Arrival Date: 17.05.2021 | Published Date: 25.07.2021 | Vol: 8, Issue: 4 | pp: 36-44 | Doi Number: http://dx.doi.org/10.38064/eurssh.221

INVESTIGATION OF THE RELATIONSHIP BETWEEN TURKEY AND DEVELOPED STOCK MARKETS IN THE PANDEMIC PERIOD: ARDL BOUND TESTING APPROACH

Anıl LÖGÜN

Res. Asst., Atatürk University, Faculty of Economics and Administrative Sciences, Department of Econometrics, Erzurum, Turkey, ORCİD: ID/0000-0003-2543-3964, logunanil@gmail.com

Rahman AYDIN

Res. Asst., Atatürk University, Faculty of Economics and Administrative Sciences, Department of Economics, Erzurum, Turkey, ORCİD: ID/0000-0003-0440-7468, rahmnaydn@gmail.com

ABSTRACT

The integration of stock markets is an essential issue for international investors who aim to make short and long term investments. This paper examines Turkey and developed stock markets co-movements during the pandemic. International portfolio diversification advantages are investigated for Turkish investors who have a portfolio in developed markets. For this purpose, the long-term relationship between stock markets is analyzed using the Autoregressive Distributed Lag (ARDL) bound test. The study covers January 2019 and April 2021, and this period is divided into two separate periods, pre-pandemic and pandemic. The results of ARDL bounds tests have not found a cointegration relationship between stock markets in both the pre-pandemic period and the pandemic period. Granger causality test results show that NIKKEI 225 (Japan), DAX (Germany), FTSE 100 (United Kingdom) and CAC 40 (France) are the cause of BIST 100 (Turkey) in the pre-pandemic period. However, Granger causality test results show that there is no causality relationship during the pandemic period. Turkish stock market investors investing in developed stock markets will benefit from portfolio diversification in the long term.

Keywords: International Portfolio Diversification, Cointegration, ARDL Bounds Testing, Developed Markets, Covid 19 pandemic

1.INTRODUCTION

The stock market integration hypothesis is that if the returns from investments in the stock markets of different countries are not correlated, potential gains can be derived from international portfolio diversification. This way shows that low co-movement of stock market prices offers investors the advantage of diversifying their assets in stock markets globally. Investors who own stock markets of other countries in a part of their portfolios can have the opportunity to increase the expected return of the portfolio without an increase in risk. International portfolio diversification enables investors to invest by following the stock markets of different countries (Palamalai and Devakumar, 2013).

Integration of stock markets is an essential issue for international investors who aim to invest. Suppose the stock market prices of different stocks are in the characteristic of a common trend. In that case, it will be difficult for investors who make portfolio diversification to gain long-term profits (Fraser and Oyefeso, 2005). If stock markets have a common trend, there is a joint force such as an arbitrage activity that brings the stock markets together in the long run, and any stock market will represent the behaviour of this market group. Therefore, cointegration tests provide information about the degree of arbitrage movements in the long run (Phylaktis and Ravazzolo, 2005).

The existence of long and short-term relationships between stock markets means integration between these stock markets. This situation will be important for investors who invest in the stock markets of different countries. The relationship between different stock markets will be information that will help investors who make international portfolio diversification to make decisions. The integration between stock markets can offer market makers an opportunity to build a broader investor base for the national market and enrich financial products (Chien, Lee, Hu and Hu, 2015).

This study examines the stock market integrations between Turkey ad developed countries and includes both pre-Covid 19 pandemic and pandemic periods analysis. Therefore, the study will contribute to the literature. First of all, we aim to provide information to international investors to reveal the dynamic linkages between

the developed markets and investors investing in Borsa Istanbul. The study presents the evidence of portfolio diversification benefits that may occur in developed markets from the perspective of Turkish investors for different periods. In addition, this study will also reveal whether the relationship between Turkey and developed markets differs during the pandemic. Revealing the relationship between emerging markets and developed markets is essential for investors who want to invest their portfolios in stock markets of different countries. In the study, the relationship between Borsa Istanbul, an emerging market, and six developed stock markets is examined within the scope of Covid 19 for both the pre-pandemic period and the pandemic period. A summary of the studies examining the relations between stock markets is presented in the literature section. After, the information on the stock market indices and the analyzed period is included in the title of the data. Then, the time series approaches used in the analysis are briefly introduced, and the analysis results are given. The last part of the study provides an overview.

2.LITERATURE REVIEW

Many studies in the literature examine the relationship between stock markets with cointegration and causality analysis. Different analysis results have been obtained in studies conducted for countries. Kanas (1998) investigates the linkages between stock markets in the UK, Germany, France, Switzerland, Italy and the Netherlands. The results show that the US stock market is not bilaterally cointegrated with any European stock market. In this context, portfolio diversification between the US stock market and European stock markets can be beneficial in the long run. Narayan, Smyth and Nandha (2004) examine the relationship between the stock markets of Bangladesh, India, Pakistan and Sri Lanka. Granger causality test results show that Bangladesh, India and Sri Lanka stock prices are the cause of Pakistan stock prices in the long run. In the short run, there is unidirectional causality from Pakistan stock prices to Indian stock prices, from Sri Lanka stock prices to India and from Pakistan stock prices to Sri Lanka. Floros (2005) examines the short and long-run relationships between stock markets in the US, Japan and the UK. The cointegration results reveal that there is a long-term relationship between the stock markets. According to Granger test results, bidirectional causality is obtained between NIKKEI 225 and FTSE 100. In addition, there is unidirectional causality between the stock market indices S&P 500 and FTSE 100, and S&P 500 and NIKKEI 225. Berument and Ince (2005) analyzed 10.23.1987 – 06.08.2004 to examine the effect of S&P 500 index returns on the Turkey stock market index. The analysis results showed that the S&P 500 index was not affected by the Turkey stock market index. Still, it was affected by the internal Dynamics of the Turkey stock market index and the S&P 500 index. In addition, the results showed that S&P 500 returns had a positive effect on the Turkey stock market index. Beine and Candelon (2007) examined the stock markets of 25 emerging countries. The panel data analysis results showed that trade and financial liberalization positively contributed to the links between emerging economies' stock markets. Valadhani and Chancharat (2007) examined the cointegration and causality between the Thailand stock market and Thailand's trading countries. They used monthly data between January 1987 and December 2005 were used in their studies. As a result of the Engle-Granger and Gregory and Hansen cointegration tests, no long-term relationships were found between the countries' stock market indices. In addition, the study concluded that investors could increase their investments through portfolio diversification in different international markets. Meric et al. (2012) analyze the relationship between stock markets after the 2008 stock market crash. They used approaches such as principal components, Granger analysis in their studies. As a result of the analysis, it reveals that portfolio diversification between stock markets has not been beneficial since the 2008 stock market crash. Granger causality test results show that the US stock market significantly impacted European and Australian stock markets after 2008. Diamandis (2009) applied cointegration tests for the Latin American stock markets for January 1988 – July 2006. He investigated the long-term relationship between stock markets to examine whether the potential benefits of an international portfolio continue in the long term in the study. Analysis results showed that there was a cointegration between Latin American stock markets. Singh (2010) examined the relationship between the India and China stock markets and the developed stock markets (US, UK, Japan, Hong Kong). Two-way causality was found between the China stock market and Hong Kong stock market in his study. According to the results, DJIA (Dow Jones Industrial Average) was the cause of the Shanghai stock market index, and FTSE was the cause of the Shanghai stock markets index. There was one-way causality between the China stock market and the FTSE and NIKKEI indices. The correlation between the China stock market indices and Hong Kong stock market index is found 0.82 and 0.79. Thalassinos and Politis (2011) investigated the cointegration between the stock markets of European countries and the stock markets of non-European countries for the period 1993 – 2007. The results showed that there was a

cointegration between European countries' stock markets. The results obtained for non-European countries, on the other hand, could not find a cointegration between Canada, Japan and Singapore stock markets and other countries' stock markets. Sahin and Sumer (2014) examine the relationship between developed and emerging countries and Turkey stock markets. They cover the period January 2009 to August 2014. The Granger approach is used to examine the causality between stock market indices using the VAR model. As a result of the analysis, it concludes that the returns of China, India, Kazakhstan and Russia affect the returns of the Turkey market. Jan et al. (2020) examined the existence of long-term relationships between the stock markets of BRICS countries between January 2009 and December 2019. BRICS have lower integration of stock markets in the long-term compared to the short-term, according to the analysis results of their studies. Salahuddin, Kashif and Rehman (2020) investigated the relationship between countries' stock markets classified according to different levels of development. They used panel cointegration and Dynamic Least Squares methods, and their study covered the period between 01.03.2000 – 10.29.2019. According to the analysis results, developed markets have a low correlation between emerging markets and frontier markets. Additionally, different findings are observed for the stock markets of countries with different levels of development. Sucuahi and Bije (2020) investigated the long-term relationship between the Phillippines stock market and sectoral indices from July 2010 to December 2019. The Johansen cointegration test results showed no long term relationship between the index formed by financial, industry, holding companies, real estate and service sectors, and the Phillippines stock market index (PSE). In contrast, a long term relationship was obtained between the mining industry index and PSE. Bhutto et al. (2020) examined the short and long term relationship between BRICS-P stock markets. They used monthly data between November 2012 and October 2018 in their studies. As a result of their studies, findings supporting the view that portfolio diversification would benefit BRICS-P countries are obtained.

Different approaches have been preferred in studies examining the impact of the Covid-19 pandemic on stock markets globally. Therefore, the continuation of the pandemic and the increase in the number of data concerned are the subject of different studies. Barut and Yerdelen Kaygın (2020) examine the impact of the Covid – 19 pandemic on the stock markets of eleven countries. They tested the existence of a long-term relationship between stock markets and the number of Covid – 19 cases with the Bayer and Hanck cointegration test. In the analysis results obtained, it is seen that there is cointegration between the stock market indices of Turkey, England, Netherlands, China and the number of Covid – 19 cases. The results show that there is a cointegration relationship between the stock market indices of Turkey, England, Netherlands, China and the number of Covid – 19 cases. Khan et al. (2020) examined the impact of the Covid – 19 pandemics on stock markets using a panel data approach and statistical tests for sixteen countries. As a result of the Panel Least Squares estimation, it was seen that the growth rate of weekly Covid – 19 cases negatively affected the stock markets return. Pavto and Raju (2020) investigated the short and long term relationship between the stock markets and macroeconomic determinants of nine emerging Asian countries. In these studies examining the period between January 2000 and August 2019, Johansen cointegration and Granger causality approaches were used. Analysis results revealed a cointegration relationship between macroeconomic variables such as consumer price index, export, import, exchange rate, Money supply, short-term interest rates and the stock markets of Asian countries. In addition, different results were obtained between macroeconomic variables and stock markets in the Granger causality test. Kusumahadi and Permana (2021) investigated the impact of the Covid – 19 pandemic on stock returns using daily data for the period between January 2019 and June 2020 for fifteen countries. Covid – 19 has a positive effect on return volatility in the study. Due to this different result, it was emphasized by the authors that various factors on stock return volatility should be examined. Madai (2021) discussed that the Covid – 19 pandemic on thirty stock returns. It revealed that changes in daily cases significantly affect stock returns in the results of the study. Covid – 19 death numbers were found to have a negative effect on returns but were statistically insignificant.

3.DATA

The study aims to investigate the existence of a long-term relationship between Borsa Istanbul and the developed markets. BIST 100 (Turkey) is chosen as an emerging market, while NIKKEI 225 (Japan), HANG SENG (Hong Kong), S&P 500 (the US), CAC 40 (France), DAX (Germany) and FTSE 100 (the United Kingdom = UK) for developed markets are utilized. Weekly data for the period January 2019 and April 2021 are used in the study. The data is obtained from the investing.com site. The World Health Organization

declared the Covid 19 outbreak as a pandemic on March 11, 2020. Therefore, the study is divided into two separate periods as of this date. The analysis is conducted for two periods, 06.01.2019 – 08.03.2020 (pre-pandemic period) and 15.03.2020 – 11.04.2021 (pandemic period). The stock market indices examined in the study are converted to the US dollar exchange rate. The logarithms of the series are included in the analysis.

Table 1: Descriptive Statistics of Stock Markets

Series	Mean		Standard Deviation		Minimum		Maximum		Skewness		Kurtosis	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Japan	5.30	5.43	0.06	0.16	5.08	5.01	5.39	5.65	-0.52	-0.40	4.81	2.47
US	7.99	8.13	0.06	0.13	7.86	7.74	8.13	8.33	0.23	-0.73	2.54	3.18
Hong Kong	8.17	8.11	0.05	0.08	8.04	7.99	8.25	8.28	-0.16	0.45	2.59	2.00
France	8.72	8.69	0.06	0.14	8.43	8.37	8.82	8.93	-1.59	-0.33	8.71	2.21
Germany	9.52	9.60	0.06	0.15	9.24	9.16	9.52	9.83	-1.24	-0.97	7.31	3.23
UK	9.14	8.99	0.06	0.10	-3.24	8.71	9.21	9.18	-3.24	-0.17	19.23	2.52
Turkey	5.18	5.11	0.09	0.15	4.95	4.87	5.33	5.41	-0.51	0.44	2.81	2.10

Note: The natural logarithms of the series are taken. (1): Pre-pandemic period. (2): Pandemic period.

The descriptive statistics of the pre-pandemic period in Table 1 show that the DAX has the highest mean. Turkey stock market index has the highest value of the stock market index according to standard deviation values. Except for Hong Kong (0.05), the standard deviation values of stock market indices of developed markets are the same. The skewness value is zero, and the kurtosis value is three, indicating that the series has a normal distribution. The skewness values of all stock market indices take negative values. Stock market indices show negatively skewed distribution in the pre-pandemic period. When we look at the kurtosis values, the kurtosis values of the stock market indices of the US, Hong Kong and Turkey are less than three, while the kurtosis values of the other stock market indices are higher than three. In the pre-pandemic period, the US, Hong Kong and Turkey stock market indices have platykurtic distribution.

According to the descriptive statistics of the pandemic period given in Table 1, the German stock market index has the highest value on the mean, like the pre-pandemic period. With the effect of the pandemic, the standard deviation values, which are considered a measure of risk, have increased in all stock market indices. During the pandemic period, the skewness values of developed markets, except Turkey, are negative. While Turkey and the US stock market indices have a positively skewed distribution, other developed stock market indices are left-skewed. Since the kurtosis values of the US and Germany stock market indices are greater than three, these stock indices have a leptokurtic distribution.

4.METHODOLOGY AND FINDINGS

The series must be stationary in financial time series analysis. For this purpose, unit root tests are applied first to examine the financial series. Unit root tests are used to determine whether the series is stationary or not in the study. In this context, Phillips and Perron (1988) unit root test and Perron (1989) unit root test with a breakpoint are applied. Table 2 shows the unit root test statistics of the two unit root tests with constant and constant and trend. According to the results, all stock market indices have a unit root at the level before the pandemic. Stock indices become stationary when their first difference is taken. Results of unit root tests show that Turkey, the US and Germany stock market indices are stationary at the first difference for the pandemic period. Japan, Hong Kong, UK and France stock market indices are stationary at the level.

Table 2: Results of Unit Root Tests

Variables	Breakpoint Unit Root Test				PP Unit Root Test			
	Constant		Constant + Trend		Constant		Constant + Trend	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
lturkey	-2.24 (0.96)	-3.92 (0.19)	-2.63 (0.97)	-3.18 (0.85)	-1.22 (0.66)	-3.06 (0.04)	2.51 (1.00)	-5.04 (0.00)
Δlturkey	-8.82 (0.00)**	-8.20 (0.00)**	-8.88 (0.00)**	-8.19 (0.00)**	-5.87 (0.00)**	-14.03 (0.00)**	-6.22 (0.00)**	-14.60 (0.00)**
ljapan	-1.67 (0.99)	-5.48 (0.00)**	-1.09 (0.99)	-6.16 (0.00)**	-2.15 (0.23)	-3.33 (0.02)*	-0.92 (0.95)	-5.95 (0.00)**
Δljapan	-8.71 (0.00)**	-14.30 (0.00)**	-8.63 (0.00)**	-14.26 (0.00)**	-7.03 (0.00)**	-11.21 (0.00)**	-7.37 (0.00)**	-12.78 (0.00)**
lus	-2.78 (0.80)	-3.07 (0.64)	-2.66 (0.97)	-6.08 (0.00)**	-1.84 (0.36)	-1.21 (0.66)	-2.47 (0.34)	-2.56 (0.29)
Δlus	-12.55 (0.00)**	-11.53 (0.00)**	-12.43 (0.00)**	-11.43 (0.00)**	-6.33 (0.00)**	-8.71 (0.00)**	-6.45 (0.00)**	-8.63 (0.00)**
lhongkong	-2.68 (0.84)	-4.04 (0.07)	-2.84 (0.95)	-3.86 (0.46)	-1.24 (0.65)	-1.65 (0.45)	1.63 (1.00)	-4.32 (0.00)**
Δlhongkong	-6.99 (0.00)**	-9.13 (0.00)**	-6.93 (0.00)**	-9.20 (0.00)**	-5.80 (0.00)**	-14.41 (0.00)**	-6.44 (0.00)**	-14.26 (0.00)**
luk	-1.96 (0.98)	-6.07 (0.00)**	-1.69 (0.99)	-6.21 (0.00)**	-1.26 (0.64)	-3.00 (0.04)*	1.36 (1.00)	-3.94 (0.02)*
Δluk	-5.07 (0.00)**	-12.00 (0.00)**	-5.198 (0.02)*	-6.21 (0.00)	-5.59 (0.00)**	-11.20 (0.00)**	-6.01 (0.00)**	-12.82 (0.00)**
lfrance	-2.53 (0.89)	-4.09 (0.13)	-1.99 (0.99)	-5.11 (0.02)*	-0.55 (0.87)	-2.34 (0.16)	0.19 (0.99)	-4.56 (0.00)**
Δlfrance	-6.90 (0.00)**	-11.53 (0.00)**	-7.17 (0.00)**	-11.47 (0.00)**	-6.13 (0.00)**	-12.99 (0.00)**	-6.66 (0.00)**	-12.73 (0.00)**
lgermany	-2.21 (0.96)	-3.77 (0.25)	-2.03 (0.99)	-6.14 (0.00)**	-2.14 (0.23)	-1.90 (0.33)	-1.95 (0.62)	-1.92 (0.63)
Δlgermany	-6.26 (0.00)**	-12.23 (0.00)**	-6.32 (0.00)**	-12.11 (0.00)**	-7.74 (0.00)**	-7.64 (0.00)**	-7.78 (0.00)**	-7.63 (0.00)**

Note: **,*, denotes 1%, 5% significant level. The level is the log of the stock market indices, and the first difference is the first difference of the level. Δ indicates the first differences of the stock market indices. (1): Pre-pandemic period (2): Pandemic period

Integration degrees of the series are obtained as I(0) and I(1) in the unit root test results of two periods. The difference in these different degrees of integration is due to the analysis results of the pandemic period. Autoregressive Distributed Lag (ARDL) bounds test approach examine the cointegration between financial time series with different degrees of integration. However, the series should not be I(2). This approach can also be applied when the series are stationary at different integrated degrees. Pesaran, Shin and Smith (2001) ARDL approach can be expressed as follows:

$$\mathbf{BIST_t} = \boldsymbol{\alpha_0} + \sum_{\mathbf{i=1}}^{\mathbf{p}} \emptyset_\mathbf{i} \Delta \mathbf{BIST_{t-i}} + \sum_{\mathbf{i=0}}^{\mathbf{p}} \boldsymbol{\delta_i} \Delta \mathbf{X_{t-i}} + \boldsymbol{\beta_1} \mathbf{BIST_{t-1}} + \boldsymbol{\beta_2} \mathbf{X_{t-1}} + \mathbf{u_t} \qquad (1)$$

p denotes the optimal lag length and Δ is the first difference of the series in equation (1). $\emptyset_\mathbf{i}$, $\boldsymbol{\delta_i}$, $\boldsymbol{\beta_1}$ and $\boldsymbol{\beta_2}$ are the slope coefficients. $BIST_t$ is the Turkey stock market index, and X_t is the stock market indices of developed markets, and i determines the nımber of lags specified in the equation (1) $\boldsymbol{\alpha_0}$ is the constant term and $\mathbf{u_t}$ is the error term. The null hypothesis means that there is no cointegration between the series, and the alternative hypothesis implies that there is cointegration between the series in the ARDL bounds test.

Table 3: Results of ARDL Bounds Test (pre-pandemic period)

	Models	F	Autocorrelation	Heteroscedasticity
Turkey – Japan	ARDL(1,4)	2.17	0.26 (0.61)	0.15 (0.70)
Turkey – Hong Kong	ARDL(1,3)	1.48	0.13 (0.72)	0.61 (0.43)
Turkey – Germany	ARDL(1,2)	1.45	0.95 (0.33)	0.72 (0.40)
Turkey – UK	ARDL(1,3)	1.16	0.36 (0.55)	0.49 (0.48)

Turkey – France	ARDL(1,3)	1.94	0.01 (0.98)	0.22 (0.64)
Turkey – US	ARDL(1,3)	2.89	0.24 (0.63)	1.03 (0.31)
Critical values for ARDL bounds test		I (0)	I(1)	
Critical values at 1%		3.13	3.65	
Critical values at 5%		3.80	4.36	
Critical values at 10%		5.38	6.03	

Note: F is the ARDL cointegration test. I(0) and I(1) mean lower and upper limit critical values, respectively. The critical values for the lower I(0) and upper I(1) bounds are taken from Narayan (2005, Appendix: Case II). Autocorrelation is the Breusch-Godfrey LM test, and heteroscedasticity is the ARCH LM test. Values in parentheses are prob-values.

The cointegration between the Turkey stock market and developed stock markets for both the pre-pandemic and pandemic periods are examined using the ARDL bounds test in the study. The appropriate lag length for ARDL models used the relationship between the Turkey stock market index and the stock market indices of developed markets depend on the Akaike Information Criterion. According to the results of Breusch – Godfrey LM and ARCH tests for all ARDL models, there are no autocorrelation and heteroscedasticity. Table 3 shows the cointegration test results between Turkey and developed markets for the pre-pandemic period. The results show that the F statistics are below the lower and upper limit values at 1%, 5% and 10% significance levels. These results indicate that there is no cointegration between the Turkey market and developed markets.

ARDL models created for stock markets in Table 4 do not have autocorrelation and heteroscedasticity. ARDL bounds test results between the Turkey stock market and developed markets for the pandemic period are given in Table 4. The F statistics for all stock market indices are below the lower and upper limit values at 1%, 5% and 10% significance levels. Analysis results show no cointegration between the Turkey stock market and developed markets for the pandemic period.

Table 4: Results of ARDL Bounds Test (pandemic period)

	Models	**F**	**Autocorrelation**	**Heteroscedasticity**
Turkey – Japan	ARDL(1,1)	2.03	0.07 (0.78)	0.45 (0.50)
Turkey – Hong Kong	ARDL(1,1)	2.05	2.42 (0.12)	0.12 (0.73)
Turkey – Germany	ARDL(1,1)	1.03	0.01 (0.99)	0.13 (0.72)
Turkey – UK	ARDL(1,1)	1.82	0.10 (0.75)	0.15 (0.70)
Turkey – France	ARDL(1,1)	1.22	0.01 (0.97)	0.13 (0.72)
Turkey – US	ARDL(1,1)	1.24	0.07 (0.79)	0.11 (0.74)
Critical values for ARDL bounds test		I (0)	I(1)	
Critical values at 1%		3.14	3.67	
Critical values at 5%		3.79	4.39	
Critical values at 10%		5.38	6.05	

Note: F is the ARDL cointegration test. I(0) and I(1) mean lower and upper limit critical values, respectively. The critical values for the lower I(0) and upper I(1) bounds are taken from Narayan (2005, Appendix: Case II). Autocorrelation is the Breusch-Godfrey LM test, and heteroscedasticity is the ARCH LM test. Values in parentheses are prob-values.

No cointegration relationship is found for both the pre-pandemic and the pandemic periods. Therefore, long-term predictions are not made, and error correction models are not established for short-term predictions in the ARDL bounds test approach. Granger (1969) causality test is applied to determine the causality between stock markets in the study. The Granger causality test is performed provided that the time series is stationary. In order to determine the relationship between the Borsa Istanbul index and stock market indices of developed markets, the following equations are established based on Vector Autoregressive (VAR) models.

$$\Delta \mathbf{BIST_t} = \alpha_0 + \sum_{i=1}^{p} \beta_i \Delta \mathbf{BIST_{t-i}} + \sum_{i=0}^{p} \delta_i \Delta \mathbf{X_{t-i}} + \mathbf{u_t} \qquad (2)$$

$$\Delta X_t = \alpha_0 + \sum_{i=1}^{p} \beta_i \Delta BIST_{t-i} + \sum_{i=0}^{p} \delta_i \Delta X_{t-i} + u_t \quad (3)$$

$\Delta BIST_t$ is the first difference of $BIST_t$ in equations (2) and (3). X_t is the developed stock market indices. Bivariate equations are created to apply the Granger causality test between BIST 100 and each developed stock market index in the study. The series should be included in the equation as stationary. The rejection of the null hypothesis indicates a causality between the two examined series in the Granger causality test. On the contrary, it means that there is a causality between the series.

Table 5 shows that the Granger causality test results examining the short-term relationship between stock market indices. For the pre-pandemic period, it is observed that there is a one-way causality from the stock market indices of Japan, Germany, the UK and France to the Turkey stock market index. According to the analysis results obtained for the pandemic period, causality could not be found between stock market indices.

Table 5: Results of Granger Causality Test

Granger Causality	Pre-pandemic period		Pandemic period	
	Lag Length	F Statistics	Lag Length	F Statistics
Turkey → Japan	2	1.29 (0.28)	1	0.48 (0.49)
Japan → Turkey	2	6.11 (0.00)*	1	0.38 (0.54)
Turkey → Hong Kong	1	1.81 (0.18)	1	1.43 (0.24)
Hong Kong → Turkey	1	0.11 (0.74)	1	1.35 (0.25)
Turkey → Germany	2	0.52 (0.60)	1	0.01 (0.91)
Germany → Turkey	2	6.17 (0.00)*	1	0.02 (0.89)
Turkey → UK	2	0.25 (0.78)	1	0.40 (0.53)
UK → Turkey	2	9.07 (0.00)*	1	1.09 (0.30)
Turkey → France	2	0.53 (0.59)	1	0.40 (0.53)
France → Turkey	2	6.23 (0.00)*	1	1.09 (0.30)
Turkey → US	1	0.36 (0.55)	1	0.23 (0.63)
US → Turkey	1	0.94 (0.34)	1	0.17 (0.68)

Note: * The rejection of the null hypothesis of no causality at the 1% significance level. Lag lengths are determined with the Bayesian Schwarz Information Criteria.

5.CONCLUSION

The short and long-term relationship between Turkey and the stock markets of six developed markets (Japan, US, Hong Kong, United Kingdom, France, Germany) is examined. In this context, ARDL cointegration analysis is performed using weekly data between January 2019 and April 2021. Pre-pandemic and pandemic periods analysis results show that a cointegration relationship between Turkey and the stock market indices of developed markets is not obtained. A unidirectional causality is obtained between Turkey, Japan, Germany, UK and France stock market indices in the pre-pandemic period. The results of Granger causality show that there is no causality between stock markets indices in the pandemic period.

Investors and researchers can evaluate a short and long term relationship between stock markets in terms of international portfolio diversification. In addition, short-term relationships between markets are examined in the study and causality are found in the pre-pandemic period. The absence of short and long term relationships between stock market indices for the pandemic period creates an opportunity for international investors who want to invest in developed markets together Turkey stock market and benefit from portfolio diversification. Investors can benefit from portfolio diversification for Hong Kong and US stock market indices for both two periods.

REFERENCES

Barut, A., & Kaygın, C. Y. (2020). Covid-19 Pandemisinin Seçilmiş Borsa Endeksleri Üzerine Etkisinin İncelenmesi. *Gaziantep Üniversitesi Sosyal Bilimler Dergisi*, *19*(COVID-19 Special Issue), 59-70.

Beine, M., & Candelon, B. (2007). Liberalization and stock market co-movement between emerging economies. *Quantitative Finance*, *11*(2), 299-312.

Berument, H., & Ince, O. (2005). Effect of S&P500's return on emerging markets: Turkish experience. *Applied Financial Economics Letters*, *1*(1), 59-64.

Bhutto, S. A., Ahmed, R. R., Štreimikienė, D., Shaikh, S., & Štreimikis, J. (2020). Portfolio Investment diversification at Global stock market: A Cointegration Analysis of Emerging BRICS (P) Group. *Acta Montanistica Slovaca*, *25*(1), 57-69.

Chien, M. S., Lee, C. C., Hu, T. C., & Hu, H. T. (2015). Dynamic Asian stock market convergence: Evidence from dynamic cointegration analysis among China and ASEAN-5. *Economic Modelling*, *51*, 84-98.

Diamandis, P. F. (2009). International stock market linkages: Evidence from Latin America. *Global Finance Journal*, *20*(1), 13-30.

Floros, C. (2005). Price linkages between the US, Japan and UK stock markets. *Financial Markets and Portfolio Management*, *19*(2), 169-178.

Fraser, P., & Oyefeso, O. (2005). US, UK and European stock market integration. *Journal of Business Finance & Accounting*, *32*(1-2), 161-181.

Granger, C. W. J. (1969), "Investigating Causal Relations by Econometric Models and Cross-Spectral Methods", *Econometrica*, 37(3), 424-438.

Jan, R. U., Ayub, U., Khan, M., Daniyal, M., & Khan, A. (2020). International Portfolio Diversification using Co-Integration Approach: Evidence from BRICS Countries. *Journal of Economics, Finance and Accounting Studies*, *2*(2), 30-42.

Kanas, A. (1998). Linkages between the US and European equity markets: further evidence from cointegration tests. *Applied Financial Economics*, *8*(6), 607-614.

Khan, K., Zhao, H., Zhang, H., Yang, H., Shah, M. H., & Jahanger, A. (2020). The impact of COVID-19 pandemic on stock markets: An empirical analysis of world major stock indices. *The Journal of Asian Finance, Economics, and Business*, *7*(7), 463-474.

Kusumahadi, T. A., & Permana, F. C. (2021). Impact of COVID-19 on Global Stock Market Volatility. Journal of Economic Integration, 36(1), 20-45.

Madai, T. (2021). Impact of COVID-19 Pandemic on Stock Market Returns. *Available at SSRN 3794199*.

Meric, G., Lentz, C., Smeltz, W., & Meric, I. (2012). International evidence on market linkages after the 2008 stock market crash. *The International Journal of Business and Finance Research*, *6*(4), 45-57.

Narayan, P. K. (2005). The saving and investment nexus for China: evidence from cointegration tests. Applied economics, 37(17), 1979-1990.

Narayan, P., Smyth, R., & Nandha, M. (2004). Interdependence and dynamic linkages between the emerging stock markets of South Asia. *Accounting & Finance*, *44*(3), 419-439.

Palamalai, S., & Devakumar, C. (2013). Stock market linkages in emerging Asia-Pacific markets. *Sage Open*, *3*(4), 2158244013514060.

Pavto, V. S., & Raju, G. A. (2020). Relationship between Asian Emerging Stock Markets and Economic Fundamentals: A Cointegration and Block Exogeneity Wald Approach. *International Journal of Economics & Business Administration (IJEBA)*, *8*(3), 280-292.

Perron, P. (1989). The great crash, the oil price shock, and the unit root hypothesis. *Econometrica: journal of the Econometric Society*, 1361-1401.

Pesaran, M. H., Shin, Y., & Smith, R. J. (2001). Bounds testing approaches to the analysis of level relationships. *Journal of applied econometrics*, *16*(3), 289-326.

Phillips, P. C., & Perron, P. (1988). Testing for a unit root in time series regression. *Biometrika*, *75*(2), 335-346.

Phylaktis, K., & Ravazzolo, F. (2005). Stock market linkages in emerging markets: implications for international portfolio diversification. *Journal of International Financial Markets, Institutions and Money*, *15*(2), 91-106.

Salahuddin, S., Kashif, M., & Rehman, M. U. (2020). Cross-Country Stock Market Integration and Portfolio Diversification Opportunities Evidence from Developed, Emerging and Frontier Countries.

Singh, G. S. P. (2010). Chinese and Indian stock market linkages with developed stock markets. *Asian Journal of Finance & Accounting*, *2*(2), E2.

Sucuahi, W., & Bije, E. (2020). Modeling Long-Term Relationships in Philippine Stock Market (PSE) Indices: A Cointegration Analysis. *Asian Economic and Financial Review*, *10*(9), 989-998.

Şahin, C., & Sümer, K. K. (2014). Gelişmiş ve Gelişmekte Olan Ülke Borsaları ile Türk Borsası Arasındaki Etkileşime Yönelik Bir İnceleme. *Trakya Üniversitesi Sosyal Bilimler Dergisi*, *16*(2), 315-338.

Thalassinos, E. I., & Politis, E. (2011). International Stock Markets: A Co-integration Analysis. *European Research Studies Journal*, *l*, *12*(4).

Valadkhani, A., & Chancharat, S. (2007). Dynamic linkages between Thai and international stock markets. *Journal of Economic Studies*.