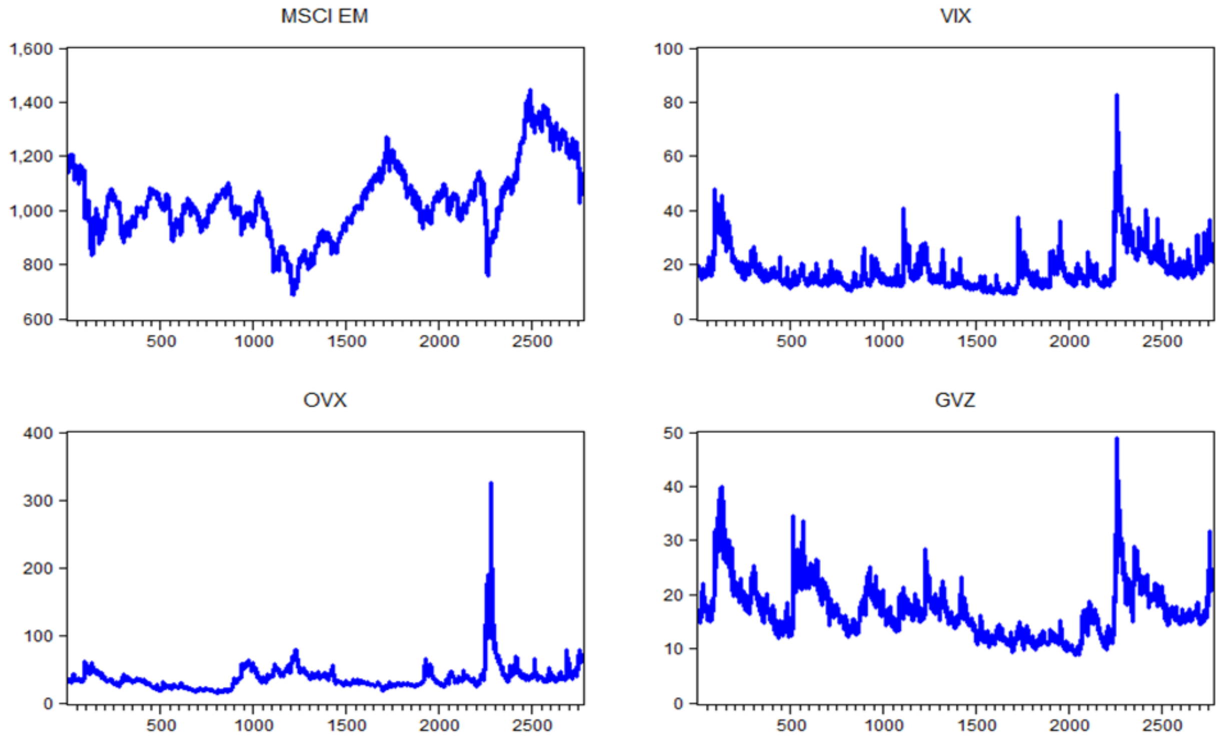
Table 2: Descriptive statistics

Statistics	MSCI EM	VIX	OVX	GVZ
Minimum	688.520000	9.140000	14.500000	8.880000
Mean	1033.206000	17.877430	36.962600	17.078730
Maximum	1444.930000	82.690000	325.150000	48.980000
Median	1017.040000	15.900000	33.670000	16.280000
Kurtosis	3.255145	15.376330	47.394740	5.971332
Jarque-Bera	112.162500	21028.660000	239634.100000	1800.144000
Skewness	0.476198	2.696759	5.150468	1.301320
Probability	0.000000	0.000000	0.000000	0.000000
Std. Dev.	136.313300	7.351530	19.243540	5.063887
Observations	2769.000000	2769.000000	2769.000000	2769.000000

Source: Calculated by the author in E-Views 8.

According to Table 2, the mean value of MSCI EM, which is the dependent variable of the analysis, is 1033.206, while its smallest value is 688.5200 and its largest value is 1444.930. When the mean values of the other variables are examined, it is seen that the mean value of VIX is 17.87, the mean value of OVX is 36.96, and the mean value of GVZ is 17.07. On the other hand, according to the standard deviation values, the deviations of MSCI EM are higher than the deviations of other variables. When the skewness coefficient is examined, it is seen that all variables have a left skewed distribution. Finally, considering the kurtosis coefficient, which helps to interpret the width in the distribution, it can be stated that all variables have a sharp distribution. The kurtosis coefficients of all variables of the study are greater than 3. When the kurtosis coefficient is greater than 3, a fat-tailed distribution occurs.

Graph 1: Graphical representation of variables for the period 28.03.2011 - 25.03.2022



Source: Calculated by the author in E-Views 8.

Graph 1 illustrates the closing values of the variables that are the subject of the research for 2769 days between 28.03.2011 - 25.03.2022. Since the data used in the study are time series data, it is vital to check the stationarity of the series, which is the most important assumption of time series analysis. In the case of a non-stationary series, a spurious regression problem is encountered in time series analyses and this situation reveals misleading results. For this purpose, the stationarities of the variables will be analyzed with the Augmented Dickey-Fuller (ADF) Unit Root Test before proceeding to the analysis (Kaya & Yarbaşı, 2020). Unit root test results of MSCI EM, VIX, OVX and GVX variables are given in Table 3.

Table 3: ADF unit root test results

Variables	Unit Root Test	Intercept		Trend and Intercept	
MSCI EM	Level	-2.382551	0.1468	-2.964635	0.1425
	1st Difference	-44.691240	0.0001	-44.688740	0.0000
VIX	Level	-5.718773	0.0000	-5.792329	0.0000
	1st Difference	-63.396260	0.0001	-63.384890	0.0000
OVX	Level	-4.921158	0.0000	-5.202715	0.0001
	1st Difference	-10.445340	0.0000	-10.448660	0.0000
GVZ	Level	-5.515748	0.0000	-5.673515	0.0000
	1st Difference	-34.477420	0.0000	-34.472480	0.0000

Source: Calculated by the author in E-Views 8.

All variables except MSCI EM were found to be statistically stationary at both constant and constant trend levels, and at 1% significance level. The MSCI EM Index became stationary after taking the first difference. Thereby, the Granger Causality Test cannot be applied in this study since all of the variables are not stationary at the same level. On the other hand, the Toda-Yamamoto Causality Test is suitable for application in the case of non-stationary spread at the same level values.

After determining the maximum number of delays, in the second step, it is necessary to define the optimal number of delays for the Toda-Yamamoto Model. The lag orders suggested by the information criteria are given in Table 4.

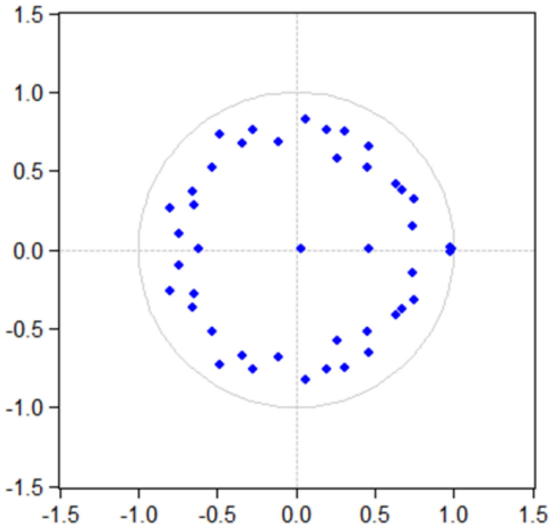
Table 4: VAR lag order selection criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-45351.63	NA	2.29e+09	32.90216	32.91076	32.90527
1	-27796.90	35045.79000	6819.898	20.17911	20.22207	20.19463
2	-27554.70	482.81060	5787.822	20.01502	20.09235	20.04295
3	-27429.13	249.96430	5345.571	19.93553	20.04722*	19.97588
4	-27376.00	105.61360	5203.494	19.90859	20.05465	19.96136
5	-27327.58	96.08876	5082.573	19.88508	20.06551	19.95026*
6	-27301.56	51.58192	5045.741	19.87781	20.09260	19.95540
7	-27281.03	40.61272	5029.221	19.87453	20.12369	19.96453
8	-27243.46	74.24284	4951.142	19.85888	20.14241	19.96130
9	-27217.94	50.36505	4917.058	19.85197	20.16986	19.96681
10	-27194.07	47.03398	4889.071	19.84626	20.19852	19.97351
11	-27147.05	92.48608	4780.329*	19.82376*	20.21039	19.96343
12	-27132.50	28.58389*	4785.374	19.82481	20.24581	19.97690

Source: Calculated by the author in E-Views 8.

According to the Akaike criterion, which is the most widely used criterion, the lag length was specified as 11. According to these results, the degree of integration of the variables is 1 (dmax=1) and the optimal lag length is 11 (k=11). Thereby, the appropriate lag length for the Toda-Yamamoto Causality Test (k+dmax) can be determined as 12.

Graph 2: Inverse roots of AR charasteristic polynomial



Source: Calculated by the author in E-Views 8.

Graph 2 illustrates that the inverse roots of the AR polynomial lie within the unit circle. Therefore, the VAR Model satisfies the stability condition. At the same time, there is no autocorrelation and varying variance problem in the model. According to these results, the VAR Model provides the necessary conditions.

Table 5: Toda-Yamamoto casuality test results

Variable	Lag (k+dmax)	Value	Probability	Results
VIX	11+1	163.65000	0.0000	Casuality
OVX	11+1	39.79451	0.0001	Casuality
GVZ	11+1	24.43738	0.0177	Casuality

Source: Calculated by the author in E-Views 8.

The results of the Toda-Yamamoto Causality Test in which the MSCI EM Index is the dependent variable and the volatility indices are the independent variables are given in Table 6. According to the results obtained, a Toda-Yamamoto causality relationship was observed from the VIX, OVX and GVX volatility indices to the MSCI EM Index. Thereby, it can be concluded that the MSCI EM Index is affected by the volatility indices.

Table 6: Variance decomposition analysis of MSCI EM

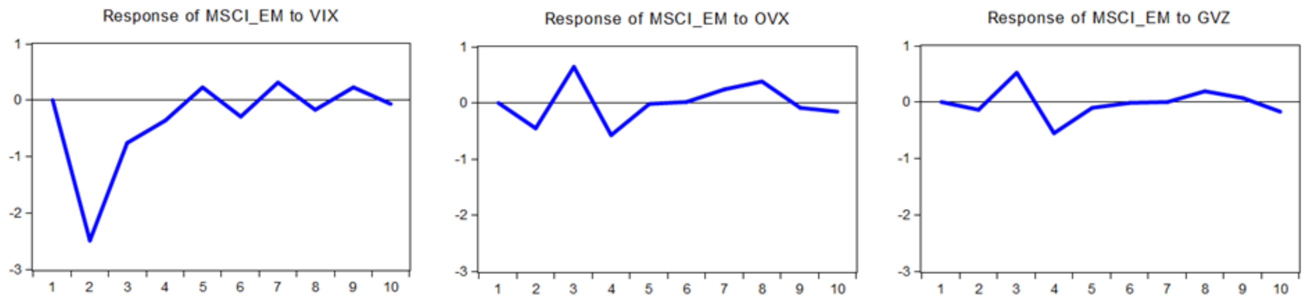
Period	S.E.	MSCI EM	VIX	OVX	GVZ
1	9.804199	100.00000	0.000000	0.000000	0.000000
2	10.248160	93.85361	5.927617	0.200374	0.018399
3	10.331730	92.76483	6.368133	0.583682	0.283358
4	10.370940	92.13077	6.436093	0.877689	0.555450
5	10.374780	92.07823	6.481086	0.877573	0.563115
6	10.381330	92.01035	6.550245	0.876580	0.562830
7	10.392810	91.87661	6.632736	0.929070	0.561587
8	10.409870	91.70051	6.636385	1.065928	0.597172
9	10.415240	91.64656	6.681500	1.070783	0.601154
10	10.421350	91.60581	6.678543	1.089858	0.625792

Source: Calculated by the author in E-Views 8.

According to the results of the variance decomposition analysis, which reveals how much the dependent variable is affected by the shocks of the independent variables, the dependent variable MSCI EM is affected by its own shocks 100% on the first day, and over 91% on the following days. In addition, the MSCI EM variable is affected by the shocks of the VIX variable by 5.93% and 6.37% on the second and third days, respectively, and by 6.68% on the tenth day; while it is not affected by the shocks of the VIX variable on the first day.

Similarly, the MSCI EM variable is also not affected by the shocks of the OVX and GVZ variables on the first day. On the other hand, it is affected by the shocks of the OVX variable by 0.20% and 0.58% on the second and third days, respectively, and by 1.09% on the tenth day; while it is also affected by the shocks of the GVZ variable by 0.02% and 0.28% on the second and third days, respectively, and 0.63% on the tenth day.

Graph 3: Impulse-Response analysis



Source: Calculated by the author in E-Views 8.

Impulse-response graphs, which illustrate the response that will occur in the other variable in return for a unit shock at the standard error level that will occur in one of the two variables, are illustrated in Graph 3. When the VIX impulse-response graph is analyzed, it is seen that the effect of a negative shock in the VIX Index on the MSCI EM Index disappeared in a five-day period. Similarly, the effects of a negative shock in the OVX and GVZ indices on the MSCI EM Index also disappeared in about a five-day period.

Conclusions

With the fluctuations in exchange rates after 1973 and the effects of liberal monetary policies that became widespread all over the world after 1980, unprecedented uncertainties emerged in the financial markets. These uncertainties increased the volatility in financial markets. From this point of view, financial market participants started to create volatility indices to measure the impact of this new uncertainty environment. The first volatility index created for this purpose was the VIX Index.

The VIX Index was created over the options trades written on the American S&P 500 Stock Market Index and measures the uncertainty in the financial markets. The VIX Index has an inverse correlation with the S&P 500 Stock Market Index. That is, an increase in the VIX Index is interpreted as an increase in uncertainty for financial market participants. Afterwards, the OVX Index was created in the same way to measure the uncertainty in the oil market and the GVZ Index was created to measure the uncertainty in the gold market.

On the other hand, market participants created MISC indices by using the weighted average of the stock market indices of the countries in order to reveal the movements of stock markets in the world collectively. The MSCI EM Index, which is the subject of this study, is also calculated with the weighted average of the stock market indices of 24 developing countries, and is frequently followed by fund and portfolio managers in international markets and used as a benchmark.

From this point of view, the relationships between the MSCI EM Index, which consists of emerging market indices, and the VIX, OVX, and GVX volatility indices, which are important indicators in international markets and called “global risk indicators”, was examined in this study. For this purpose, Toda-Yamamoto Causality Test and variance decomposition analysis were performed for the period 28.03.2011 - 25.03.2022, and impulse-response function graphs were created to determine the shocks between the variables.

According to the results of the analysis, a Toda-Yamamoto causality relationship was observed from the VIX, OVX and GVX volatility indices to the MSCI EM Index. Consequently, it can be concluded that the MSCI EM Index is affected by the volatility indices, and this finding should be taken into account by financial market investors.

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