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A Study on Co-movement between Stock Market Indexes with Empirical Analysis

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Abstract

Main aim of the study is to determine whether there is co-movement between stock market indexes of developed-European countries and Turkey by considering effect of Global Financial Crisis in 2008. Because of that, the co-movement is indicated for two different periods: 1996:M1-2008:M12 represents pre-crisis period and 2009:M1-2020:M11 represents post-crisis period. Developed-European countries stock market index is single index which is calculated by Morgan Stanley Capital International by considering 15 developed countries' stock market index in Europe. To clarify the results, firstly, unit root tests are applied to find the integration level of series. After detecting that series are integrated at same level in each period, Johansen cointegration test is used and one cointegrated relationship is found for post-crisis period while there is no cointegration in pre-crisis period. Finally, Granger causality test is progressed. One-way Granger causality is detected from developed- European countries stock market index to stock market index of Turkey

Keywords: *Comovement, Stock Market Indexes, Causality Analysis*
Jel Classification *C50, G10*

Hisse Senedi Piyasası Endeksleri Arasındaki Ortak Hareket Üzerine Ampirik Bir İnceleme

Öz

Bu çalışmada Avrupadaki gelişmiş ülkelerin hisse senedi endeksleri ile Türkiye'deki hisse senedi endeksi arasında bir ortak hareket olup olmadığını belirlemek amaçlanmıştır. 2008 yılında yaşanan Global finansal krizin etkisini gözlemlemek amacıyla, hisse senetleri arasındaki ilişki kriz öncesi için 1996M1-2008M12 dönem aralığı, kriz sonrası için 2009:M1-2020M11 dönem aralığında ayrı ayrı incelenmiştir. Avrupadaki gelişmiş ülkelerin hisse senedi endeksleri için, Morgan Stanley Capital International tarafından, Avrupada'daki 15 gelişmiş ülkenin hisse senedi piyasasını göz önünde bulundurak, hesaplanan endeks kullanılmıştır. Öncelikle serilerin bütünleşme derecelerini belirlemek adına birim kök testlerinden faydalanılmış. Her dönem için serilerin aynı derecede bütünleşik oldukları belirlendikten sonra Johansen eşbütünleşme testi uygulanmıştır. Kriz öncesi dönem için herhangi bir eşbütünleşik ilişki görülmezken, kriz sonrası dönemde seriler arasında bir eş bütünleşik ilişki olduğu gözlenmiştir. Son olarak yapılan Granger nedensellik testine göre ise Avrupa'daki gelişmiş ülkelerin hisse senedi endeksinden Türkiye'deki hisse senedi endeksine tek yönlü nedensel bir ilişki bulunmuştur.

Anahtar Kelimeler: *Ortak Hareket, Hisse Senedi Piyasaları Endeksi, Nedensellik Analizi*
JEL Sınıflandırması: *C50, G10*

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1.Introduction

Involvement of activity between financial markets and their instruments has been increased because of rise of liberalization, globalization, and privatization processes in financial system of emerging economies. The issue is important for the cross-border investments in periods where markets are highly volatile. The diversification decisions by international investors are mainly depend on the nature and size of the relationship (*co-movement*) between dissimilar stock markets, particularly, in emerging economies. Because of that, it is very significant to figure out the co-movement and interdependence between varied markets to diversify the risk of portfolios and to gain high return. To reach the global financial assets extends occasions of investors to get higher risk-adjusted rates of return. Recently, many countries have deregulated their financial system to attract more foreign portfolio investments, to create a surplus in capital account, to improve their economic condition. The condition leads an integration of world capital market, so portfolio investments have increased in financial system in emerging economies (Modi et al., 2010: 165).

In the literature, there is no exact definition related term of co-movement. In a definition, it is defined as a pattern of positive correlation (Barbaris et al., 2005). But this definition depends on the correlation coefficient and does not clearly define the meaning of co-movement. Moreover, it could be adopted the term of co-integration (Baur, 2003: 5). Wang and Guo (2018) described co-movement as changes in price of one asset associated with another due to connectedness among financial assets. The extent of co-movement involves common movement between varied assets or sectors in the same market or between the same or different markets in the same country/region or between the same or different markets in different countries/regions. The globalization policies have increased co-movement in financial markets and made co-movement a significant factor for optimal asset allocation (Wang and Guo, 2019: 44). Baur (2003: 4-5) defined it as 'co-movement is the common movement of returns that is shared by all returns at time t'. Moreover, there are some concepts are used associated with co-movement which are connectedness, interdependence, spillover, and contagion. Connectedness and interdependence are used when the co-movement between stock markets is strong (Gül Oral, 2018: 6). Diebold and Yılmaz (2009) used this term as volatility spillover. Volatility spillover is defined as fluctuations of volatility of a country's stock market could be impacted by the stock market volatility of its territory countries (Roni et al., 2018: 98). Similarly, there are varied definition of contagion. Forbes and Rigobon (2002) defined it "a significant increase in cross market linkages after a shock to one country or group of countries".

For some reason, it is not clear whether the correlation between returns of stock markets across countries have increased. Probably, the condition is depending on biased reading of data. Deliberating about development in stock markets in the media could exaggerate significant of seldom and low but synchronously occurring happening change in international stock returns.

Whereas the change might appear to propose strong anecdotal proof for greater co-movement, an attentive empirical search about that issue could be needed to calculate behavior of the returns in the sample periods (Berben and Jansen, 2005: 833). There has been a consensus about causal effect of one country's stock market performance on other countries' stock market performances within a specific region since Asian financial crisis in 1997. Integration of international stock markets and interaction between prices of stocks have been examined by many economics empirically. To know the level of interactions between stock markets is advantageous to create optimal portfolio diversification with low risk. Also, it is very important issue for policymakers to interpret the timing of intervention in the period of stock market instability and recession. Generally, it is accepted that markets with low correlation provide to have higher diversification benefits because of higher distribution of risk (Jiang et al, 2017: 384). With financial integration, foreign fund and portfolio managers want to reduce the systematic risk in their own countries, which cannot be eliminated theoretically by investing in different countries (international diversification). This international diversification can work if the markets in different countries of investment do not move together and act independently (Öztürk, 2018: 110).

By considering these conditions, it is aimed to find a correlation between stock market index of Turkey and stock market index of developed countries in Europe for pre- and post-Global Financial Crisis periods by using monthly data. In the second part of the study, reasons of co-movement are criticized while relationship between liberalization policies, crisis and co-movement are indicated in third part. Then, literature review is presented in forth part and data descriptions and methodological interpretations are defined in fifth part. At the end, the conclusion is included.

2. Reasons of co-movement

Integration is one of the major reasons to create correlation in financial markets. It could be said that financial markets called as integrated if assets with same risks have same expected returns regardless of the market. In this context, risk means to be exposed some mutual global factors. On the other hand, if a market is segmented from other financial markets in the world, its covariance with mutual global factors couldn't clarify its expected return. Also, a reward to risk is another significant issue. Some common rewards related with risk exposure are exist in global integrated financial markets. The risk reward is not significant when explaining the cross section of expected returns since it is mutual in all integrated market. Nonetheless, risk rewards may not be identical in segmented markets because of difference of risk sources (Bekeart and Harvey, 1995: 403-404). At this point, Taylor and Tonks (1989) suggested that there are two views in the economics literature about the internationalization of the equity markets. In the first group, studies focused on potential earnings of investors by diversifying their portfolios across different stock markets. It was implied that the earnings from diversified portfolios particularly increased into markets with a low correlation with domestic stock markets. However, the increase tended

to happen in the short term because country specific factors could impact other countries in the long term. The second view in the literature indicated whether stock markets are segmented or integrated. If markets are segmented equity prices are determined according to domestic market whereas prices are determined in integrated market following international stock markets (Taylor and Tonks, 1989: 332). For instance, Solnik and McLeavey (2003) implied that emerging markets were segmented from the international markets. Harvey (1995) and Erb, Harvey and Viskanta (1998) found that emerging markets aren't priced as if they were integrated in the world market. Returns on local companies are mainly impacted by domestic conditions. However, increasing liberalization this condition is disappeared. Despite all the problems of emerging markets that creates high risk are still an attractive opportunity for portfolio allocation because of high volatility. Also, the contribution of emerging markets to the total risk of the global portfolio is small because the correlation between emerging and developed markets (Solnik and McLeavey, 2003: 491).

Pretorius (2002) defined three sub-title to answer why co-movement exists in stock market. First one is contagion effect. It is part of concept of co-movement that couldn't be expressed by economic reasons. The second one is economic integration. It means that the more the economies of two nations are integrated, the more interdependent and integrated their stock markets will be. Beside trade relationship, economic integration involves co-movement in the economic determinants which impact stock market returns like interest rate and inflation. The last one is stock market characteristics that affects the scope of interdependence of stock market, namely industrial similarity, volatility and size of market (Pretorius, 2002: 90). On the other hand, two main explanations are mentioned in the literature to answer why co-movement exist between stock markets. First is based on fundamental factors. Similarity degree of macroeconomic conditions and composition of industry structure create co-movement. Second one is based on market contagion of information or risk spillovers. Factors like investment behavior policy shocks cause some fluctuations in a market so the spillover of this information leads to a strong co-movement effect on other markets (Barbaris et al., 2005: 312; Wang and Guo, 2019: 46).

There are varied causes to correctly evaluate the level of co-movement between different stock markets. It is very important for investors to design a well-diversified portfolio. This condition is depending on the degree of correlation between return of international stock market. An arrangement in portfolios could be required because of the fluctuations in international correlation patterns. On the other hand, policy makers take into consideration correlation in international equity markets because their impacts on the stability in global financial system. Moreover, correlation between stock markets contributes preparing monetary policies by central banks. Main reasons of this condition are international propagation shocks via equity market, the wealth channel and confidence effects. These type of spillover effects of international equity

markets have gotten more importance because of the global trend towards a bigger status of equity markets in the economy (Berben and Jansen, 2005: 833).

3. Liberalization policies, crisis, and co-movement

After collapse of Bretton Woods regime in 1974, countries started to change their exchange rate regime gradually. Firstly, developed countries left fixed exchange rate regime by turning floating regime and liberalized their capital account then developing countries followed them. In parallel with the developments, opening stock markets was one of the policy tools on the liberalization path (Berben and Jansen, 2005: 833). As a result of this, the world has been integrated because of liberalization of trade activities, services and international capital flows following rise of globalization after 1980s. This condition requires interdependence between national economies and coordinated improvement. Financial globalization is prominent factor of economic globalization in financial institutions, markets, and free capital movements. Thanks to technological developments and deregulation policies in financial system, economic transaction between countries have become sufficient. Moreover, transnational asset allocation has gotten more prevalent. Because of the integration and deepening process, national financial markets impact each other. Co-movement of stock markets is a result of this condition (Wang and Guo, 2019: 43). After 1980s, the importance of development of stock markets raised visibly. The increase in the degree of co-movement between international equity markets is a conclusion of that situation. National economies are often impacted by disorders deriving from foreign stock markets and these disorders tent to hold far-going consequences. It is a consensus of financial system participants, the media, academicians, and policy makers. It is stated that integration in financial market has arisen thanks to improvement in electronic communication, financial innovation and growing economic and political integration as well as financial deregulation (Berben and Jansen, 2005: 833).

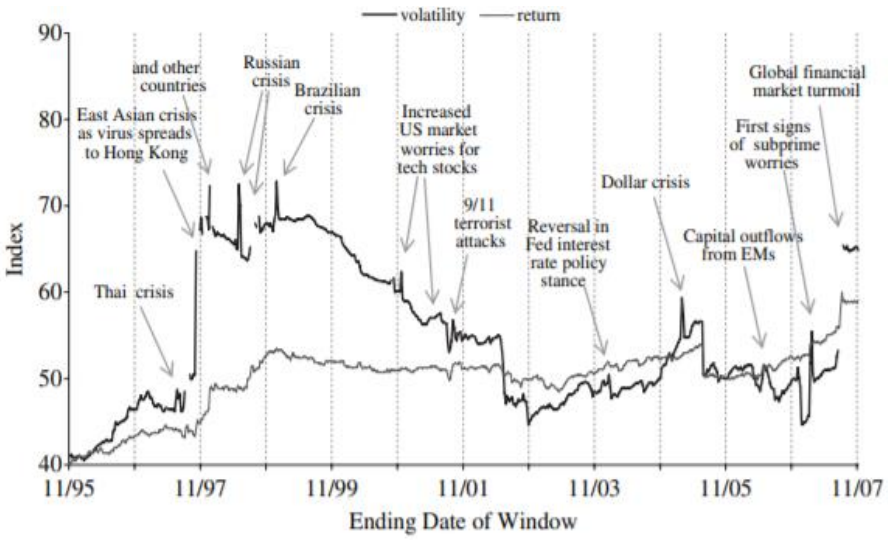
Figure 1. Stock Market Indices during Asian Financial Crisis in 1997

Source: Forbes And Rigobon, 2002: 2225

In 1990s, almost all developed and developing countries opened their stock market to international area so globalization level in financial markets increased and co-movement between stock markets deepened. However, the Asian financial crisis in 1997 interrupted the transaction by impacting stock markets of countries in different regions like Brazil, Canada, Germany, and South Africa (Figure 1). Actually, the US market crash in October 1987 impacted some stock markets in the world, but its effects were limited because of low degree of integration between nations. The real blow came to international financial markets in 2008. The financial crisis in 2008 not only caused economic and financial shocks at the center of the crisis, but it also quickly spread to other countries. A simultaneous collapse happened in the stock markets by showing a type of 'contagion' that was different from past. Due to the fact that communication between basic channels in the past couldn't clarify the co-movement in stock markets during crisis, the qualification and determinant factors of the co-movement of stock markets before and after financial crisis has attracted the attention (Forbes and Rigobon, 2002: 2224, Wang and Guo, 2019: 44).

Diebold and Yılmaz (2018) created a volatility spillover index based on variance decomposition method in VAR model including 19 stock markets (seven developed-12 developing) and covering 1992-2007. In volatility spillover plot (Figure 2), some important economic events are highlighted which are Asian Financial Crisis, Russian Crisis, and financial turmoil in 2007. Also, it is shown that some events which aren't economic impacts volatility spillover like terrorist attacks in 2001. It is obvious that such well known events created large volatility spillover, but the highest volatility spillover index obtained in subprime crisis in 2007 (Diebold and Yılmaz, 2009: 166).

Figure 2. Plot of Volatility Spillover in Global Stock Markets (1995-2007)



Source: Diebold and Yılmaz, 2009: 165

Lastly, opening up to free trade by national economies is another reason to increase correlation between stock markets. Most of the economies accept free trade under the pressure of World Trade Organization (WTO). Moreover, regional agreements like NAFTA, ASEAN and the European Union are appeared. As a result of this conditions, economies have gotten more synchronized. Finally, globalization of corporations is another important factor to increase correlation between stock market prices. It isn't important the legal nationality of a company. If a firm competes in global area, its value will be affected by global factors. It is not surprising to find that country factors get less important and the co-movement between national stock markets will increase (Solnik and McLeavey, 2003: 473).

4. Literature Review

The interactions between stock markets have attracted the attention in finance literature. The academic literature about the issue is very large. The relationship between national stock markets indexes have been exercised. Some early studies which belong to Agmon (1973), Hilliard (1979), Eun and Shim (1989) and found that interdependence of stock markets between countries is high. After the financial crisis in 1987, stock markets in the world collapsed ordinarily, number of empirical studies which examine the integration between the stock markets have been increased (Jiang et al., 2017: 3). King et al. (1994), Longin and Solnik (1995) and Morana and Beltratti (2002) associated co-movement with volatility and found that correlation rises in the periods of volatility. However, the results could be varied according to sample period chosen, the frequency of observation and the methodologies that is used (Ali et al., 2011: 396).

Table 1: Literature Review of Studies Covers Different Stock Market Indexes

Study	**Markets under study**	**Period of study**	**Methodology used**	**Results found**
Elyasiani et al. (1998)	Sri Lanka, Taiwan, Singapore, Japan, South Korea, Hong Kong, India and the US	1 January 1989-10 June 1994	VAR and Granger causality test	No significant interdependence is discovered between the Sri Lankan market and the equity markets of the US and the Asian markets.
Metin and Muradoğlu(2001)	Japan, the UK and the US	29 December 1988- 29 January 1998 (weekly)	VAR and VEC model	There are no exact results related with the co-movement between stock markets.
Morana and Beltratti (2008)	the US, the UK, Germany, and Japan	1973-2004	Principle component analysis	Evidence of strong linkages across markets, as measured by co-movement in prices and returns and in volatility process, has been found.
Rua and Nunes (2009)	Germany, Japan, the UK, and the US	January 1973-December 2007	Wavelet analysis	Co-movement between markets is stronger at the lower frequencies suggesting that the benefits from international diversification may be relatively less important in the long term.

Huyghebaert and Wang (2010)	East Asian stock markets	1 July 1992- 30 June 2003	VAR analysis, Granger causality test	Stock market interactions are limited before Asian crisis in 1997. After the crisis, shocks in Hong Kong and Singapore largely effect other East Asian stock markets.
Graham and Nikkinen (2011)	Finnish stock market and stock markets of both developed and developing markets	1 January 1999- 15 October 2009	Wavelet analysis	Co-movement of stock market returns between Finland and emerging regions occur for long term fluctuations. However, the co-movements are apparent in both long term and short-term fluctuations after 2006.
Lahrech and Sylwester (2011)	Argentina, Brazil, Chile and Mexico and the US	30 December 1988- 26 March 2004	DCC multivarete GARCH model	Results show an increase in the degree of co-movement between these four countries and the US.
Dajcman et al. (2012)	The UK, Germany, France, and Austria	1997-2010 (daily)	DCC- GARCH and wavelet cointegration analysis	Co-movement between stock markets are time varying and scale dependent. The global financial crisis of 2007-2008 only slightly and independently impact the already high level of co-movement.
Bienkowski et al. (2014)	Poland, Czech Republic, Hungary and the US	2007-2013	VAR-GARCH-BEKK model	Stock markets in Poland, Czech Republic, Hungary and the US are strongly dependent on the stock market of the US.
Lehkonen (2015)	23 developed, 60 emerging markets	1986-2010	Pooled OLS estimation	Integration increased slightly for emerging markets but decreased for developed countries during the crisis. Also, integration is mostly impacted by financial openness, intuitional environment, and global financial uncertainty.

Table 2. Literature Review of Studies Covers Stock Market Index of Turkey

Study	**Markets under study**	**Period of study**	**Methodology used**	**Results found**
Boztosun ve Çelik (2011)	Turkey, Austria, Belgium, France Germany, the Netherlands, Spain, Sweden, and Switzerland	January 2002-December 2009	Johansen cointegration test	There is cointegrated relationship between Turkey, Norway, Netherland, Belgium, Germany and the UK.
Yıldız and Aksoy (2014)	Turkey and MSCI emerging market index	January 1990-December 2011	Engle Granger cointegration test and VEC model	There is cointegration between stock markets in the long term.
Akel (2015)	Brazil, Indonesia, South Africa, India, and Turkey	November 2000-December 2013	Johansen cointegration test, Granger causality test	There is long-term and short-term cointegration and causality relation between these countries' stock markets.

Hatipoğlu and Sekmen (2016)	Turkey, the US, the UK, Germany and Japan	1995-2015 (monthly)	GO-GARCH	Before financial crisis, stock market of Tukey was integrated with stock market of the UK while it was integrated with stock market of Germany.
Şimşek (2016)	Turkey, Brazil, Russia, India, China, South Africa	3 January 2008-21 January 2015	ARCH and GARCH	Stock market of Turkey is associated with stock market of BRICS countries.
Özşahin (2017)	BRICS and Turkey	2000-2016 (monthly)	FMOLS and DOLS	It is indicated that there has been a long-term positive relationship between the stock markets.
Öner (2018)	Turkey, Argentina, Qatar, Egypt, Pakistan	5 January 2009-20 March 2018	Granger causality test	There is causal relationship from stock market of Turkey to stock market of Qatar, Egypt, and Pakistan and from stock market of Argentina to stock market of Turkey.
Öztürk (2018)	Turkey and MSCI emerging market index	January 2003-July 2017	Johansen cointegration test	There exists significant long run relationship between stock market of Turkey and stock markets of 24 emerging markets before the financial crisis.
Münyas (2020)	Turkey, the UK, Germany, Italy, France, Norway and Australia	9 January 2019-5 June-2020 (daily)	VEC model	There is positive and significant relationship between stock market of Turkey and the developed countries.
Parmaksız and Kocabıyık (2020)	Turkey, Brazil, Russia, India, China, South Africa	January 2020-December 2019	Toda Yamamato causality test	There is causality from stock market of Brazil and Russia and Turkey- from stock market of Turkey to stock market of India.

5. Data and Methodology

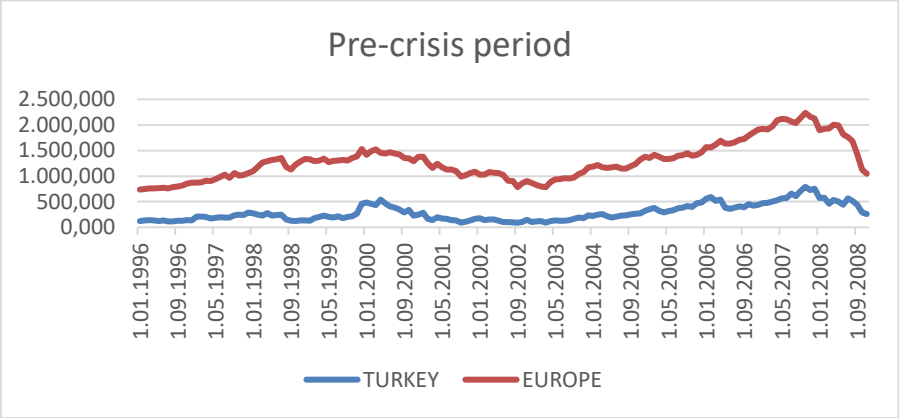
5.1 Data

In this study, to detect whether co-movement exists between stock markets of developed countries in Europe and stock market of Turkey. To do this, stock market index of Turkey and MSCI Europe Index which is calculated by Morgan Stanley Capital International are used. It is a free float adjusted market capitalization weighted index. It is created to measure stock market performance in Europe. It consists of 15 countries' stock market indexes which are Austria, Belgium, Denmark, Finland, France, Germany, Ireland, Italy, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, and the United Kingdom. Pre- and post- periods of Global Financial Crisis in 2008 are indicated separately by considering monthly data. January 1996 is chosen as beginning of period to detect the effect of trade integration between Turkey and European Union because of introduction of Custom Union.

Table 3. Data Description

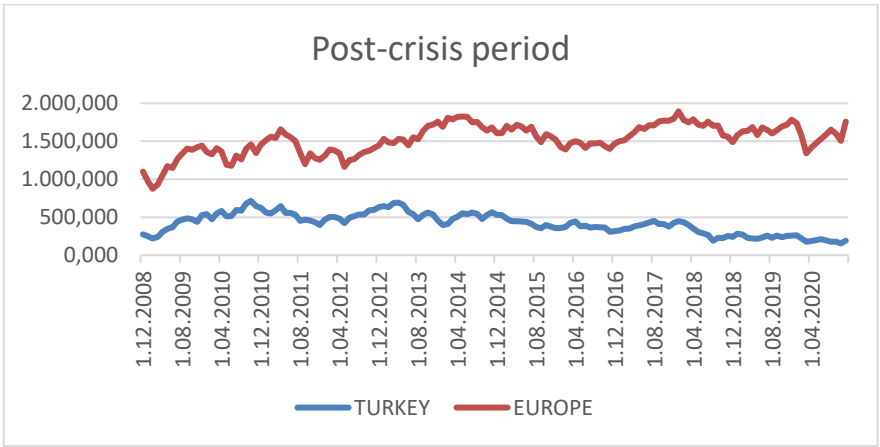
Variable	Explanation	Source	Period
TURKEY	Stock market index of Turkey (TURKEY)	MSCI	1996:1-2008:12
EUROPE	Consist of 15 developed country's stock market indexes in Europe	MSCI	2009:1-2020:M11

Figure 3. Graphic of Stock Market Indexes in Pre-Crisis Period



When the graphics of data (Figure3 and Figure 4) are investigated, it can be said that there is a similar trend in two periods. Especially, there was sharp decrease with the beginning of Global Financial Crisis in 2008. However, to detect the co-movement, it is required to use some advanced methods. In the study, firstly, stationary of data is checked to apply Johansen cointegration. Then, Granger causality test is used to understand way of the relationship.

Figure 4. Graphic of Stock Market Indexes in Post-Crisis Period



5.2 Methodology

5.2.1 Unit root tests

Because Dickey-Fuller disregards whether the error terms are auto correlated, Dickey and Fuller developed Augmented Dickey Fuller (ADF) test. The null hypothesis of the test implies series have unit root. If ADF statistic is less than McKinnon critical values, null hypothesis can't be rejected.

Table 4. Results of Unit Root Tests

PRE-CRISIS PERIOD (1996M1-2008M12)						
	ADF (level)			**ADF (first difference)**		
Variables	**Intercept**	**Trend and intercept**	**None**	**Intercept**	**Trend and intercept**	**None**
TURKEY	-1.989312 (0.2914)	-2.183512 (0.4950)	-0.759311 (0.3859)	-13.08782 (0.0000)	-13.06500 (0.0000)	-13.12595 (0.0000)
EUROPE	-1.812882 (0.3732)	-1.373085 (0.8651)	-0.164694 (0.6252)	-9.369927 (0.0000)	-9.454124 (0.0000)	-9.391303 (0.0000)
PRE-CRISIS PERIOD (1996M1-2008M12)						
	PP(level)			**PP(first difference)**		
Variables	**Intercept**	**Trend and intercept**	**None**	**Intercept**	**Trend and intercept**	**None**
TURKEY	-2.007787 (0.2833)	-2.331137 (0.4144)	-0.730048 (0.3989)	-13.08610 (0.0000)	-13.06328 (0.0000)	-13.12415 (0.0000)
EUROPE	-1.784454 (0.3871)	-1.247220 (0.8965)	-0.156797 (0.6280)	-9.365634 (0.0000)	-9.447187 (0.0000)	-9.386868 (0.0000)
POST-CRISIS PERIOD (2009M1-2020M11)						
	ADF(level)			**ADF(first difference)**		
Variables	**Intercept**	**Trend and intercept**	**None**	**Intercept**	**Trend and intercept**	**None**
TURKEY	-1.546592 (0.5072)	-3.694427 (0.0259)	-0.585129 (0.4623)			
EUROPE	-3.122066 (0.0272)	-3.505195 (0.0426)	0.469323 (0.8149)			
POST-CRISIS PERIOD (2009M1-2020M11)						
	PP(level)			**PP(first difference)**		
Variables	**Intercept**	**Trend and intercept**	**None**	**Intercept**	**Trend and intercept**	**None**
TURKEY	-1.582029 (0.4891)	-3.657103 (0.0286)	-0.583958 (0.4628)			
EUROPE	-3.122066 (0.0272)	-3.472746 (0.0463)	0.532543 (0.8298)			

Probabilities are shown in parentheses.

The PP unit root test is improved version of ADF test. In PP test, creation of process of error term is less restricted. Also, it is tried to fix the problem of autocorrelation by correcting test statistics in PP test (Sinha, 1997: 77). The null hypothesis means series have unit root. If PP statistics is less than McKinnon critical values, the null hypothesis can be accepted.

Results of both unit root tests are proved that both variables aren't stationary at their level in the pre-crisis period. They get stationary when their first differences are taken so it can't be rejected the null hypothesis. However, in the post crisis period the opposite condition is valid. The all series are stationary at their level. Null hypothesis is rejected. Both series are stationary at same level in pre- and post-crisis periods.

5.2.2 Johansen co-integration test

Johansen co-integration test demonstrates that there can be more than one co-integrated relation between variables by providing multi-equation approximation. After finding that series are stationary at same level, co-integration test can be run. Johansen's method involves simultaneous estimation of dynamic VAR models (Bahmani-Oskooee and Rhee, 1997: 106). For this reason, convenient lag length will be chosen based on VAR model. Then, Johansen co-integration test will be applied.

Table 5. Choosing Lag Length Criteria for Pre-Crisis and Post-Crisis Period

PRE-CRISIS PERIOD (1996M1-2008M12)			
Lag length	**AIC**	**SC**	**HQ**
0	25.97939	26.01989	25.99584
1	21.49226	21.61377*	21.54163
2	21.44718*	21.64970	21.52946*
3	21.48218	21.76570	21.59737
POST-CRISIS PERIOD (2009M1-2020M11)			
Lag length	**AIC**	**SC**	**HQ**
0	25.68706	25.73010	25.70455
1	21.37032*	21.49945*	21.42280*
2	21.42336	21.63857	21.51081
3	21.45736	21.75864	21.57979

In the study, Akaike Information Criteria (AIC), Schwarz Information Criteria (SC), and Hannan Quinn Information Criteria (HQ) are considered to find optimum lag length. These critical values are computed, and optimum lag length is chosen by comparing the values. For pre-crisis period, lag length is chosen as 1 by considering SC while for post crisis period lag

length is also chosen as 1 according to AIS, SC and HQ. At first lag, there is no serial correlation between variables.

Table 6. Johansen Cointegration Test for Pre-Crisis Period

Trace test results for Johansen co-integration test (pre crisis period)				
Unrestricted Cointegration Rank Test (Trace)				
Hypothesized No. of CE(s)	**Eigenvalue**	**Trace Statistic**	**0.05 Critical Value**	**Prob.****
None *	0.070648	14.47852	15.49471	0.0707
At most 1	0.020535	3.195256	3.841465	0.0738
Trace test indicates **no cointegrations** at the 0.05 level				
* denotes rejection of the hypothesis at the 0.05 level				
**MacKinnon-Haug-Michelis (1999) p-values				
Maximum Eigenvalue test results for Johansen co-integration test (pre crisis period)				
Hypothesized No. of CE(s)	**.Eigenvalue**	**Max-Eigen Statistic**	**0.05 Critical Value**	**Prob.****
None *	0.070648	14.47852	14.26460	0.1406
At most 1	0.020535	3.195256	3.841465	0.0738
Max-eigenvalue test indicates **no cointegrations** at the 0.05 level				
* denotes rejection of the hypothesis at the 0.05 level				
**MacKinnon-Haug-Michelis (1999) p-values				

Johansen cointegration test produced different outputs for the periods. When no cointegrated relationship couldn't be found in pre-crisis period, 1 cointegrated relationship is found in post-crisis period. It means there is long term cointegrated relationship between TURKEY and EUROPE.

Table 7. Johansen cointegration test for pre-crisis period

Trace test results for Johansen co-integration test (post crisis period)				
Unrestricted Cointegration Rank Test (Trace)				
Hypothesized No. of CE(s)	**Eigenvalue**	**Trace Statistic**	**0.05 Critical Value**	**Prob.****
None *	0.130939	20.61743	15.49471	0.0077
At most 1	0.005863	0.829162	3.841465	0.3625
Trace test indicates **1 cointegrating equation** at the 0.05 level				
* denotes rejection of the hypothesis at the 0.05 level				
**MacKinnon-Haug-Michelis (1999) p-values				
Maximum Eigenvalue test results for Johansen co-integration test (post crisis period)				
Hypothesized No. of CE(s)	**.Eigenvalue**	**Max-Eigen Statistic**	**0.05 Critical Value**	**Prob.****
None *	0.130939	19.78827	14.26460	0.0061
At most 1	0.005863	0.829162	3.841465	0.3625
Max-eigenvalue test indicates **1 cointegrating equation** at the 0.05 level				
* denotes rejection of the hypothesis at the 0.05 level				
**MacKinnon-Haug-Michelis (1999) p-values				

5.2.3 Granger causality test (post crisis period)

Existing cointegrated relation between the series is an evidence of (at least one way) Granger causal relation between the data. The way of Granger causality could be detect controlling the F-test and its probability value (Akinboade and Braimoh, 2010: 159). Granger causality test provides a correlation between current value of one variable and the past values of other variables. Regression of Granger causality could be presented as;

$$X_t = \alpha_0 + \sum_{i=1}^{m} \alpha_i X_{t-i} + \sum_{i=1}^{m} b_i Y_{t-i} + u_i \quad (1)$$

$$Y_t = b_0 + \sum_{i=1}^{m} b_i Y_{t-i} + \sum_{i=1}^{m} a_i X_{t-i} + u_i \quad (2)$$

In the regression (1), α_0 shows the constant term and u_i is error term that is white noise process has distribution of u_t ~N $(0,\sigma_u{}^2)$ with zero mean and constant variance.

$H_0: \sum_{i=1}^{m} b_i = 0$ (There is no causality from Y to X.)

$H_1: \sum_{i=1}^{m} b_i \neq 0$ (There is causality from Y to X)

In the study, one period lag is chosen (based on VAR) is selected. It is found that there is Granger causality from EUROPE to TURKEY at 1% significance level. Null hypothesis could be rejected according to probability of F statistics.

Table 8. Results of Granger Causality Test for Post-Crisis Period

Lag length=1	**F statistics**	**Probability**	**Result**
from TURKEY to EUROPE	0.63355	0.4274	H_0 is accepted
from EUROPE to TURKEY	12.0790	0.0007	H_0 is rejected

6. Conclusion

After collapse of Bretton Woods, firstly, developed countries started to liberalize their financial system. Then, developing countries adapted these policies gradually in 1980s. This condition has increased integration in terms of not only economically but also financially. Because of the integration process, financial markets have started to each other. Co-movement of stock markets is result of the situation. This issue is very important for international investor to create optimal portfolio to gain more earnings and avoid risk. Such factors like financial crisis or shocks, economic-noneconomic fundamentals or regional agreements could impact the co-movement between stock market indexes.

In the study, it is aimed to detect whether co-movement exists between stock market of developed countries in Europe and stock market index of Turkey in pre-post crisis period. Also, it is aimed to find the effect of Custom Union between European Union and Turkey in 1995 to

investigate to impact of trade integration on co-movement of stock market indexes. 1996:M1 and 2008:M12 is considered as pre-crisis period whereas 2009:M1 and 2020:M11 is chosen as pre-crisis period. To understand the relationship between indexes, Johansen cointegration test is applied because pre-post crisis period's series are integrated at same level. Cointegration test results proved that there is no cointegrated relation in pre-crisis period while there is one cointegrated relationship between post-crisis periods. After, Granger causality test prove that the way of relationship is from stock market indexes of developed countries in Europe to stock market indexes of Turkey.

Relationship in pre-crisis period implies that trade integration couldn't create a co-movement between the stock market indexes of developed countries in Europe and Turkey. This condition conflicts with literature because there is common belief that trade integration leads stock markets to behave together. On the other hand, post crisis relationship could point out the contagion effect. As it is known, financial crisis jumped from developed countries to emerging markets. Moreover, this condition supports the view that developed countries stock markets are leading stock markets of emerging markets. Finally, the cointegrated relationship between stock market indexes of developed countries in Europe and Turkey should be considered by international investors to decrease risk of their portfolios.

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