Contributions to Economics

Hasan Dincer · Ümit Hacioglu
Serhat Yüksel *Editors*

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Financial Economics and Growth Dynamics

Chapter 1
Regional or Local Damage? Contagion Effects of Greek Debt Crisis Revisited

Melik Kamışlı, Serap Kamışlı, and Fatih Temizel

Abstract The term contagion has become one of the central topics in the financial literature after devastating effects of Asian Crisis. In general terms, contagion is the increase in the relationships between the markets after a shock that occur in a country or in a group of countries. The consecutive crises that the world is facing in recent years caused an increase in the number of studies that try to find the answer if the crises change the volatility spillovers between the countries and cause contagion effects or not. When the contagion is considered as the initiation of volatility spillover from the financial markets of crisis-originating country to the financial markets of other countries, capital markets of emerging markets are expected to become very fragile due to the foreign capital flows. For this reason, the effects of crises are felt more profoundly in these markets, and these markets are exposed to contagion effects more than developed countries. The determination of contagion effects is crucial especially for international investors that aim to decrease portfolio risk by international diversification. Also it will provide valuable information to policy makers that can be used in decision processes. There are various econometric methodologies that detect the contagion effects and one of them is frequency domain causality approach. In this context, in the study, contagion effects of Greek debt crisis on 34 European stock markets are analyzed by traditional and frequency domain causality approach. According to the results, there are contagion effects from Greek stock market to Czech Republic, Spain, Estonia, Hungary, Ireland, Iceland, Lithuania, Luxembourg, and Portugal stock markets.

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Introduction

Portfolio management decisions of the investors are affected from too many factors, notably the relationships between the financial markets. One of these factors is the financial crises. Because, on the one hand, crises cause deteriorations in economic and financial variables, on the other hand, they affect the other markets through the contagion channels. This situation and the recent crises cause increase in the number of the studies which investigate that if the crises cause contagion effect or not, and the relationships between the markets are analyzed on the basis of the crises. But, despite the increase in the number of studies on contagion effects, there is no consensus on the theoretical or empirical definition of the contagion. Yet, determination and measurement of the contagion is quite important for both academic researches and for policy makers (Gómez-Puig and Rivero 2014).

The term contagion is a relatively new term for the financial literature. This term was not used in financial world until 1990s and emerged after devastating effects of 1997 Asian Crisis. After this crisis, the financial researches generally analyzed the effects of crisis on the emerging markets. Especially, capital markets of emerging countries are fragile in both downtrends and uptrends (Tiryaki and Ekinci 2015). For this reason, the effects of crises on these countries are greater, and contagion effects are seen much in these countries. But, 2008 Global Crises showed that contagion is not a phenomenon that affects only the emerging countries; this is an event that may affect whole of the financial system through different channels (Kolb 2011).

In general terms, contagion is an event which occurred in one country, and has a rapid effect on many countries. Forbes and Rigobon (2002) defines the contagion as the increase in the relationships between the markets after a shock that occurred in one of the markets, while Masson (1999) defines the contagion as the beginning of the crisis in one country, that cannot be explained by macroeconomic factors, because of the crisis that occurred in another country. With reference to the definitions, it can be said that contagion causes change in the market sensitivity, and after the crisis the new information in the market is interpreted differently than it was in the past. Definitions also indicate that if the markets display high degree of co-movements in stable times and after a shock the interrelation is still high, then this is not a contagion (Gómez-Puig and Rivero 2014). On the other hand, if the effects are gradual, this is referred to as a spillover (Kolb 2011).

According to Naoui et al. (2010), significant increase in the possibility of crisis in one country increases because of the crisis that occurred in another country. To another definition, contagion is significant increases in the relationships, which are measured by the co-movements of the asset prices and financial flows, after a shock compared to stable periods (Dornbusch et al. 2000). Contagion can be described on the basis of market volatility too. In terms of volatility, contagion can be defined as the beginning of volatility spillover from the crisis country to the other.

In the light of this explanation, to qualify the increases in the relationships as contagion, the following features should be determined (Claeys and Vasicek 2014):

- Great and significant changes in the relationships.
- Sudden changes in the relationships.
- To be unable to explain the changes by macro-economical connections.

In recent years, there occurred unforeseen crises in too many countries in different regions of the world. Especially, the crisis that started in America in 2008 affected almost all the regions of the world. While the effects of this crisis are not understood properly, The Greek debt crisis started in Euro area.

The Greek economy is a relatively small economy in Euro area with its GDP which is less than 3% of total Eurozone GDP (Bhanot et al. 2012). But the crisis that occurred in this country in November 2009 has affected almost all countries in the region. These effects have been caused by financial transactions besides trade relations. Especially due to the financial liberalization, the relationships between the financial markets have increased and the markets have become interconnected. Therefore, especially stock markets in the Eurozone have been affected more from the Greek debt crisis. Three potential transition channels for the crises may be identified. Firstly, investors make analogies between the crisis country and the countries that they invest in, and this situation affects their investment decisions. Secondly, in crisis periods increasing volatility affects the attitudes of the investors towards risk and risk aversion increases. Investors prefer to invest in safety areas (Vayanos 2004). Thirdly, losses that occurred due to the crises may cause decreases in funding sources of the institutions in the other countries.

Arghyrou and Tsoukalas (2011) explained the development of the crisis in five stages ranging from 2007 USA Sub-Prime Crisis to announcements of the new Greek government. The first stage begins with the increases in Greek CDS spreads due to the Sub-Prime Crisis, the second stage includes the effects of the peak of Global Crisis, and the third stage covers the period in which recovery packages were started to be applied between April and August 2009. The fourth stage of the crisis includes three important events: snap election; the new government's announcements about the previous government; and in mid-November 2009, submission of the proposed public budget of Greece to the European Commission. The third event was also stated as the beginning of the final stage.

In the light of these explanations, the purpose of this research is to investigate the contagion effects of 2009 Greek debt crisis and to present valuable information to the investors that they can use in their risk management and portfolio allocation decisions.

Literature Review

There are too many studies in the literature that analyze the contagion effects of crises. Mink and Haan (2013) analyzed the contagion effects of Greek debt crisis on the basis of banking sector, while Samitas and Tsakalos (2013) investigated the contagion effect on stock markets. Similarly, Mollah et al. (2016) determined the contagion effects of Global Financial and European debt crisis on stock markets. In

the studies of Dungey and Gajurel (2014) and Luchtenberg and Vu (2015), the contagion effects of 2008 global crisis on stock markets were researched. But the contagion phenomenon is not the event that only affects the stock markets; there may be contagion effects in other markets too. So, Missio and Watzka (2011) analyzed the contagion for government bond yields after the European debt crisis. Dua and Tuteja (2016) studied on the contagion effects of Global Financial and European debt crisis on currencies.

The contagion effects of the crises can be determined by many econometric methodologies, and there are too many studies in the literature that use traditional approaches in the analyses. But in recent years, the new methods, which allows the researcher to analyze the time-varying structure and frequency dimensions of the causality dynamics, have been developed. Bodart and Candelon (2009), Ciner (2011a, b, c), Mermod and Dudzeviciute (2011), Aslanoğlu and Deniz (2012), Bozoklu and Yılancı (2013), Joseph et al. (2014), and Tiwari (2014) used frequency domain causality test in their study to investigate the relationships between the markets.

Bodart and Candelon (2009) examined the contagion effects of Latin America and Asian Crises and found that crisis showed regional contagion. Ciner (2011b) found that there are spillovers between currency futures in crisis periods. Mermod and Dudzeviciute (2011), Aslanoğlu and Deniz (2012), Bozoklu and Yılancı (2013), and Tiwari (2014) used frequency domain causality approach to analyze the relationships between macroeconomic variables. Similarly, Ciner (2011a) investigated the relationships between commodity prices and inflation by using frequency domain causality test. In his another study, Ciner (2011c) examined the relationships between currencies and interest rates with the same methodology. Joseph et al. (2014) determined the relationships between spot and future market by applying frequency domain causality test.

But there are limited studies in the literature that analyze the contagion effects of 2009 Greek debt crisis. In this context, it is thought to contribute to the literature with this method and large dataset.

Data and Methodology

The purpose of this research is to analyze the contagion effects of Greek debt crisis on frequency dimension differently from the traditional approaches. In this context, the main hypothesis of the research can be expressed as follows:

H_0 Greek debt crisis does not show contagion effect on the basis of stock returns.

H_1 Greek debt crisis shows contagion effect on the basis of stock returns.

In the research, both the traditional and the frequency-based causality tests are used to determine the contagion effects. Traditional causality tests produce one test

statistic for the relationship between the variables. But to accept that the relationships do not change over the time is not realistic without discriminating the short, mid, and long-run. In this context, the frequency-based causality approach refuses the fundamental assumption of traditional causality test that "one test summarizes the relationship which is valid for all frequencies between the variables" by producing more than one test statistic for different frequencies. Therefore, frequency-based causality approach gives the opportunity of investigating the causality dynamics in different frequencies instead of depending on one test statistic as it is in traditional analyses (Ciner, 2011b). This situation was firstly stated in the studies of Geweke (1982) and Hosoya (1991). Later Breitung and Candelon (2006) developed the frequency domain causality based on these studies.

Breitung and Candelon analysis depends on the studies of Geweke (1982) and Hosoya (1991) which consider finite (p) order VAR model that has two dimensional vectors Y_t and X_t.

The causality criteria that is proposed by Geweke (1982) is as follows:

$$M_{X\to Y}(\omega) = log\left[1 + \frac{||\psi_{12}(e^{-i\omega})||^2}{||\psi_{11}(e^{-i\omega})||^2}\right] \tag{1.1}$$

$$\text{If } \left|\psi_{12}\left(e^{-i\omega}\right)\right| = 0, \text{There is no Granger causality from } X_t \text{ to } Y_t \text{ at frequency } \omega. \tag{1.2}$$

In testing hypothesis, that is "X_t is not cause of Y_t at frequency ω," the null hypothesis is as follows:

$$M_{X\to Y}(\omega) = 0 \tag{1.3}$$

Breitung and Candelon (2006) developed the following linear restrictions to test the hypothesis above

$$\sum_{k=1}^{p} \theta_{12,k} \cos(k\omega) = 0 \tag{1.4}$$

$$\sum_{k=1}^{p} \theta_{12,k} \sin(k\omega) = 0 \tag{1.5}$$

Based on the linear restrictions, the null hypothesis "$M_{X\to Y}(\omega) = 0$" is expressed as follows:

$$H_0 = R(\omega)\beta \tag{1.6}$$

Here, β is the vector of Y_t coefficients and

$$R(\omega) = \begin{bmatrix} \cos(\omega) & \cos(2\omega)\ldots & \cos(p\omega) \\ \sin(\omega) & \sin(2\omega)\ldots & \sin(p\omega) \end{bmatrix} \tag{1.7}$$

Therefore, the null hypothesis that there is no Granger causality at frequency ω can be tested by using F test for the linear restrictions. F test distributes approximately as $F(2, T-2p)$ for $\omega \epsilon (0, \pi)$. Here, 2 states the restriction number, T is the number of observations, and p is the lag length of VAR model.

In the research stock returns calculated based on the weekly price data of Austria (AUT); Belgium (BEL); Bosnia-Herzegovina (BIH); Bulgaria (BGR); Croatia (HRV); Cyprus (CYP); Czech Republic (CZE); Denmark (DNK); Estonia (EST); Finland (FIN); France (FRA); Germany (DEU); Greece (GRC); Hungary (HUN); Iceland (ISL); Ireland (IRL); Italy (ITA); Latvia (LVA); Lithuania (LTU); Luxembourg (LUX); Macedonia (MKD); Malta (MLT); the Netherlands (NLD); Norway (NOR); Poland (POL); Portugal (PRT); Romania (ROU); Serbia (SRB); Slovakia (SVK); Slovenia (SVN); Spain (ESP); Sweden (SWE); Switzerland (CHE); Turkey (TUR); and United Kingdom (GBR) stock markets. Returns are calculated as follows:

$$R_t = ln\left(\frac{F_t}{F_{t-1}}\right) \tag{1.8}$$

F_t refers to closing price at t^{th} week.

The data set is limited between 09/16/2008–7/25/2015 and divided into two periods. The first period starts with the collapse of Lehman Brothers that is accepted as the beginning of the Global Crisis (15/09/2008) and finishes at 11/03/2009. The second period starts with the statement of financial falsification by the new government that came to power in Greece, that is accepted as the beginning of the Greek debt crisis (11/04/2009), and finishes on 7/25/2015. Therefore, 358 weekly stock market return data belongs to aforementioned countries are used in the analyses. The data was gathered from Thomson Reuters Datastream.

To investigate the contagion effect, first standard VAR-Granger causality test is applied. The test results show that there is no causality in the first period, but there is causality in the second period indicating that there is contagion effect from Greek stock market to stock markets of selected countries. After applying VAR-Granger causality test, the contagion effect is tested by frequency causality test based on the study of Bodart and Candelon (2009). Depending on this study, the existence of contagion is proved by the existence of high frequency relationship ($w > 2.00$) in the postcrisis period while there is no low frequency relationship ($w < 0.05$) in the precrisis period.

In light of this information, the steps of the research are as follows:

- Determination of descriptive statistics of Euro area stock markets' return and analysis of the stationarity of the series.
- Calculation of the unconditional correlations between Greek stock market and stock markets of European countries.

- Investigation of contagion effect of 2009 Greek debt crisis to European stock markets by VAR-Granger causality test.
- Determination of contagion effect of 2009 Greek debt crisis to European stock markets by frequency domain causality test.

Empirical Results

The determination of the contagion effect is very important for risk management and portfolio allocation decisions. But besides the determination of the contagion effects, descriptive statistics of the series presents valuable information for the investors. The descriptive statistics must be analyzed also for checking that if the prior conditions of the further analyses are satisfied or not. Therefore, the descriptive statistics of the European stock markets' returns are given in Table 1.1 before investigating the contagion effects.

When Table 1.1 is investigated, it is seen that most of European stock markets have negative average returns between 2008 global crisis and 2009 Greek debt crisis. The stock markets that have lowest average returns are Iceland, Bulgaria, Serbia, Latvia, and Croatia stock markets, respectively. In this period, Turkey, Sweden, and Bosnia-Herzegovina stock markets have positive average returns. On the other hand, in the mentioned period, stock markets of Cyprus and Serbia have the highest standard deviations. Stock market returns of developed countries such as Switzerland, United Kingdom, France, and Sweden have lower risk relative to stock market returns of other countries. All of the countries except Slovakia, Denmark, Malta, and Bosnia-Herzegovina have negative skewness values, and kurtosis values of all of the stock markets are higher than three. This situation indicates that almost all of the stock markets in Euro area move away normal distribution due to the shocks which occurred depending on the 2008 global crisis.

In order to check the prior condition of VAR-Granger causality and frequency domain causality test, the stationarity of the stock returns is tested by augmented Dickey–Fuller (ADF) (1981) and Phillips–Perron (PP) (1988) unit root tests, and the results are presented together with the descriptive statistics in Table 1.1. Both ADF and PP tests show that none of the series has unit root; in other words all of the stock markets in Euro Area are stationary in the first period.

It is seen from Table 1.2 that there are important changes in average returns of European stock markets in the second period. The stock markets that have negative average returns are Cyprus, Greece, Bosnia-Herzegovina, Portugal, Macedonia, Slovenia, Czech Republic, Croatia, Spain, Serbia, and Italy, respectively. All of the European stock markets except these countries have positive average returns. On the other hand, the stock markets that have the highest standard deviations are Cyprus, Greece, Italy, Spain, and Portugal stock markets. But differently from the first period, returns of the stock markets of developed countries such as Germany, France, Finland, and Norway have high risk too in the second period. Also, all of the stock markets have high skewness values except Bulgaria, Cyprus, Macedonia,

Table 1.1 Descriptive statistics of 1st period

	Mean	Median	Std. Dev.	Skewness	Kurtosis	Jarque-Bera	ADF	PP
AUT	−0.0043	0.012	0.060	−0.979	3.960	11.89*	−6.59*	−6.60*
BEL	−0.0039	0.003	0.043	−1.020	4.310	14.69*	−4.99*	−4.86*
BGR	−0.0131	−0.002	0.064	−1.011	4.975	19.97*	−5.10*	−5.21*
BIH	0.0015	−0.002	0.085	3.281	20.453	869.2*	−7.06*	−7.09*
CHE	−0.0020	0.003	0.032	−1.155	5.302	26.59*	−6.94*	−6.94*
CYP	−0.0058	0.002	0.074	−0.411	3.289	1.90	−5.04*	−5.04*
CZE	−0.0023	0.003	0.055	−0.735	4.121	8.55*	−5.99*	−5.99*
DEU	−0.0020	0.002	0.043	−0.716	3.627	6.11**	−6.00*	−5.87*
DNK	−0.0028	0.004	0.068	0.651	6.720	38.84*	−9.37*	−9.47*
ESP	0.0005	0.007	0.038	−0.894	3.570	8.81*	−6.36*	−6.36*
EST	−0.0044	−0.005	0.048	−0.208	3.691	1.63	−5.08*	−5.18*
FIN	−0.0039	0.004	0.041	−0.636	3.070	4.06	−6.07*	−6.03*
FRA	−0.0024	0.007	0.038	−0.892	3.831	9.68*	−6.10*	−5.99*
GBR	−0.0007	0.002	0.035	−0.814	4.193	10.19*	−6.02*	−5.91*
GRC	−0.0028	0.005	0.051	−0.910	3.786	9.82*	−5.47*	−5.50*
HRV	−0.0077	−0.009	0.055	−0.484	3.484	2.93	−5.33*	−5.42*
HUN	0.0005	0.004	0.059	−0.934	4.464	14.07*	−6.14*	−6.11*
IRL	−0.0066	0.007	0.055	−0.927	4.146	11.88*	−6.09*	−6.06*
ISL	−0.0333	−0.004	0.154	−5.849	39.637	697.7*	−3.28**	−7.24*
ITA	−0.0036	0.006	0.047	−0.695	3.065	4.84*	−5.76*	−5.78*
LTU	−0.0068	−0.001	0.057	−0.051	5.469	15.27*	−4.77*	−4.93*
LUX	−0.0055	0.003	0.049	−1.051	4.736	18.57*	−5.63*	−5.62*
LVA	−0.0083	0.002	0.046	−0.661	3.193	4.46	−5.60*	−5.60*
MKD	−0.0062	−0.010	0.058	−0.397	3.710	2.83	−4.98*	−5.02*
MLT	−0.0033	−0.004	0.022	0.741	3.737	6.84**	−5.68*	−5.71*
NLD	−0.0041	0.003	0.044	−0.814	3.510	7.27**	−5.52*	−5.47*
NOR	−0.0006	0.008	0.054	−0.913	4.015	10.92*	−6.42*	−6.42*
POL	−0.0013	0.001	0.049	−0.650	3.316	4.47	−6.32*	−6.29*
PRT	0.0003	0.005	0.035	−1.439	7.107	62.88*	−7.15*	−7.18*
ROU	−0.0022	0.008	0.060	−0.971	4.308	13.71*	−6.19*	−6.34*
SBR	−0.0089	−0.002	0.073	−0.583	4.124	6.55**	−5.93*	−6.05*
SVK	−0.0068	−0.006	0.030	0.529	5.623	20.00*	−5.90*	−5.90*
SVN	−0.0064	0.000	0.040	−1.349	5.660	35.88*	−7.01*	−7.09*
SWE	0.0019	0.007	0.040	−0.724	4.297	9.45*	−6.65*	−6.58*
TUR	0.0040	0.011	0.052	−0.744	3.390	5.91***	−6.51*	−6.54*

*,**,*** indicates significance levels for 1%, 5% and 10% respectively

Croatia, Estonia, Bosnia-Herzegovina, and Latvia. Kurtosis values of all of the stock markets are higher than three in the second period. High skewness values and the kurtosis values which are higher than three show that series are far away normal distribution in the second period too, but this time due to the shocks that occurred depending on the 2009 Greek debt crisis. ADF and PP unit root tests show that stock markets in Euro Area are stationary in the second period too.

Table 1.2 Descriptive statistics of 2nd period

	Mean	Median	Std. Dev.	Skewness	Kurtosis	Jarque-Bera	ADF	PP
AUT	0.0006	0.002	0.024	−0.535	4.871	78.01*	−17.10*	−17.10*
BEL	0.0012	0.002	0.019	−0.519	4.666	64.68*	−18.67*	−18.63*
BGR	0.0012	0.001	0.017	−0.061	4.158	22.75*	−14.09*	−14.60*
BIH	−0.0018	−0.003	0.013	1.169	8.230	551.1*	−14.22*	−14.01*
CHE	0.0009	0.002	0.017	−0.988	6.378	257.2*	−15.23*	−16.88*
CYP	−0.0091	−0.006	0.054	0.077	6.588	216.6*	−16.21*	−16.09*
CZE	−0.0003	0.001	0.019	−0.834	5.818	180.1*	−16.00*	−15.70*
DEU	0.0020	0.003	0.022	−0.573	5.420	120.3*	−17.24*	−17.25*
DNK	0.0027	0.005	0.020	−0.639	4.830	83.68*	−16.87*	−16.83*
ESP	−0.0002	0.000	0.026	−0.074	3.345	2.37	−17.20*	−17.10*
EST	0.0027	0.002	0.018	1.127	10.159	945.9*	−13.68*	−13.43*
FIN	0.0011	0.003	0.022	−0.636	6.018	180.1*	−18.27*	−18.28*
FRA	0.0008	0.002	0.022	−0.327	4.631	51.87*	−17.89*	−17.81*
GBR	0.0009	0.001	0.017	−0.379	4.762	61.78*	−17.53*	−17.55*
GRC	−0.0029	−0.001	0.041	−0.202	3.694	10.84*	−17.04*	−17.11*
HRV	−0.0003	−0.001	0.014	0.477	8.495	522.3*	−13.47*	−13.72*
HUN	0.0014	0.002	0.022	−0.318	4.654	52.73*	−16.35*	−16.35*
IRL	0.0020	0.004	0.020	−0.663	5.149	107.1*	−17.79*	−17.74*
ISL	0.0026	0.002	0.014	−0.196	3.839	14.42*	−16.38*	−16.51*
ITA	−0.0001	0.001	0.027	−0.295	3.799	16.56*	−16.87*	−16.86*
LTU	0.0020	0.001	0.015	−0.315	12.691	1583.6*	−15.07*	−15.00*
LUX	0.0007	0.001	0.020	−0.247	4.924	66.25*	−16.62*	−16.59*
LVA	0.0030	0.002	0.018	1.448	11.402	1326.3*	−13.77*	−13.59*
MKD	−0.0008	−0.001	0.017	0.100	6.194	172.01*	−14.90*	−15.11*
MLT	0.0009	0.001	0.011	−0.111	7.562	350.4*	−15.19*	−15.31*
NLD	0.0013	0.003	0.020	−0.412	4.710	60.57*	−17.55*	−17.41*
NOR	0.0019	0.004	0.021	−0.723	5.869	173.3*	−18.02*	−17.94*
POL	0.0001	0.001	0.020	−0.457	4.267	40.95*	−16.83*	−16.78*
PRT	−0.0012	−0.001	0.025	−0.323	3.910	20.90*	−16.88*	−16.79*
ROU	0.0015	0.003	0.020	−0.555	6.887	274.32*	−15.40*	−15.40*
SBR	−0.0002	0.001	0.019	−0.188	5.935	147.02*	−13.75*	−13.87*
SVK	0.0004	0.002	0.017	−1.342	10.056	957.4*	−18.81*	−18.81*
SVN	−0.0006	0.000	0.017	−0.156	4.617	45.52*	−15.59*	−15.59*
SWE	0.0013	0.003	0.019	−0.522	5.833	153.1*	−18.63*	−18.61*
TUR	0.0020	0.004	0.027	−0.618	4.144	47.67*	−16.68*	−16.70*

* indicates significance levels for 1%

To decrease portfolio risk and benefit from diversification, it is needed that there is negative or low correlation between the financial assets. For this reason, in the next step unconditional correlations between the returns of Greek and European stock markets are calculated and given in Table 1.3.

The unconditional correlations given in Table 1.3 show the direction and magnitude of the relationships between the returns of Greek and European stock markets

Table 1.3 Unconditional correlations between Greek stock market returns and stock market returns of European countries for the 1st and 2nd period

	1. Period	2. Period		1. Period	2. Period
AUT–GRC	0.530	0.668	ISL–GRC	0.183	0.308
BEL–GRC	0.509	0.640	ITA–GRC	0.591	0.663
BGR–GRC	0.202	0.314	LTU–GRC	0.201	0.347
BIH–GRC	0.005	0.254	LUX–GRC	0.444	0.586
CHE–GRC	0.409	0.562	LVA–GRC	0.140	0.188
CYP–GRC	0.479	0.647	MKD–GRC	0.099	0.341
CZE–GRC	0.487	0.592	MLT–GRC	−0.125	0.184
DEU–GRC	0.463	0.628	NLD–GRC	0.461	0.647
DNK–GRC	0.397	0.435	NOR–GRC	0.408	0.601
ESP–GRC	0.578	0.581	POL–GRC	0.431	0.530
EST–GRC	0.216	0.392	PRT–GRC	0.587	0.621
FIN–GRC	0.446	0.615	ROU–GRC	0.304	0.512
FRA–GRC	0.511	0.619	SBR–GRC	0.199	0.397
GBR–GRC	0.436	0.588	SVK–GRC	0.053	0.071
HVR–GRC	0.240	0.419	SVN–GRC	0.185	0.431
HUN–GRC	0.335	0.546	SWE–GRC	0.428	0.521
IRL–GRC	0.460	0.558	TUR–GRC	0.305	0.501

by periods. As it is seen from the table that there is negative correlation only between Greek and Malta stock market returns in the first period. Also, there are low correlations between Greek and Bulgaria, Bosnia-Herzegovina, Estonia, Croatia, Iceland, Lithuania, Latvia, Macedonia, Serbia, Slovakia, and Slovenia stock market returns. But results indicate that the correlations between the returns of Greek stock market and stock market of European countries increased after the Greek debt crisis. There is no negative correlation between Greek and European stock markets in the second period. On the other hand, there are low correlations between Greek and Bosnia-Herzegovina, Latvia, Malta, and Slovakia stock market returns. According to the unconditional correlation results, investors who invest in Greek stock market can diversfy their portfolios by investing in Bosnia-Herzegovina, Latvia, Malta, and Slovakia stock markets. However, it is not realistic to assume that the relations between stock markets are stable within the specified period. The contagion effect of regional and global crises may affect the relationships between the markets in different periods. Therefore, in the next step of the research contagion effect of Greek debt crisis from Greek stock market to European stock markets are first investigated with VAR-Granger causality test, and results are presented in Table 1.4.

The results of VAR-Granger causality test indicate causality between Greek and Austria, Bulgaria, Germany, Estonia, Finland, Croatia, Ireland, Iceland, Lithuania, Macedonia, Romania Slovakia, and Slovenia stock markets for the period between 2008 global crisis and 2009 Greek debt crisis. There is no causality between Greek and rest of the other European stock markets for the same period. But after the Greek debt crisis, causality between Greek and Denmark, Iceland, Luxembourg, Portugal,

Table 1.4 VAR-Granger causality test results

	1. Period	2. Period		1. Period	2. Period
GRC ≠> AUT	Yes	No	GRC ≠> ISL	Yes	Yes
GRC ≠> BEL	No	No	GRC ≠> ITA	No	No
GRC ≠> BGR	Yes	No	GRC ≠> LTU	Yes	No
GRC ≠> BIH	No	No	GRC ≠> LUX	No	**Yes**
GRC ≠> CHE	No	No	GRC ≠> LVA	No	No
GRC ≠> CYP	No	No	GRC ≠> MKD	Yes	No
GRC ≠> CZE	No	No	GRC ≠> MLT	No	No
GRC ≠> DEU	Yes	No	GRC ≠> NLD	No	No
GRC ≠> DNK	No	**Yes**	GRC ≠> NOR	No	No
GRC ≠> ESP	No	No	GRC ≠> POL	No	No
GRC ≠> EST	Yes	No	GRC ≠> PRT	No	**Yes**
GRC ≠> FIN	Yes	No	GRC ≠> ROU	Yes	Yes
GRC ≠> FRA	No	No	GRC ≠> SBR	No	No
GRC ≠> GBR	No	No	GRC ≠> SVK	Yes	No
GRC ≠> HVR	Yes	No	GRC ≠> SVN	Yes	Yes
GRC ≠> HUN	No	No	GRC ≠> SWE	No	No
GRC ≠> IRL	Yes	No	GRC ≠> TUR	No	No

Optimal VAR lag length is selected based on AIC information criteria and diagnostic tests
Bold "yes" indicates contagion effect from Greek stock market to related stock market

Romania, and Slovenia stock markets there can be seen. In determining the contagion effect with VAR-Granger causality test, the existence of contagion is accepted if there is causality in postcrisis period while there is no causality before the crisis period. Therefore, according to VAR-Granger causality test results, the Greek debt crisis shows contagion effect to Denmark, Luxembourg, and Portugal stock markets.

According to Forbes and Rigobon (2002), contagion is significant increases in the relationships between the markets after a shock that occurred in one of the markets. If the markets display high degree of co-movements in stable times and after a shock the interrelation is still high, then this is not a contagion (Gómez-Puig and Rivero 2014). For this reason, the contagion effect can be determined healthier if the causality relations between the markets are analyzed for precrisis and postcrisis periods considering the frequency dimensions. But VAR-Granger causality test method produces one test statistic to test the causality relationships for the determined periods. In this context, in the next step of the research to investigate the contagion effect of Greek debt crisis, the causality between Greek stock market and stock market of European countries are investigated by frequency domain causality test for the first and second period. The graphics of frequency domain causality test results are given in Appendix, and summarized version of the results is shown in Table 1.5.

Analyses show that there are causality relationships between Greek stock market return and return of many of the European stock markets in short, mid, and long run

Table 1.5 Evidence of contagion

	1. Period			2. Period			
	Low Freq.	Mid Freq.	High Freq.	Low Freq.	Mid Freq.	High Freq.	Contagion
GRC ≠> AUT	–	✓	✓	✓	✓	–	–
GRC ≠> BEL	–	–	✓	–	–	–	–
GRC ≠> BGR	✓	✓	✓	✓	✓	✓	–
GRC ≠> BIH	✓	–	–	–	–	–	–
GRC ≠> CHE	–	–	–	–	–	–	–
GRC ≠> CYP	–	–	–	✓	–	–	–
GRC ≠> CZE	–	–	–	✓	✓	✓	✓
GRC ≠> DEU	–	✓	✓	–	✓	–	–
GRC ≠> DNK	✓	–	–	✓	–	✓	–
GRC ≠> ESP	–	–	–	–	✓	✓	✓
GRC ≠> EST	–	✓	✓	–	✓	✓	✓
GRC ≠> FIN	–	✓	✓	–	–	–	–
GRC ≠> FRA	–	–	–	–	–	–	–
GRC ≠> GBR	–	✓	✓	–	–	–	–
GRC ≠> HRV	✓	–	–	–	–	–	–
GRC ≠> HUN	–	–	–	–	–	✓	✓
GRC ≠> IRL	–	–	–	✓	✓	✓	✓
GRC ≠> ISL	–	–	✓	✓	✓	✓	✓
GRC ≠> ITA	–	–	–	–	–	–	–
GRC ≠> LTU	–	✓	✓	–	–	✓	✓
GRC ≠> LUX	–	–	–	✓	✓	✓	✓
GRC ≠> LVA	–	–	✓	–	–	–	–
GRC ≠> MKD	✓	–	✓	–	–	✓	–
GRC ≠> MLT	✓	–	✓	–	–	✓	–
GRC ≠> NLD	–	–	–	–	–	–	–

GRC $\neq>$ NOR	✓	–	–	✓	✓	✓	–
GRC $\neq>$ POL	–	–	–	–	–	–	–
GRC $\neq>$ PRT	–	✓	✓	✓	✓	✓	✓
GRC $\neq>$ ROU	–	✓	✓	✓	✓	–	–
GRC $\neq>$ SRB	✓	–	✓	✓	✓	✓	–
GRC $\neq>$ SVK	✓	✓	–	–	–	✓	–
GRC $\neq>$ SVN	✓	✓	–	✓	–	✓	–
GRC $\neq>$ SWE	–	–	–	–	–	–	–
GRC $\neq>$ TUR	–	✓	–	✓	✓	–	–

for the period between 2008 global crisis and 2009 Greek debt crisis. But there is no causality between Greek stock market and Switzerland, Cyprus, Czech Republic, Spain, France, Hungary, Ireland, Italy, Luxembourg, Netherlands, Poland, and Sweden stock markets in this period. On the other hand, on the basis of mid and high frequencies, it is determined that return of Greek stock market is the cause of Austria stock market return for the frequency between 0.96–3.14; Germany stock market return for the frequency between 1.22–2.39; Estonia stock market return for the frequencies between 0.82–1.51 and 2.17–3.14; Finland stock market return for the frequency between 1.63–2.31; United Kingdom stock market return for the frequency between 1.29–2.06; Lithuania stock market return for the frequencies between 1.30–1.77 and 2.53–3.14; Portugal stock market return for the frequencies between 1.67–1.79 and 1.96–2.54; and Romania stock market return for the frequency between 1.12–1.68 and 2.41–3.14. On the basis of high frequency, return of Greek stock market is the cause of Belgium, Iceland, and Latvia stock market returns for the frequencies between 3.04–3.14, 2.61–2.82, and 2.38–2.64, respectively. Turkey is the sole country that has causality only in the mid run with Greek stock market with the frequency between 1.50 and 1.62.

In the first period that begins with the 2008 global crisis, it is determined that return of Greek stock market is the cause of Bulgaria stock market return for the frequency between 0.01–1.36; Bosnia-Herzegovina stock market return for the frequency between 0.01–0.60; Denmark stock market return for the frequency between 0.01–0.44; Croatia stock market return for the frequency between 0.01–0.56; Macedonia stock market return for the frequency between 0.01–0.60; Malta stock market return for the frequency between 0.01–0.61; Norway stock market return for the frequency between 0.01–0.36; Serbia stock market return for the frequency between 0.01–0.50; Slovakia stock market return for the frequency between 0.01–1.25; and Slovenia stock market return for the frequency between 0.01–0.34 on the basis of low frequency (in the long run). In other words, the causality from Greek stock market return to Bulgaria, Bosnia-Herzegovina, Denmark, Croatia, Macedonia, Malta, Norway, Serbia, Slovakia, and Slovenia stock market returns start at 5^{th}, 10^{th}, 14^{th}, 11^{th}, 10^{th}, 10^{th}, 17^{th}, 13^{th}, 5^{th}, and 18^{th} week, respectively. According to the results of the first period, there are causality relationships between Greek stock market return and stock market return of Bulgaria, Bosnia-Herzegovina, Denmark, Croatia, Macedonia, Malta, Norway, Serbia, Slovakia, and Slovenia. To qualify the causality from Greece as contagion, there should not be causality in the low frequency in precrisis period. Therefore, these countries are excluded from the scope of contagion investigation.

It is seen that important changes occurred in the relationships between Greek stock market and stock markets of European countries on high, mid, and low frequency dimensions after the 2009 Greek debt crisis. There is no causality between Greek stock market return and stock market returns of Belgium, Bosnia-Herzegovina, Switzerland, Finland, France, United Kingdom, Croatia, Italy, Latvia, Netherlands, Poland, and Sweden in the second period. On the basis

of low frequency, there is only causality between Greek stock market return and stock market return of Cyprus for the frequency between 0.17–0.30. On the basis of mid frequency, there is only causality between Greek stock market and stock market return of Germany for the frequency between 1.19–1.25. On the basis of high frequency, Greek stock market return is the cause of Hungary stock market return for the frequency between 2.34–3.14; Lithuania stock market return for the frequency between 2.90–3.14; Macedonia stock market return for the frequency between 2.15–2.48; Malta stock market return for the frequency between 2.43–2.78; and Slovakia stock market return for the frequency between 2.07–2.21 and 2.53–2.62.

On the basis of low and mid frequencies, Greek stock market return is the cause of Austria stock market return for the frequency between 0.01–1.29; Romania stock market return for the frequency between 0.01–1.63; and Turkey stock market return for the frequency between 0.01–1.52. There are causality relationships between Greek stock market return and stock market returns of Denmark and Slovenia for the frequencies 0.54–0.59, 2.40–2.56, 2.65–2.75 and 0.17–0.24, 0.50–0.64, 2.55–2.66, respectively, on the basis of low and high frequencies. On the basis of mid and high frequencies, Greek stock market return is the cause of Spain stock market return for the frequencies between 1.21–1.42, 1.76–1.92, 2.83–2.96 and Estonia stock market return for the frequencies between 1.59–1.74, 2.28–2.73.

In the research, the evidence of causality relationships between Greek stock market return and stock market returns of some of the European countries is found after the 2009 Greek debt crisis for low, mid, and high frequencies. The return of Greek stock market is the cause of Bulgaria stock market return for the frequencies between 0.01–0.12, 0.51–0.53, 1.65–1.74, 2.39–2.45; Czech Republic stock market return for the frequencies between 0.53–0.59, 1.90–2.04, 2.64–2.74; Ireland stock market return for the frequencies between 0.50–0.53, 1.22–1.23, 1.58–1.75, 3.07–3.14; Luxembourg stock market return for the frequencies between 0.56–0.62, 1.59–1.99, 2.58–3.14; Norway stock market return for the frequencies between 0.64–0.82, 1.22–1.38, 2.97–3.14; Portugal stock market return for the frequencies between 0.43–0.59, 1.17–1.40, 2.78–2.95; and Serbia stock market return for the frequencies between 0.11–0.13, 1.03–1.16, 1.71–2.15. Also there is causality between Greek stock market return and Iceland stock market return for all frequencies.

According to empirical results and the contagion theory, there are contagion effects from Greece stock market to stock market of Czech Republic, Spain, Estonia, Hungary, Ireland, Iceland, Lithuania, Luxembourg, and Portugal after the 2009 Greek debt crisis. On the other hand, there are relationships between Greek stock market and stock market of Austria, Bulgaria, Germany, Denmark, Macedonia, Malta, Norway, Romania, Serbia, Slovakia, Slovenia, and Turkey in both precrisis and postcrisis periods that cannot be considered as contagion. Results also show that there is no causality relationship between Greece stock market and stock market of Switzerland, France, Italy, Poland, Netherlands, and Sweden in both precrisis and

postcrisis periods. So, investors who invest in Greek stock market can diversify their portfolios by investing in these markets, and vice versa. Another important finding of the research is that the causality between Greek stock market and stock market of Belgium, Bosnia-Herzegovina, Finland, United Kingdom, Croatia, and Latvia has disappeared after the 2009 Greek debt crisis.

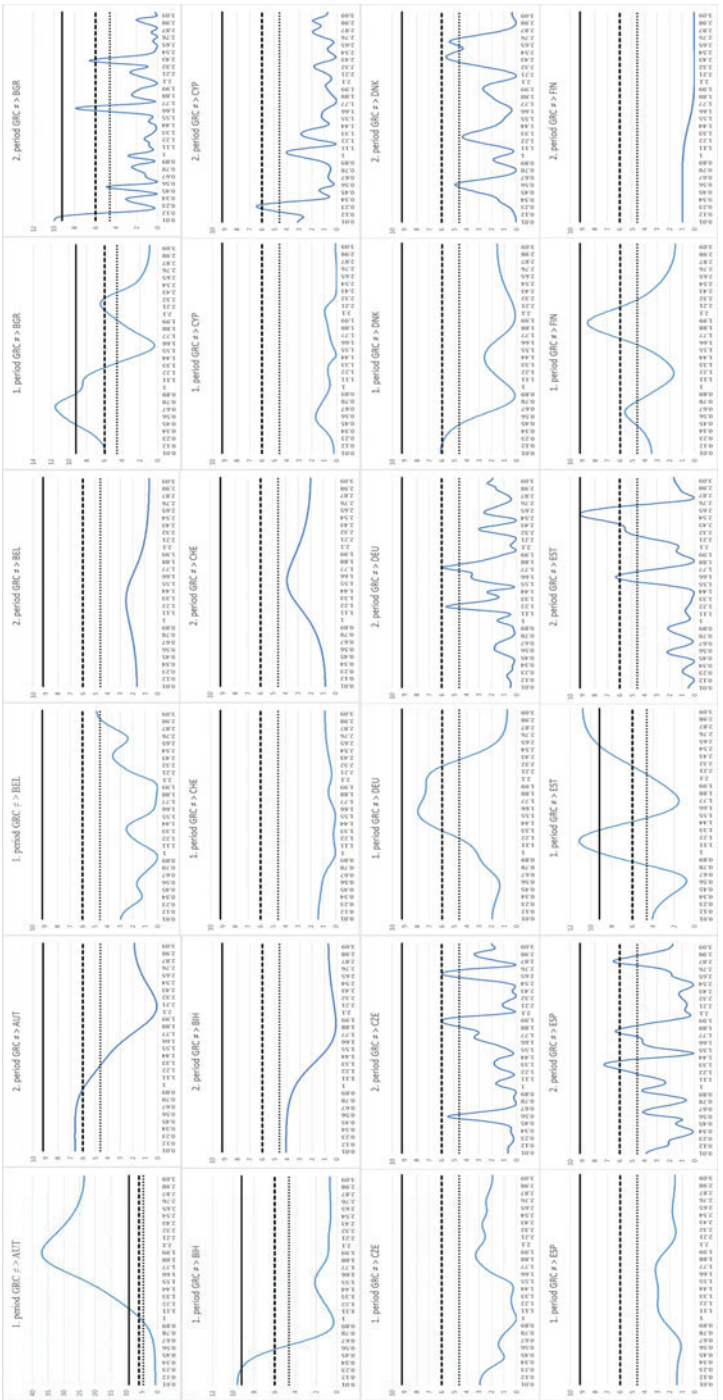
Conclusion

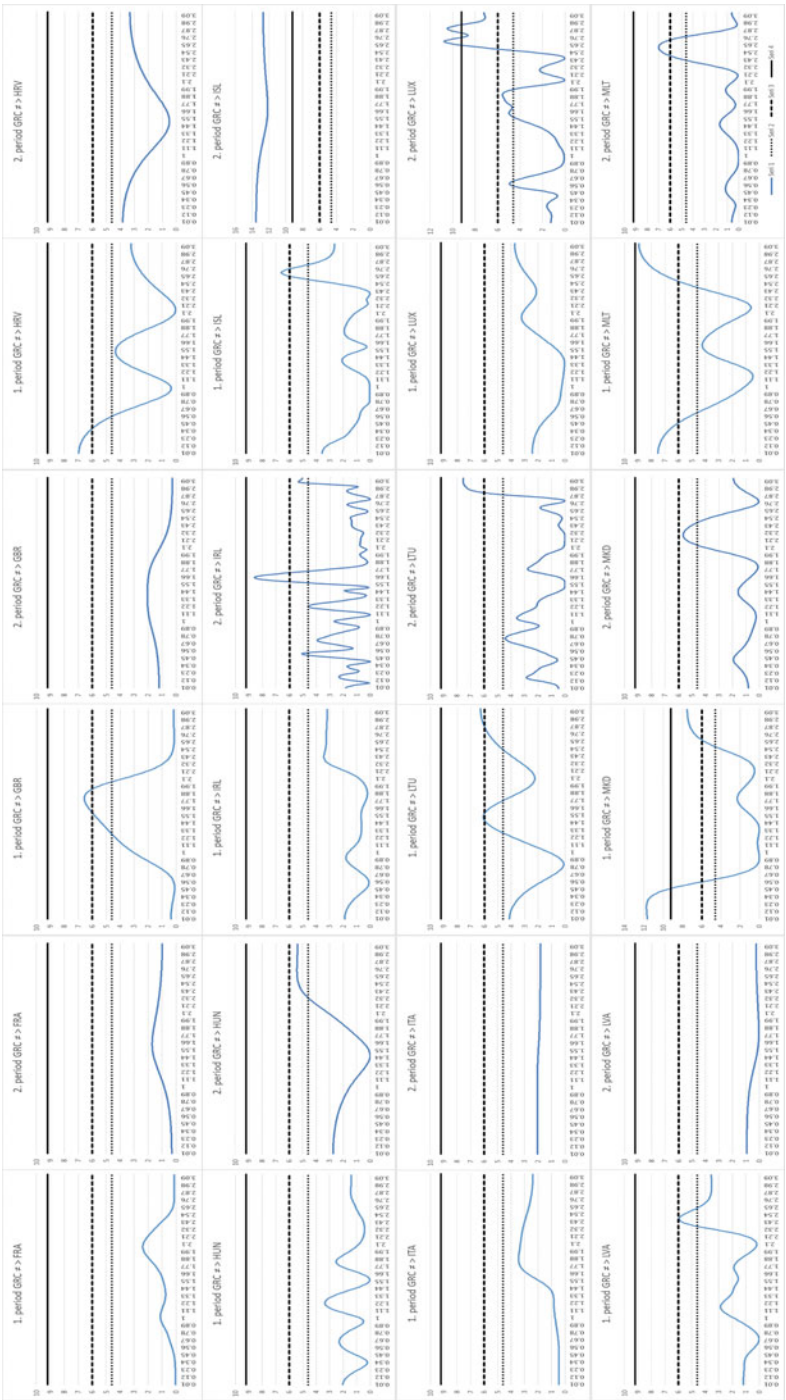
The purpose of this research is to investigate the contagion effects of 2009 Greek debt crisis and to present valuable information to the investors that they can use in their risk management and portfolio allocation decisions. In line with this purpose, the causality relations between Greek stock market and stock markets of 34 European countries are analyzed with both traditional and newly developed approaches for the precrisis and postcrisis periods. The analyses that are made with traditional approach show that there is contagion effect of the Greek debt crisis only to Denmark, Luxembourg, and Portugal stock markets.

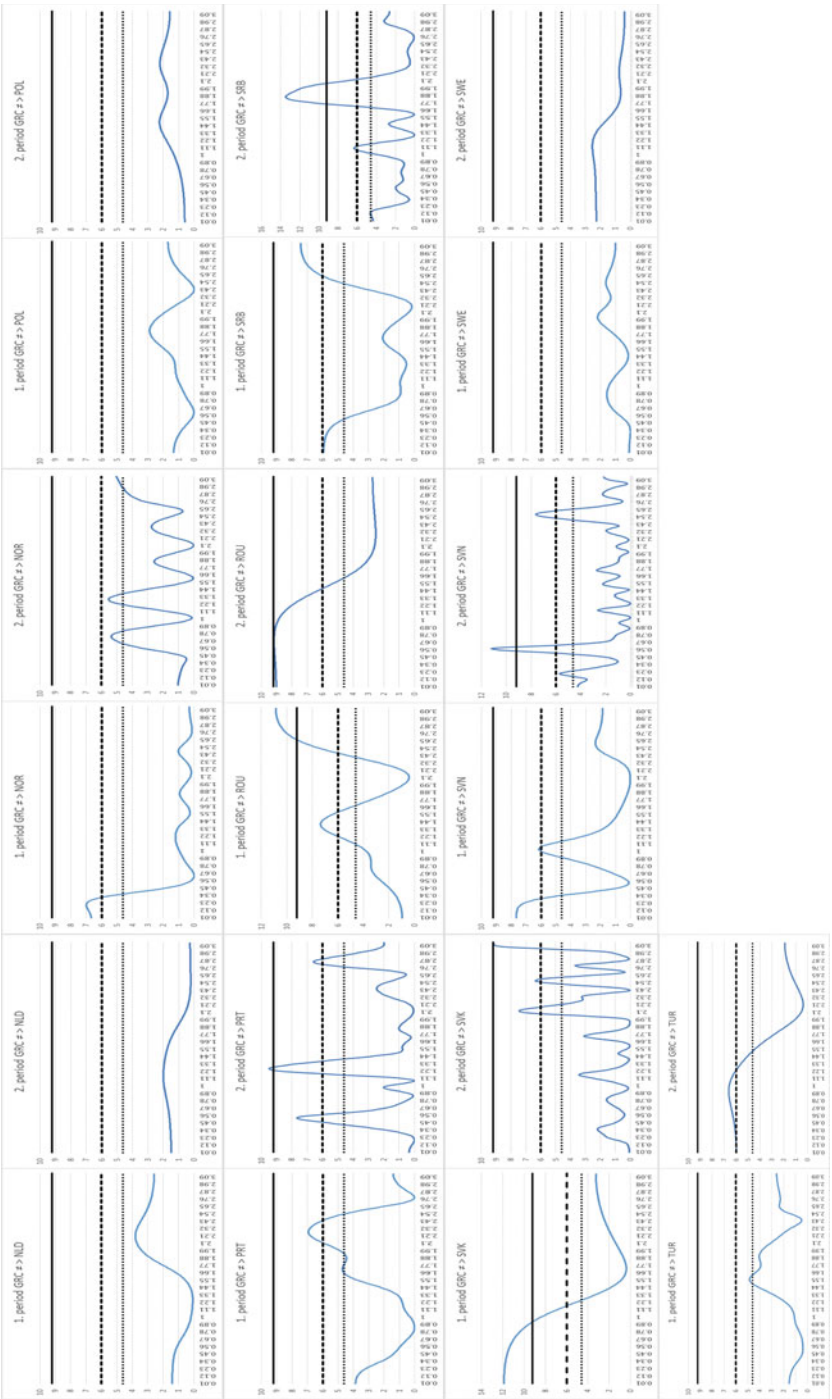
After the traditional approach, the relationships between Greek stock market and stock markets of 34 European countries are investigated on frequency dimension based on the current contagion literature. Findings of the frequency-based approach prove that there are contagion effects from Greek stock market to stock markets of Czech Republic, Spain, Estonia, Hungary, Ireland, Iceland, Lithuania, Luxembourg, and Portugal after the 2009 Greek debt crisis. This situation shows that Czech Republic, Estonia, Hungary, Lithuania, and Luxembourg stock markets are affected from the crisis besides Spain, Ireland, Iceland, and Portugal that are frequently criticized countries in the European Debt Crisis period.

It is determined by the research that the relationships between Greek stock market and stock markets of Belgium, Bosnia-Herzegovina, Finland, United Kingdom, Croatia, and Latvia are disappeared in the debt crisis period while there are relationships for different frequencies in the precrisis period. Results also indicate that investors can diversify their portfolios by investing in Switzerland, France, Italy, Poland, the Netherlands, and Sweden stock markets when they invest in Greek stock market, and vice versa.

Appendix: Graphics of Frequency Domain Causality Test Results




1. period GRC ≠ > FRA
2. period GRC ≠ > FRA
1. period GRC ≠ > GBR
2. period GRC ≠ > GBR
1. period GRC ≠ > HRV
2. period GRC ≠ > HRV
1. period GRC ≠ > HUN
2. period GRC ≠ > HUN
1. period GRC ≠ > IRL
2. period GRC ≠ > IRL
1. period GRC ≠ > ISL
2. period GRC ≠ > ISL
1. period GRC ≠ > ITA
2. period GRC ≠ > ITA
1. period GRC ≠ > LTU
2. period GRC ≠ > LTU
1. period GRC ≠ > LUX
2. period GRC ≠ > LUX
1. period GRC ≠ > MKD
2. period GRC ≠ > MKD
1. period GRC ≠ > MLT
2. period GRC ≠ > MLT
1. period GRC ≠ > LVA
2. period GRC ≠ > LVA


1. period GRC ≠ > NLD
2. period GRC ≠ > NLD
1. period GRC ≠ > NOR
2. period GRC ≠ > NOR
1. period GRC ≠ > POL
2. period GRC ≠ > POL
1. period GRC ≠ > PRT
2. period GRC ≠ > PRT
1. period GRC ≠ > ROU
2. period GRC ≠ > ROU
1. period GRC ≠ > SRB
2. period GRC ≠ > SRB
1. period GRC ≠ > SVK
2. period GRC ≠ > SVK
1. period GRC ≠ > SVN
2. period GRC ≠ > SVN
1. period GRC ≠ > SWE
2. period GRC ≠ > SWE
1. period GRC ≠ > TUR
2. period GRC ≠ > TUR

References

Arghyrou, M. G., & Tsoukalas, J. D. (2011). The greek debt crisis: Likely causes, mechanics and outcomes. *The World Economy, 34*(2), 173–191. https://doi.org/10.1111/j.1467-9701.2011.01328.x.

Aslanoğlu, E., & Deniz, P. (2012). How does stability in financial openness affect growth? *Topics in Middle Eastern and African Economies, 14*, 164–189. http://ecommons.luc.edu/cgi/viewcontent.cgi?article=1156&context=meea.

Bhanot, K., Burns, N., Hunter, D. & Williams, M. (2012). *Was there contagion in Eurozone sovereign bond markets during the Greek debt crisis?*, The University of Texas at San Antonio, College of Business Working Paper Series, No:# 006FIN-73-2012. http://business.utsa.edu/wps/fin/0006FIN-073-2012.pdf

Bodart, V., & Candelon, B. (2009). Evidence of interdependence and contagion using a frequency domain framework. *Emerging Markets Review, 10*(2), 140–150. https://doi.org/10.1016/j.ememar.2008.11.003.

Bozoklu, S., & Yılancı, V. (2013). Energy consumption and economic growth for selected OECD countries: Further evidence from the Granger causality test in the frequency domain. *Energy Policy, 63*, 877–881. https://doi.org/10.1016/j.enpol.2013.09.037.

Breitung, J., & Candelon, B. (2006). Testing for short and long-run causality: A frequency-domain approach. *Journal of Econometrics, 132*(2), 363–378. https://doi.org/10.1016/j.jeconom.2005.02.004.

Ciner, Ç. (2011a). Commodity prices and inflation: Testing in the frequency domain. *Research in International Business and Finance, 25*(3), 229–237. https://doi.org/10.1016/j.ribaf.2011.02.001.

Ciner, Ç. (2011b). Information transmission across currency futures markets: Evidence from frequency domain tests. *International Review of Financial Analysis, 20*(3), 134–139. https://doi.org/10.1016/j.irfa.2011.02.010.

Ciner, Ç. (2011c). Eurocurrency interest rate linkages: A frequency domain analysis. *International Review of Economics and Finance, 20*(4), 498–505. https://doi.org/10.1016/j.iref.2010.09.006.

Claeys, P., & Vasicek, B. (2014). Measuring bilateral spillover and testing contagion on sovereign bond markets in Europe. *Journal of Banking and Finance, 46*, 151–165. https://doi.org/10.1016/j.jbankfin.2014.05.011.

Dickey, D. A., & Fuller, W. A. (1981). Likelihood ratio statistics for autoregressive time series with a unit root. *Econometrica, 49*(4), 1057–1072. https://doi.org/10.2307/1912517.

Dornbusch, R., Park, Y. C., & Claessens, S. (2000). Contagion: Understanding how it spreads. *The World Bank Research Observer, 15*(2), 177–197. https://doi.org/10.1093/wbro/15.2.177.

Dua, P., & Tuteja, D. (2016). Financial crises and dynamic linkages across international stock and currency markets. *Economic Modelling, 59*, 249–261. https://doi.org/10.1016/j.econmod.2016.07.013.

Dungey, M., & Gajurel, D. (2014). Equity market contagion during the global financial crisis: Evidence from the world's eight largest economies. *Economic Systems, 38*(2), 161–177. https://doi.org/10.1016/j.ecosys.2013.10.003.

Forbes, K. J., & Rigobon, R. (2002). No contagion, only interdependence: Measuring stock market comovements. *The Journal of Finance, 57*(5), 2223–2261. https://doi.org/10.1111/0022-1082.00494.

Geweke, J. (1982). Measurement of linear dependence and feedback between multiple time series. *Journal of the American Statistical Association, 77*, 304–324. https://doi.org/10.1080/01621459.1982.10477803.

Gómez-Puig, M., & Rivero, S. S. (2014). Causality and contagion in EMU sovereign debt markets. *International Review of Economics and Finance, 33*, 12–27. https://doi.org/10.1016/j.iref.2014.03.003.

Hosoya, Y. (1991). The decomposition and measurement of the interdependence between second-order stationary processes. *Probability Theory and Related Fields, 88*(4), 429–444. https://doi.org/10.1007/BF01192551.

Joseph, A., Sisodia, G., & Tiwari, A. K. (2014). A frequency domain causality investigation between futures and spot prices of Indian commodity markets. *Economic Modelling, 40*, 250–258. https://doi.org/10.1016/j.econmod.2014.04.019.

Kolb, R. W. (2011). What is financial contagion? In R. W. Kolb (Ed.), *Financial contagion* (pp. 3–10). Hoboken: Wiley. https://doi.org/10.1002/9781118267646.

Luchtenberg, K. F., & Vu, Q. V. (2015). The 2008 financial crisis: Stock market contagion and its determinants. *Research in International Business and Finance, 33*, 178–203. https://doi.org/10.1016/j.ribaf.2014.09.007.

Masson, P. (1999). Contagion: Macroeconomic models with multiple equilibria. *Journal of International Money and Finance, 18*(4), 587–602. https://doi.org/10.1016/S0261-5606(99)00016-9.

Mermod, A. S., & Dudzeviciute, G. (2011). Frequency domain analysis of consumer confidence, industrial production and retail sales for selected European countries. *Journal of Business Economics and Management, 12*(4), 589–602. https://doi.org/10.3846/16111699.2011.599406.

Mink, M., & Haan, J. (2013). Contagion during the Greek sovereign debt crisis. *Journal of International Money and Finance, 34*, 102–113. https://doi.org/10.1016/j.jimonfin.2012.11.006.

Missio, S., & Watzka, S. (2011). *Financial contagion and the European debt crisis*, CESIFO Working Paper No. 3554. http://www.cesifo-group.de/DocDL/cesifo1_wp3554.pdf

Mollah, S., Quoreshi, A. M. M. S., & Zafirov, G. (2016). Equity market contagion during global financial and Eurozonecrises: Evidence from a dynamic correlation analysis. *Journal of International Financial Markets, Institutions and Money, 41*, 151–167. https://doi.org/10.1016/j.intfin.2015.12.010.

Naoui, K., Khemiri, S., & Liouane, N. (2010). Crises and financial contagion: The subprime crisis. *Journal of Business Studies Quarterly, 2*(1), 15–28.

Phillips, P. C. B., & Perron, P. (1988). Testing for a unit root in time series regression. *Biometrika, 75*(2), 335–346. https://doi.org/10.2307/2336182.

Samitas, A., & Tsakalos, I. (2013). How can a small country affect the European economy? The Greek contagion phenomenon. *Journal of International Financial Markets, Institutions and Money, 25*, 18–32. https://doi.org/10.1016/j.intfin.2013.01.005.

Tiryaki, H. N., & Ekinci, A. (2015). Financial contagion in global crises and its effect on Turkish economy. *Sakarya İktisat Dergisi, 4*(1), 1–30. http://www.sdu.dergipark.gov.tr/download/article-file/319613.

Tiwari, A. K. (2014). The frequency domain causality analysis between energy consumption and income in the United States. *Economia Aplicada, 18*(1), 51–67. https://doi.org/10.1590/1413-8050/ea307.

Vayanos, D. (2004). *Flight to quality, flight to liquidity, and the pricing of risk*. NBER Working Paper Series, No: 10327. http://www.nber.org/papers/w10327