



RESEARCH ARTICLE

THE IMPACT OF CROSS-COUNTRY TRADE RELATIONS on THE CONTAGION of
GLOBAL FINANCIAL CRISIS: THE CASE OF TURKEY

Fatih ÇEMREK ^{1,*}  , Hakkı POLAT ² 

¹ Department of Statistics, Faculty of Science and Letters, Eskişehir Osmangazi University, Eskişehir, Turkey

² Middle East Technical University, Ankara Türkiye

ABSTRACT

This study has been written to examine the channels through which the global economic crises spread to the markets of countries with growing economies like Turkey. According to data from the Turkish Statistical Institute (TÜİK), stock market index data of the seven countries with high trade volume (Germany, France, UK, Russia, China, United States of America and Italy) and of the seven countries with low trade volume (Botswana, Gabon, Kenya, Southern Cyprus, Iceland, New Zealand and Jamaica) between 2005 and 2011 was used. With the data used, volatility transfers occurred during the 2007-2008 crisis period were tried to be introduced with the aid of the multivariate GARCH models. As a result of the analyses, it has been determined that trade is an effective channel for transferring volatility.

Keywords: International trade, Financial crisis contagion, Multivariate GARCH Models, Conditional correlation

1. INTRODUCTION

The modern economic system [1] which has been tried to be shaped by Western countries for centuries to transfer the existing capital in the world to the center, social ideology and political image studies by governments to legitimize this economic system [2], globalization used as a means of transferring specialized labor and resources [3] are among the important factors in determining the magnitude of the chaos and collapse which a current economic crisis will create. The area where the laws of economics and physics are similar is that an event that begins at a certain point is not limited to that point, but it also spreads to the environment. While physicists call this event momentum, economists call this interaction event "Financial Contagion." For example, an economic crisis that begins in country A is not limited to that country, but it also spreads to the other countries which are economically and politically related to country A. This definition is generally valid and has been proven by experimental studies [4, 5, 6, 7, 8].

In this study, the impact of 2007-2008 economic crisis, which started in the United States (US), the main actor of today's macroeconomic system formed under the factors mentioned above and included in post-modern economic crisis category was examined on Turkey's growing economy. While examining the effect, the role of trade in the spread of the global economic crisis has been taken into account [5,9]. The study is unique due to its sample group including Turkstat data on the seven countries Turkey had the highest trade volume with (Germany, America, France, Britain, China, Italy and Russia) and the seven countries with the lowest (in accessible data sets) trade volume (Botswana, Gabon, Kenya, Iceland, New Zealand, Southern Cyprus and Jamaica) between 2000-2016, which has not been dealt with in any of the studies related to Turkey so far.

Within the scope of the study, compiling daily stock market data between 2005-2011, the data is divided into three parts: the pre-crisis period, the crisis period and the post-crisis period, and it is tried to

*Corresponding Author: fcemrek@ogu.edu.tr

Received: 29.01.2021 Published: 26.03.2021

Note: This study was compiled from author Hakkı POLAT's doctoral dissertation of the same name, which was approved in Eskişehir Osmangazi University, Institute of Science, Department of Statistics in August 2017

determine whether the trade is effective in the realization of volatility transfer by opening an extra channel in the crisis period compared to the non-crisis periods, thanks to conditional correlations calculated through Multivariate GARCH models.

As a result of the analysis, two important findings have been obtained: first, there is a volatility transfer in crisis periods compared to non-crisis periods, and the second is that trade plays an important role in the formation of this transfer. The analyzes are parallel to the studies in the literature. However, compared to other studies in the literature, it makes an important contribution to the literature thanks to its unique sample group. There are numerous studies on Turkey and European, American and Asian countries. However, there are no studies in the literature investigating the situations of African countries struggling with intense economic and social problems, especially during the crisis period, using econometric and statistical methods. In this respect, this study has a feature which can lead to further studies. Information about the previous studies in the literature is given below.

2. LITERATURE

Economic crises have been studied by many researchers in terms of administrative [10], social [11], political [12], social [13], public health [14] aspects. Recently, the impact of economic crises in Thailand, Korea, Russia and Brazil on other countries with growing and developing economies has drawn the attention of researchers to the problem known as the financial crisis contagion (Financial Contagion). The Mexican crisis in 1994 has already brought this problem to an important point. However, new global economic crises with stronger and more widespread effects have also opened up more specific topics such as capital inflows, fiscal discipline efforts, fiscal reforms and prudent capital account regulations to discussion. As a result of all these discussions, the researchers started to wonder why a country like Bulgaria should be affected if Brazil experiences economic problems, as these two countries are not very related to each other economically and politically.

Conducting research on the explanation of crisis contagiousness, depending on the nature of the factor driving the contagion, is important in understanding the underlying problems and solution policies. For example, if there is trade-related contagion, countries have little alternatives other than diversifying trade or trying to adjust the exchange rate. Conversely, if contagion is threatening a country financially, countries may take other measures such as prudent capital account regulations. Moreover, at the international level, in industrialized countries, direct regulation can improve the situation of a country in an economic crisis [15]. Accordingly, three broad theories emerge to explain contagion from a theoretical perspective: first, trade links and competitive devaluation; second, contagion driven by financial markets; and third, macroeconomic similarities [15].

Eichengreen et al. (1996) analyzed the global economic crisis transmission in 20 member countries of the Organization for Economic Cooperation and Development (OECD). Eichengreen et al. (1996) defined contagion as an increase in the likelihood of an economic crisis in one country as a result of an economic crisis in another one. They cited contagion as a means of spreading more easily from countries with similar macroeconomic characteristics to countries with closer trade links. Eichengreen et al. (1996) stated that if there is an economic crisis spread, the main factors in its occurrence are the countries' own economic balances and political approaches, and especially the shock transfers among European countries can be caused by macroeconomic conditions and changes in law [4].

Kaminsky and Reinhart (1998) followed a similar method as in the studies of Eichengreen et al. (1996); however, they used a larger country sample in their study. They defined economic crises with a different criterion and analyzed the contagion between countries in the same cluster during crisis periods by grouping the countries they included in the sample according to their similarities. Kaminsky and Reinhart claimed financial links to be a potentially important transmission mechanism. However, they argued that

it is difficult to distinguish between the two channels due to the high correlation between trade and financial links. They found weak evidence of financial connectivity being an important channel [5]. Dungey and Gajurel (2014) argue that there are two non-mutually exclusive theories explaining crisis transmission mechanisms. On examining the literature from this view, there is a group of researchers arguing that the economic foundations of different countries are interconnected with cross-border goods, services and capital flows [8]. When an economic crisis begins in a country, commercial and financial ties make many countries dependent on each other [5, 16]. In addition, shocks which may occur in global phenomena such as an economic crisis in one of the developed industrial countries, changes in oil prices, interest rates and exchange rates will simultaneously negatively affect the fundamentals of many countries' economies and possibly cause this crisis to spread [4].

These fundamental effects are also called Spillovers [17], Interdependence [6] or Fundamentally Based Contagion [5]. Another group argues that the global economic crisis has passed from one country to the other due to market defects or the behavior of international investors [17, 18, 19, 20, 21]. Information asymmetry makes the knowledge investors have about a country's economic fundamentals more uncertain. An economic crisis in one country can alert international investors to re-evaluate the risks of other countries, and uninformed or less informed investors may have difficulty following better-informed investors' strategies. This situation causes excessive equal movements in the markets [22, 23, 24, 25]. Due to the distribution of investors' attention, the fact that the crisis is to the extent predicted by the investors is important for the existence of contagion [26]. Sudden changes in market confidence and expectations have been identified as important factors causing contamination [17, 26].

The most important consequence of the global financial crisis is that financial markets around the world have suffered greatly. However, it is difficult to determine whether international trade links or market behaviors were more influential as the reason for the spread of the crisis worldwide [8]. Different experimental findings in contagiousness tests depend largely on how the crisis transmission channel is defined and applied in an empirical setting [7]. Detection of infectious effects requires identification and measurement of the underlying causes of these effects.

The first empirical literature on financial crisis and contagion focused on fundamental mechanisms and aimed at the development of early warning systems [4, 5, 16]. Subsequent empirical studies focused on mechanisms based on financial behavior [7, 27].

3. DATA SET

Many studies in the literature on global financial crisis contagion have used stock market index data of countries (Dungey et al.2005; Dungey et al.2007; Dungey and Gajurel 2014; Eichengreen et al.1996; Kaminsky and Reinhart 2003; Forbes and Rigobon 2002; Favero and Giavazzi 2002). Stock market indexes are frequently preferred by researchers today because they are updated on a minute-by-minute basis thanks to the developing communication technologies and they react faster to events. Especially the results of unexpected situations such as economic crisis are first seen and followed up on stock exchanges. In this study, stock indices of 15 countries between 31.12.2011 and 01.06.2005 were selected. The indices are of national BIST 100 indices in Turkey, Botswana Costa Se DMS. Idx in Botswana, Cotation Assistée en Continu 40 in France, Cyprus General Index in Southern Cyprus, Deutscher Aktienindex 30 in Germany, FTSE 100 London in England, Gabon National Index in Gabon, OMX Iceland in Iceland, Jamaica SE Main Index in Jamaica, Nairobi SE (NSE20) in Kenya, New York Stock Exchange (NYSE) in the USA, NZX 50 in New Zealand, Shanghai Stock Exchange in China, Milano Italia Stock Exchange Index in Italy and Moscow Interbank Currency Exchange in Russia. It is explained below which criteria are taken into consideration when selecting the mentioned indices. The period interval used by Dungey and Gajurel (2014) in their studies was taken as reference while selecting the period interval.

Both Kali and Reyes (2010) and Glick and Rose (1999) stated that trade between countries is the main factor in the spread of economic crises [9, 28]. Based on these views, determining the countries included in the analysis, Turkey's foreign trade data between 2000 and 2016 from Turkey Statistics Institute (TUIK) were taken into account. Compiling the import and export figures which Turkey carried out in 16-year period, the countries with the highest and lowest trading volume were identified and are given in Table 1 (Source: TSI).

Table 1 Turkey Foreign Trade Statistics Between 2000-2016

| No | Country Name | Total Volume (Thousand USD) * | Average (Thousand USD) ** |
|-----|------------------------------------|-------------------------------|---------------------------|
| 1 | Germany | 452.929.035 | 28.308.065 |
| 2 | Russian Federation | 350.340.154 | 21.896.260 |
| 3 | China | 254.489.516 | 15.905.595 |
| 4 | Italy | 248.183.668 | 15.511.479 |
| 5 | USA | 227.546.844 | 14.221.678 |
| 6 | France | 196.648.305 | 12.290.519 |
| 7 | England | 195.102.873 | 12.193.930 |
| 262 | St Pierre | 68 | 4,26 |
| 263 | St. Helena | 62 | 3,89 |
| 264 | Micronesia | 49 | 3,05 |
| 265 | Norfolk Island | 16 | 0,98 |
| 266 | Antarctica | 4 | 0,28 |
| 267 | Heard Island ve Mc. Donald Islands | 3 | 0,16 |
| 268 | British Indian Ocean Islands | 2 | 0,11 |

* Total trade volume between 2000-2016 (total import and export) ** Average annual trade volume between 2000-2016 (total import and export)

When Table 1 is examined, most of Turkey's import and export trade as the sum is seen that with Germany. After Germany, Russia, China, Italy, USA, France and England are listed. At the end of the ranking are St. Pierre, St. Helena, Micronesia, Norfolk Island, Antarctica, Herad and McDonald Islands, and British Indian Ocean Islands, which appear to be autonomous states or territories with very small land areas and populations.

As a data selection method, starting from the bottom of the list created, it has been tried to reach indices related to these countries through Datastream™, the database of Thomson Reuters™, which is one of the world's most respected and leading macroeconomic analysis organizations. Starting from the bottom of the list, all regions and countries have been tested one by one, and it is aimed to obtain information in the appropriate time interval and quality. However, since the regions and countries in the rankings given in Table 1 could not even form state structures before the economic restructuring, it was not possible to reach the data of many countries at the bottom of the list. Therefore, the countries with most qualified data set reached and Turkey's total imports and exports total between the years 2000-2016 are shown the table given below.

Table 2 Trade Volume of Low-Level Countries Included in the Study Between 2000-2016

| No | Country Name | Total Volume (Thousand USD) * | Average (Thousand USD) ** |
|-----|-----------------|-------------------------------|---------------------------|
| 108 | Kenya | 1.675.893 | 104.743 |
| 109 | New Zeland | 1.602.944 | 100.184 |
| 129 | Gabon | 598.687 | 37.418 |
| 135 | Iceland | 475.516 | 29.720 |
| 141 | Jamaica | 383.688 | 23.980 |
| 193 | Southern Cyprus | 48.883 | 3.055 |
| 204 | Botswana | 18.533 | 1.158 |

* Total trade volume between 2000-2016 (total import and export) ** Average annual trade volume between 2000-2016 (total import and export)

Based on the researches in the literature given in the previous parts of the study, an analysis study will be carried out by considering two important factors in the spread of financial crises. The first of the two important issues in this study is the determination of the difference between the conditional correlations calculated with stock indexes of the selected countries and Turkey out of the crisis and non-crisis periods; the second is the effect of the trade level on the spread of the financial crisis. Based on this situation, the research model and hypotheses will be as follows:

Table 3 Research Hypotheses

| Period Effect | Trade Volume Effect |
|---|---|
| $H_0: \mu_{\rho}^{pre-crisis} = \mu_{\rho}^{crisis\ period} = \mu_{\rho}^{post-crisis}$ | $H_0: \mu_{\rho}^{high\ trade\ volume} = \mu_{\rho}^{low\ trade\ volume}$ |

After obtaining stock market data for countries, the data set was divided into three groups to test whether the difference between conditional correlations between crisis and non-crisis periods is statistically significant. Dungey and Gajurel (2014) acknowledged the date of July 17th, 2007, when bankruptcies and crisis signals began to increase and Bearn Stearns announced his bankruptcy, as the beginning of the 2007-2008 crisis. Also, Dungey and Gajurel stated that the crisis period should be based on the dates of July 17, 2007 and August 31, 2009 in their studies. Accordingly, the date range to be considered in the analysis is given in the table below:

| Period | Date Range |
|--------------------|-------------------------|
| Pre-crisis Period | 01.06.2005 - 16.07.2007 |
| Crisis Period | 17.07.2007 - 31.08.2009 |
| Post-crisis Period | 01.09.2009 - 31.12.2011 |

After determining the research model and hypotheses, the results of the analyzes made are given in the next part of the study.

4. METHODS and RESULTS

OxMetrics 6.0™ and E-views 8™ programs were used in the analysis. In the next part of the analysis, the index will be expressed as BIST 100: Borsa Istanbul 100 Index, BOTS: Botswana Composite Index, CAC40: France Cotation Assistée en Continu 40 Index, CGE: Southern Cyprus General Index, DAX 30: Germany Deutscher Aktienindex 30 Index, FTSE 100: England London Stock Exchange 100 Index, GAB: Gabon General Index, IZ: Iceland OMX Index, JAM: Jamaica General Index, MIB: Italy Milan

Stock Exchange Index, MICEX: Russia Index, NSE 20: Kenya Nairobi 20 Index, NYSE: USA New York Stock Exchange, NZX: New Zealand NZX 50 Index, and SSE: China Shanghai Stock Exchange Index.

4.1. Multivariate GARCH Models

Time dependent correlations are generally estimated from multivariate GARCH models. Engle (2002), using these multivariate models, revealed the Dynamic Conditional Correlation model (Dynamic Conditional Correlation-DCC). While explaining this model, he stated that he actually made use of the elastic structure of univariate GARCH models. He remarked that several univariate GARCH models with flexible and extensible properties are the basis of the approach he proposed. Engle defined that although univariate GARCH models are not fully linear, due to the multivariate models, dynamic conditional correlation values can be calculated by simple operations with the help of most likelihood functions. Engle demonstrated that the inherent elasticity of multivariate GARCH models derived from univariate GARCH models can give sensitive results for different situations in empirical applications [29].

Engle took basis on Bollerslev's fixed conditional correlation model while developing the dynamic conditional correlation model. The fixed conditional correlation model is expressed as [30];

$$H_t = D_t \Gamma D_t \tag{1}$$

Engle (2002), based on this model, defined an R matrix consisting of constant conditional correlations as follows;

$$E_{t-1}(\epsilon_t \epsilon_t') = D_t^{-1} H_t D_t^{-1} = R \tag{2}$$

$$\epsilon_t = D_t^{-1} r_t \tag{3}$$

Engle defined equation number 3 as the H matrix in univariate GARCH models adapted to the multivariate structure. He described this model as a complete model including relationships with other variables, having predictive values, and taking external variables into account. Calculation of the R matrix considering the positive definition and other conditions in classical volatility models is as [31];

$$Q_t = (1 - \sum_{m=1}^M \alpha_m - \sum_{n=1}^N \beta_n) \bar{Q} + \sum_{m=1}^M \alpha_m (\epsilon_{t-m} \epsilon_{t-m}') + \sum_{n=1}^N \beta_n Q_{t-n} \tag{4}$$

and calculated as

$$R_t = Q_t^{*-1} Q_t Q_t^{*-1} \tag{5}$$

Engle and Sheppard (2001) stated that the first step of matrix computation is to calculate the Q matrix generated from standardized values and suggested that this matrix can be calculated as follows;

$$Q_t^* = \begin{bmatrix} \sqrt{q_{11}} & \cdots & 0 \\ \vdots & \ddots & \vdots \\ 0 & \cdots & \sqrt{q_{kk}} \end{bmatrix} \tag{6}$$

Q_t^* , Q_t' is a diagonal matrix consisting of the square root of diagonal components and calculated as

$$\rho_{ijt} = \frac{q_{ijt}}{\sqrt{q_{ii} q_{jj}}}$$

Engel and Sheppard (2001) indicated that, thanks to the model given in equation number 6, while capturing the dynamic relationships between volatilities, they could fulfill the condition for the correlation matrix to be positive. This model is still used frequently in empirical applications.

4.2. RESULTS and DISCUSSION

As known, although Box & Jenkins method takes the autoregressive continuity and movement mean structure into account, the method assumes that the variances of the series of interest do not change over time. However, Engle (1982) opposed these propositions and showed that variances in time-dependent series can change and this can be modeled. In this context, the results of the ARCH-LM test conducted to determine whether the series handled contain ARCH effects or not are given in the table below.

As seen in Table 4, it is seen that all series have an ARCH effect.

Table 4 ARCH-LM Test Results

| Series | Lag Length | F. | p. |
|----------|------------|----------|---------|
| BIST 100 | 5 | 19,27432 | <0,001* |
| BOTS | 5 | 2,635985 | 0,0483* |
| CAC 40 | 5 | 54,93127 | <0,001* |
| CGE | 5 | 31,90875 | <0,001* |
| DAX 30 | 5 | 52,92266 | <0,001* |
| FTSE 100 | 5 | 73,96133 | <0,001* |
| GAB | 5 | 32,51768 | <0,001* |
| IZ | 5 | 28,65502 | <0,001* |
| JAM | 5 | 7,433972 | <0,001* |
| MIB | 5 | 51,66177 | <0,001* |
| MICEX | 5 | 43,42192 | <0,001* |
| NSE 20 | 5 | 90,38737 | <0,001* |
| NYSE | 5 | 94,16301 | <0,001* |
| NZX | 5 | 92,90622 | <0,001* |
| SSE | 5 | 45,94713 | <0,001* |

*Ho: Covariance existence (No ARCH effect) *p<0,05*

Examining Table 5, it is seen that the models with the smallest error criterion value are Engle's DCC models after the evaluations made considering the Akaike and Schwartz criteria, which are one of the most used error criteria in model selection. It is realized that DCC GARCH (2,1) for the pre-crisis period, DCC GARCH (1,1) for the crisis period, and the DCC GARCH (1,1) model for the post-crisis period has the smallest error criteria values. According to this, it can be concluded that the Dynamic Conditional Correlation approaches developed by Engle (2002) are the most successful models among the models tested for the related 15 countries for the 2007-2008 crisis period data used in this study.

Table 5 Multivariate GARCH Model Error Criteria Values

| Period | Model | ARCH(p) | GARCH(q) | Akaike | Schwartz |
|---------------------------|------------|---------|----------|-----------|-----------|
| Pre-crisis Period | D-VECH | 1 | 1 | 155,0097 | 157,936 |
| | D-VECH | 2 | 1 | 155,3057 | 159,1684 |
| | BEKK | 1 | 1 | 156,1148 | 156,4737 |
| | BEKK | 2 | 1 | 154,8840 | 155,3600 |
| | Engle-DCC | 1 | 1 | 154,6124 | 156,0326 |
| | Engle-DCC* | 2 | 1 | 154,4867* | 156,0240* |
| Crisis Period | D-VECH | 1 | 1 | 170,7120 | 173,6302 |
| | D-VECH | 2 | 1 | 170,9962 | 174,8482 |
| | BEKK | 1 | 1 | 169,3984 | 170,6825 |
| | BEKK | 2 | 1 | 168,9153 | 170,3161 |
| | Engle-DCC* | 1 | 1 | 168,4896* | 169,9059* |
| | Engle-DCC | 2 | 2 | 168,6414 | 170,2911 |
| Post-crisis Period | D-VECH | 1 | 1 | 151,3060 | 152,5013 |
| | D-VECH | 2 | 1 | 151,3744 | 153,439 |
| | BEKK | 1 | 1 | 151,3060 | 152,5013 |
| | BEKK | 1 | 2 | 151,1164 | 152,4204 |
| | Engle-DCC* | 1 | 1 | 150,9394* | 152,3665* |
| | Engle-DCC | 1 | 2 | 150,9489 | 152,4847 |

* It shows the model with the smallest information criterion value.

When Table 6 is examined, it can be said that there is an increase in the conditional correlations with the BIST 100 index in all countries except Botswana, Southern Cyprus, and New Zealand in the transition from the pre-crisis period to the crisis period. In the transition from the crisis period to the post-crisis period, the conditional correlations of the markets of Southern Cyprus, Iceland, Kenya, New Zealand and China with BIST 100 increased, while the conditional correlations of Botswana, France, Germany, England, Gabon, Jamaica, Italy, Russia and the USA markets with BIST 100 decreased. As the reasons for these changes were mentioned earlier in the study, it will not be discussed again. In order to test whether this change between periods is statistically significant or not, one-way analysis of variance used in the analysis of repeated measurements was applied. The results are given in Table 7.

Table 6 Conditional Correlation Means by Periods

| Stock Exchanges | Pre-Crisis Conditional Correlation Means | Crisis Period Conditional Correlation Means | Post-Crisis Conditional Correlation Means |
|------------------|--|---|---|
| BİST100- BOTS | -0,0582 | 0,0378 | -0,0209 |
| BİST100- CAC 40 | 0,4342 | 0,6650 | 0,5439 |
| BİST100- CGE | -0,0327 | 0,0305 | -0,0482 |
| BİST100- DAX 30 | 0,4252 | 0,6591 | 0,5329 |
| BİST100- FTSE100 | 0,4742 | 0,6632 | 0,5487 |
| BİST100- GAB | 0,0358 | -0,0509 | 0,0401 |
| BİST100- IZ | 0,0177 | -0,0127 | 0,0238 |
| BİST100- JAM | 0,0566 | -0,0953 | -0,0231 |
| BİST100- MIB | 0,4120 | 0,6569 | 0,5106 |
| BİST100- MICEX | 0,4797 | 0,6316 | 0,4565 |
| BİST100- NSE20 | -0,0303 | 0,0146 | 0,0160 |
| BİST100- NYSE | 0,3207 | 0,4869 | 0,4272 |
| BİST100- NZX | -0,0309 | -0,0162 | 0,0858 |
| BİST100- SSE | 0,0960 | 0,1908 | 0,1550 |

Table 7 Dependent Sampling Variance Analysis Results According to Crisis and Non-Crisis Periods

| Period | Mean | Std. Deviation | F. | p. |
|--------------------|----------|----------------|----------|---------|
| Pre-crisis Period | 0,185706 | ,2136993 | | |
| Crisis Period | ,276654 | ,3137540 | 2688,580 | <0,001* |
| Post-crisis Period | ,258504 | ,2387769 | | |

* $p < 0,05$ $H_0: \mu_{\rho}^{pre-crisis\ period} = \mu_{\rho}^{crisis\ period} = \mu_{\rho}^{post-crisis\ period}$

When the table is analyzed, $H_0 = \mu_{\rho}^{pre\ crisis} = \mu_{\rho}^{during\ crisis} = \mu_{\rho}^{post\ crisis}$ hypothesis which claims that the conditional correlations between periods remain constant can be rejected with 95% reliability, so conditional correlations can be said to indicate statistically significant differences in crisis and non-crisis periods. The results of the dependent sample variance analysis conducted to determine whether there is a conditional correlation increase between the markets of different countries in crisis and non-crisis periods are given in Table 8 below.

Table 8 Conditional Correlation Dependent Sampling Variance Analysis Results Between Periods According to Countries

| Conditional Correlation | Pre-Crisis Mean | Crisis Mean | Post-Crisis Mean | F | p |
|-------------------------|-----------------|-------------|------------------|-----------|---------|
| BİST100-BOTS | -0,058 | 0,038 | -0,021 | 2887,653 | *<0,001 |
| BİST100-CAC 40 | 0,434 | 0,665 | 0,544 | 37014,537 | *<0,001 |
| BİST100-DAX30 | 0,425 | 0,659 | 0,533 | 37110,310 | *<0,001 |
| BİST 100-FTSE100 | 0,474 | 0,663 | 0,549 | 25742,422 | *<0,001 |
| BİST 100-GAB | 0,036 | -0,051 | 0,040 | 4700,710 | *<0,001 |
| BİST 100-JAM | 0,057 | -0,095 | -0,023 | 11329,001 | *<0,001 |
| BİST 100-MIB | 0,412 | 0,657 | 0,511 | 43226,478 | *<0,001 |
| BİST 100-MICEX | 0,480 | 0,632 | 0,456 | 16901,377 | *<0,001 |
| BİST 100-NSE 20 | -0,030 | 0,015 | 0,016 | 827,699 | *<0,001 |
| BİST 100-NYSE | 0,321 | 0,487 | 0,427 | 14260,753 | *<0,001 |
| BİST 100-NZX | -0,031 | -0,016 | 0,086 | 4646,903 | *<0,001 |
| BİST 100-SSE | 0,096 | 0,191 | 0,155 | 1711,729 | *<0,001 |
| BİST 100-IZ | 0,018 | -0,013 | 0,024 | 9,586 | *<0,001 |
| BİST100-CGE | -0,033 | 0,030 | -0,048 | 2870,980 | *<0,001 |

* $p < 0,05$ $H_0: \mu_{\rho}^{pre-crisis} = \mu_{\rho}^{crisis\ period} = \mu_{\rho}^{post-crisis}$

On studying Table 8, it is seen that the hypothesis claiming that the difference between the conditional correlation means of the relevant stock market indices included in the analysis with the BIST100 index in crisis and non-crisis periods is insignificant, and so it will be rejected with 95% reliability. However, another important issue in the table is that the conditional correlation means of the countries included in the high trade volume group are higher than the conditional correlations of the countries in the group with low trade volume, as shown in Table 9. These findings are in line with studies conducted with different sample groups and periods in the literature. An independent sample t-test was applied to test whether the conditional correlations of trade volume between the BIST 100 index and other country markets show a statistically significant difference in crisis and non-crisis periods, and the results are given in the table below.

Table 9. Results of the Independent Sample t-test by Trade Volume

| Period | Trade Volume | N | Mean | Std. Dev | p. |
|-------------|--------------|------|--------|----------|---------|
| Pre-Crisis | Low Level | 3871 | -0,006 | 0,043 | *<0,001 |
| | High Level | 3871 | 0,377 | 0,126 | |
| Crisis | Low Level | 3885 | -0,013 | 0,050 | *<0,001 |
| | High Level | 3885 | 0,564 | 0,164 | |
| Post-Crisis | Low Level | 4263 | 0,105 | 0,049 | *<0,001 |
| | High Level | 4263 | 0,453 | 0,131 | |

* $p < 0,05$

When Table 9 is analyzed, it is seen that the hypothesis claiming that the difference between the means of the conditional correlations between the BIST 100 index and other countries' stock markets for the pre-crisis period to be statistically insignificant will be rejected. The same situation is valid for the crisis and post-crisis periods. Therefore, it can be said that the trade volume between countries and the conditional correlations between countries are an effective factor on the changes in crisis and non-crisis periods. Another conclusion to be drawn from the table is that the biggest difference between the conditional correlations of low and high-level countries with the BIST 100 index is during the crisis period (0.577). Consequently, it is important in terms of showing that there is a conditional correlation increase during the crisis period compared to non-crisis periods, and that trade has an effect on this increase.

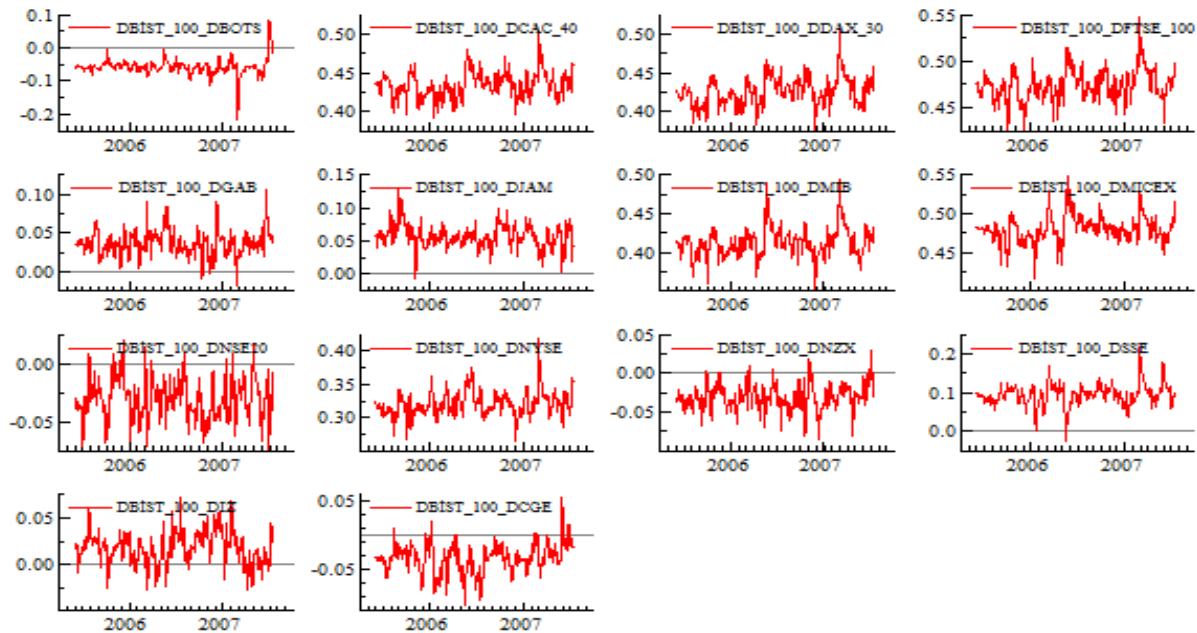


Figure 1 Pre-Crisis Engle DCC GARCH Conditional Correlation Graphs

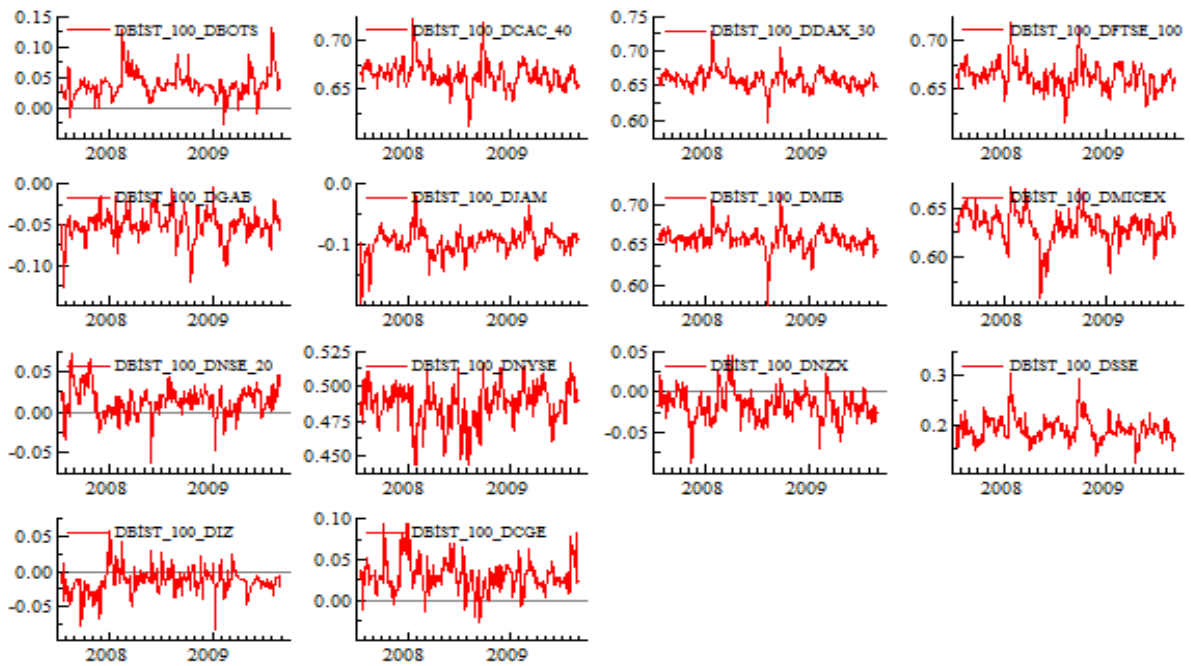


Figure 2 Crisis Period Engle DCC GARCH Conditional Correlation Graphs

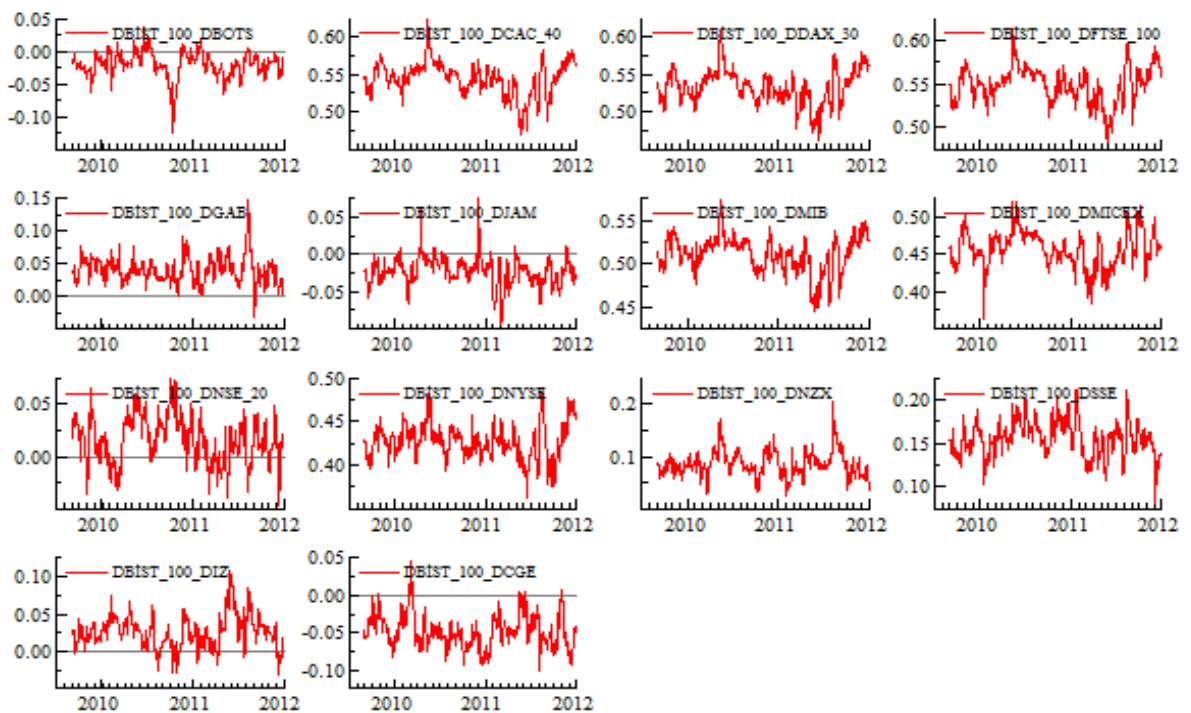


Figure 3 Post-Crisis Period Engle DCC GARCH Conditional Correlation Graphs

5. CONCLUSION and RECOMMENDATIONS

Studies on the cause of economic crises and how they spread are still ongoing today. Basically, rational and non-deterministic human behaviors, and political reasons which are difficult to control and manage compose the most difficult parts of these studies. It is easier to analyze the results than to understand the causes of this intricate structure. On the one hand, there is a group of 20% owning 80% of the total wealth in the world; on the other hand, 80 % can only have 20% of all wealth. From this point of view, what the current economic system represents or what it serves is a controversial issue. However, as has been said before, the analysis made with quantitative data over the events which have been experienced provides input to the researchers' studies at worst for the analysis of the results of this system.

This study, considering the results of the economic crisis more than the causes and covering the recent major global economic crisis of Turkey's emerging economy, included 14 countries with which Turkey has low and high-level trade relations in the years 2005-2011. Thanks to working with time dependent variables, GARCH models with multivariate were preferred in analysis in order to reveal the dynamic structure.

As a result of the analysis, the following results were obtained:

1. Multivariate GARCH models yielded successful results in determining the conditional variances and conditional correlations of time-dependent series,
2. Trade is effective in the occurrence of shock transfers between the markets of the two countries by opening a transfer channel in times of economic crisis.
3. Trade level plays an important role in determining the magnitude of shock transfers in times of crisis.
 - a. Turkey's interaction with the countries having low level of trade relations market has increased in the transition period from the pre-crisis period to the crisis period, but indicates variability to a degree not allowing a generalization to be made in the post-crisis period,
 - b. conditional correlations on the market of the countries with which Turkey has a high-level trade volume show an increase from the pre-crisis period to the crisis period and a decline from the crisis period to the post-crisis period,
 - c. Multivariate statistical methods are successful in determining the difference between the means of conditional correlations obtained,

Globalization brings many consequences. However, the most important of these is its creating a complex and sensitive global financial market. Since financial markets are basically unstable, actors in these markets often fail to prevent the crisis in times of crisis [32]. As a matter of fact, emerging market collapses and excessive lending to private banks and companies in developing countries by the private banks and non-bank financial intermediaries in developed countries are the biggest indicators of this failure. However, when a crisis breaks out, pre-agreed measures to cope with crisis situations can increase confidence in the system without imposing excessive restrictions. Economic crises have always existed and will continue to exist. What is important here is that each crisis is different from the other and may have unexpected consequences.

In addition, as a result of the literature review, it has been concluded that the studies on shock transfers are generally carried out with tests in the fields of financial mathematics and financial econometrics. However, as in every field, it has been determined that there is a greater need for Statistics science in studies on financial crises. In this study, the use of one-way analysis of variance, which is one of the basic tests of statistics, to compare 3 different crisis and non-periods, is also important in terms of showing that interdisciplinary studies will yield more beneficial results.

CONFLICT OF INTEREST

The author stated that there are no conflicts of interest regarding the publication of this article.

REFERENCES

- [1] Modelski G, Thompson WR. Seapower in global politics. Springer 1988: 1494–1993.
- [2] Gramsci A. The philosophy of praxis, Selections from the prison notebooks of Antonio Gramsci. London, UK, The Electric Book Company Ltd. 1971.
- [3] Giddens A. The Consequences of Modernity. Cambridge Polity 1990; 53(83): 245-260.
- [4] Eichengreen B, Rose AK, Wyplosz, C. Contagious currency crises. National Bureau of Economic Research 1996: 5681.
- [5] Kaminsky GL, Reinhart CM. Financial crises in Asia and Latin America: Then and now. The American Economic Review 1998: 88(2), 444-448.
- [6] Forbes KJ, Rigobon R. No Contagion, only interdependence: measuring stock market comovements. The Journal of Finance 2002: 57(5), 2223-2261.
- [7] Dungey M, Fry R, González-Hermosillo B, Martin VL. Empirical Modelling of contagion: A review of methodologies. Quantitative Finance 2005: 5(1), 9-24.
- [8] Dungey M, Gajurel D. Equity market contagion during the global financial crisis: Evidence from the World's Eight largest economies. Economic Systems 2014: 38(2), 161-177.
- [9] Glick R, Rose AK. Contagion and Trade: Why are currency crises regional?. Journal of International Money and Finance 1999: 18(4), 603-617.
- [10] Mitton T. A cross-firm analysis of the impact of corporate governance on the East Asian financial crisis. Journal of Financial Economics 2002: 64(2), 215-241.
- [11] Ghai D. The IMF and the South: The Social Impact of Crisis and Adjustment. London, UK: Zed Books, 1991.
- [12] Nelson J. M. (1990), Economic Crisis and Policy Choice: The Politics of Adjustment in the Third World. New Jersey, USA. Princeton University Press, 1990.
- [13] Elder Jr GH. Children of the Great Depression: Social Change in Life Experience. NY USA. Westview Press, 1999.
- [14] Kentikelenis A, Karanikolos M, Papanicolas I, Basu S, McKee M, Stuckler D. Health Effects of financial crisis: Omens of a Greek tragedy. The Lancet 2011: 378(9801), 1457-1458.
- [15] Hernández L F, Valdés RO. What drives contagion: Trade, neighbourhood, or financial links? International Review of Financial Analysis 2001: 10(3), 203-218.
- [16] Van Rijckeghem C, Weder B. (2001), Sources of contagion: is it Finance or trade. Journal of International Economics 2001: 54(2), 293-308.

- [17] Masson P. Contagion: macroeconomic models with multiple equilibria. *Journal of International Money and Finance* 1999: 18(4), 587-602.
- [18] Diamond DW, Dybvig PH. Bank runs, deposit insurance, and liquidity. *Journal of Political Economy* 1983 91(3), 401-419.
- [19] Dornbusch R, Park YC, Claessens S. Contagion: Understanding how it spreads. *The World Bank Research Observer* 2000: 15(2), 177-197.
- [20] King MA, Wadhvani S. Transmission of volatility between stock markets, *Review of Financial Studies* 1990: 3(1), 5-33.
- [21] Kodres LE, Pritsker M. A rational expectations model of financial contagion. *The Journal of Finance* 2002: 57(2), 769-799.
- [23] Goldstein M, (1998), “The Asian Crisis: Causes, cures, and systematic implications. *Institute for International Economics* 1998: Vol (55).
- [22] Calvo GA, Mendoza EG. Capital-Markets crises and economic collapse in emerging markets: An informational-frictions approach. *The American Economic Review* 2000: 90(2), 59-64.
- [24] Pasquariello P. Imperfect competition, information heterogeneity, and financial contagion. *Review of Financial Studies* 2007: 20(2), 391-426.
- [25] Yuan K. Asymmetric price movements and borrowing constraints: A rational expectations equilibrium model of crises, contagion, and confusion. *The Journal of Finance* 2005: 60(1), 379-411.
- [26] Mondria J, Quintana- Domeque C. Financial Contagion and Attention Allocation. *The Economic Journal* 2013: 123(568), 429-454.
- [27] Bekaert G, Hodrick RJ. *International Financial Management*. New Jersey, NJ: Pearson Prentice Hall Press, 2009.
- [28] Kali R, Reyes J. Financial contagion on the international trade network. *Economic Inquiry* 2010: 48(4), 1072-1101.
- [29] Engle R. Dynamic conditional correlation: A simple class of multivariate generalized autoregressive conditional heteroskedasticity models. *Journal of Business & Economic Statistics* 2002: 20(3), 339-350.
- [30] Bollerslev T. Modelling the coherence in short-run nominal exchange rates: A multivariate generalized ARCH model. *The Review of Economics and Statistics* 1990: 498-505.
- [31] Engle RF, Sheppard K. Theoretical and empirical properties of dynamic conditional correlation multivariate GARCH. *National Bureau of Economic Research* 2001: W (8554).
- [32] Kindleberger CP. *Comparative Political Economy*, Cambridge, USA. MIT Press, 2000.