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Author: Harun Ercan

Supervisor: Prof. Walter György

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CORVINUS UNIVERSITY OF BUDAPEST

FACULTY OF BUSINESS ADMINISTRATION AND MANAGEMENT

Finance Department

HARUN ERCAN

**The FINANCIAL INTEGRATION and ITS FLIPSIDE
with a FOCUS on BANKING and STOCK MARKETS of
CENTRAL, EASTERN, and SOUTHEASTERN EUROPEAN COUNTRIES**

A dissertation submitted in partial fulfillment of the requirements for the degree of

Doctor of Philosophy

in Corvinus University of Budapest

Budapest, 2021

Declaration

1. I hereby declare that I have compiled this thesis using the listed literature and resources only.
2. I hereby declare that my thesis has not been used to gain any other academic title.
3. I fully agree with my work being used for study and scientific purposes.

In Budapest on

Harun Ercan

15.08.2021

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PREFACE

The basis for this research originally stemmed from my personal interest and academic background. This thesis has been organized as a combination of my work throughout my study.

Writing a doctoral thesis requires a lot of effort and endurance. For this difficult period, I received a lot of help and support from friends, co-authors, professors, the faculty, and the university staff. I would like to thank them all for their precious help.

In truth, I could not have achieved my current level of success without strong support from my family. I would like to thank my family for their love and encouragement.

I also deeply thank my supervisor, Prof. Walter Gyorgy, for his excellent guidance and support during this process. His support kept me motivated throughout the process.

Lastly, may this thesis be beneficial for readers and authors for their future research.

CHAPTER 1

As a very popular research topic, the integration among financial markets has been studied by many researchers. This thesis aims to investigate the effect of financial integration on European markets from another point of view. For this reason, various researches have been combined to assess the impact of financial integration on different types of financial markets. This thesis focuses primarily on the CESEE region and covers Bulgaria, Croatia, the Czech Republic, Hungary, Poland, Romania, and Turkey. The countries are selected to be a sample from EU member states and EU candidates. Some CESEE countries are not included in the research due to some data limitations (Albania, Bosnia and Herzegovina, Kosovo, Montenegro, North Macedonia, Serbia, Slovakia, Slovenia, Russia, and Ukraine).

This study uses and combines the results of the various research methodologies such as wavelet technique, cluster analysis, and GARCH models. After the introduction of the thesis and hypotheses, the second chapter explains financial integration and its impacts on Central, Eastern, and Southeastern European economies. In the third chapter of this thesis, cluster analysis gives us an overview of the banking sector clusters in Europe. “The Cluster Analysis of the Banking Sector in Europe” which is a part of “Economics and Management of Global Value Chains: Regional Clusters, Local Networks, and Entrepreneurship” was written with my co-author Saysi Sayaseng. By using banking sector ratios, similarities and differences in the sector have been analyzed. This chapter provides hints about the integrity of the union banking sector. The following chapter employs a wavelet method to investigate the co-movements of stock markets during the debt crisis and after with a focus on central and southeastern European economies and a member candidate country. “A Wavelet Coherence Analysis: Contagion in Emerging Countries Stock Markets” which was published in *Periodica Polytechnica Social and Management Sciences* is written with my co-author Ilhami Karahanoglu. This chapter allows the reader to see the uneven impacts of integration during and after the crisis. The fifth chapter of the thesis analyses the spillover effects causing by Germany, the US, and the UK to observe the relationship between developed and developing markets. Finally, the last chapter combines and concludes the results of the sections.

Due to the size of the financial markets and dissertation limitations, the research area of the thesis is narrowed only to banking and stock markets. Moreover, using only banking and stock market data brings comparison advantages, as well the availability and soundness of data is

higher than many other markets. The other markets such as money markets, bond markets, commodity markets, or other financial institutions can be further analyzed and the results of this thesis can be compared as a suggestion for further studies in the future.

1.1 Introduction

The financial system performs an important function in the economic development process. One of the most important functions of a financial system is the intermediation between savers and investors. A more effective and low-cost financial system can boost the development of the whole economy. For a better financial system, the financial integration of markets can be very beneficial as it increases the opportunities in domestic markets.

Financial integration of the markets requires a single set of rules, equal access, and treatment. Financial integration has markedly been growing, especially after decreasing the barriers to investment and lifting the restrictions for the transfers of the capital account. Therefore, during the higher financial integration process since the 1970s, these effects spread deeper in almost every part of the world and every society.

The integration of financial markets of countries is assumed by many scholars to have positive impacts. Many researchers supported the idea that the deregulation of domestic rules is needed especially in developing markets to increase the effectiveness of financial integration and success of economic transactions (Mc Kinnon, 1973, Shaw, 1973, Balassa, 1973). Financially integrated markets may allow higher capital flow which is especially needed in developing markets. The integration can provide an allocation of capital that increases efficiency, meanwhile, it helps to diversify risks. Also, macroeconomic discipline and higher transparency can be achieved by international organizations. On the other hand, financial integration may increase the competition while market depth is growing, while financial stability is expected to rise. Nevertheless, recent experiences have shown us that the cost of financial integration could be heavier than the benefits in some cases. Some economies may have debt problems as some countries are losing control of economic and financial structure and independence of monetary and fiscal policies. Concentration and allocation of capital flows and difficulty of accessing may consist of a threat as well as oligopoly markets after the merger of companies. Contagion and spillovers during high volatility periods may adversely affect domestic markets. In this context, the impact of international financial integration on Central and South-Eastern European economies is examined in the thesis.

Chapter 2 of this thesis explains the dynamics of financial integration with a focus on Europe from different perspectives. In the first part of the chapter financial integration is explained with its pros and cons. Later, financial crises and their impact on emerging European markets have been debated. The GDP levels of economies are investigated to observe the vulnerability of markets after the integration of European markets. The second part of the chapter provides a summary of the European Union and the financial markets with a focus on Central, Eastern, and South-Eastern European Countries. This chapter enables the reader to see understand the changes in the level of market access of the CESEE in the last two decades.

In Chapter 3 of this thesis, cluster analysis is employed to observe the resemblance of banking sector ratios in Europe. The selected ratios are selected to cover the main financial activities in balance sheets and to represent the main characteristics of the banking sector. The chapter aims to provide an overview of the banking sector comparison among countries. Although it is expected that the ratios should be similar after many years of European economic integration, the impact of financial integration in Europe is observed to be limited. The banking sector clusters are existing due to geographical closeness more than the integration in the whole union. And the more developed countries clustered together as another indicator of non-convergence during the study period.

In the 4th Chapter of the thesis, the research focuses on the contagion during the Greek Debt crisis. The wavelet analysis is employed to compare the impact of crisis with non-volatile periods of integration. The analysis illustrates that the impact of the crisis is hazardous, as the positive effects of integration are very limited. The countries had an impact on other economies during higher volatility periods, unlike other times.

Chapter 5 employed the DCC-mGARCH model to investigate the market reactions against the shocks, volatility transmission, and spillover effects between Germany, the US, the UK, and stock markets of Croatia, Greece, Hungary, Poland, Romania, and Turkey in the last two decades, to examine the risk-return profile of Central and Southeastern European (CESEE) stock markets from a portfolio management viewpoint.

Central, Eastern, and South-Eastern European (CESEE) economies are traditionally in need of capital inflow to continue their growth. Therefore, the chapter aims to explain the impact of shocks from developed economies on particular markets. For this reason, a DCC-mGARCH (1,1) model is used to investigate the conditional returns and time-varying volatilities as well as potential market shocks and spillover effects. According to the results of the model, the US

has a spillover effect on Central and South-Eastern European (CESEE) stock markets whereas Germany and the UK have fewer spillovers on these countries.

The last chapter (Chapter 6) combines and summarizes the results of the parts of this thesis. The impact of financial integration is evaluated in the light of the previous chapters. Lastly, further suggestions for growing markets in Europe are provided.

1.2 Research Problem

Economic and financial integration may have benefits and harms as the research in the literature explains. Recent financial crises have affected developing markets and their investors severely in the last few decades. Some international organizations promote positive sides of financial integration in their publications. However, without ignoring the benefits, the harms of integration are needed to be explained for taking better measures and improving the whole system.

It is impossible in the modern world for a country to stay out of the financial integration phenomenon. Many countries have benefited from integration, as trade and financial integration is increasing rapidly over the last 50 years. However, financial instability has become an important fact that it can cause a decline in economic growth while some social problems may occur. Especially, the disruptive impact of the financial crisis in the last decades may have been linked with the high degree of financial integration. Due to the lack of explanation in the economic theory, the relationship and the effects of financial integration on volatility is the main empirical question of this research. The harm of integration in developing European markets is the main focus of this thesis while the benefits are not neglected. Moreover, the less developed part (CESEE) of a highly integrated financial market (the EU) is studied to observe the possible leverage effect of integration on these countries. All in all, this thesis aims to identify the integrity of the financial sector in Europe, contagion and negative spillovers of financial crises, the impact of financial integration on capital market volatility, and the spillovers from developed markets on Central, Eastern, and Southeastern Europe.

1.3 Research Questions

The financial integration in international markets and its benefits and negative aspects of it is a very vast research area. This thesis, therefore, is limiting the topic to investigate the impacts on developing markets. The general question of this thesis aims to clarify the impact of financial integration for the less developed part of Europe in today's world during and after recent changes and crises. The research questions of this study are as follows:

1. Is there a cross-border and international integration of the banking sector in Europe?
2. What is the relationship between financial integration and economic volatility?
3. What are the effects of financial integration during crises in Eastern European countries?
4. Is the impact of financial integration on capital markets volatile?
5. Is the financial integration beneficial for the economies in CESEE?

1.4 Hypotheses of the Dissertation

The hypotheses of the thesis are created in line with the idea that financial integration can be both beneficial or harmful for different economies. Although the countries in this research are parts of the same union, some countries in the EU have been severely affected by the shocks while some other countries had only small stress or no harm in their domestic markets. Concerning that the Union is created by the developed countries, the rules might have been set for the favor of these economies whereas the favors for developing market are neglected. Although there would be a convergence in many aspects of social life among member countries, the fragility and the volatility of the markets are still very questionable especially in developing markets. This dynamic process needs a better observation of cases regarding economic and financial integration.

Due to the differences in the market structure of less developed parts of the EU, the impacts may differ especially during panic times. For a better understanding of the topic following hypotheses are tested.

H1: The banking sector ratios of the EU countries show similarities among neighbor countries in cooperation.

H2: There is a change in the clusters of banking sector ratios of countries after the crisis.

H3: The impact of integration is stronger especially during crises and high volatility periods

H4: There are observable negative effects of integration for selected countries in the form of contagion in the integrated region

H5: There is a spillover effect that is observable for the CESEE region coming from developed markets.

H6: The spillovers from developed markets have been impacting developing markets in the CESEE region similarly

1.5 Overview of the methodology of the research

In each chapter, a detailed description of the methodology of the research is given to analyze the hypothesis outlined above. The short overview of the applied methodology in the given chapters is as follows:

For the comparison of the banking sector of countries in Europe, a cluster analysis has been employed. The cluster analysis allows grouping bank sector ratios during a period. Therefore, it investigates the similarity of the banking sector ratios. As the members are more integrated with each other, the convergence of the ratios and changes between groups are expected to be visible. If there is no resemblance or no clear group changes among countries during the period, this research can support the idea that financial integration for the banking sector ratios is limited.

To compare the impact of financial integration during crises and normal times (high volatility and low volatility) a wavelet coherence analysis has been employed. In this analysis, the contagion effect of the crisis is focused on stock markets during high and low volatility periods. The comparison has been made by analyzing the co-movements of stock market data with an emphasis on South-Eastern and Central European economies.

For the spillover effect coming from developed markets, a DCC-mGARCH method is used. The relation between CESEE and the US, the UK, and the German stock markets has been investigated in this part of the thesis. Daily stock prices of markets have been analyzed to observe the volatility transmission and spillover effects of DAX, DJI, and FTSE on ASE, BUX, CRBEX, BETI, WIG, and XU100. The spillover effects of three developed markets from different continents on six different developing markets in CESEE are aimed to be analyzed to observe the financial integration with a comparison.

1.6 Contribution of the Thesis

Financial integration has been studied by many scholars over the years. Some of these analyses resulted that increased financial integration of developing economies has an adverse impact on macroeconomic volatility. And some studies claimed that there is a negative relation between volatility and growth.

This thesis aims to contribute to the existing literature by filling the gap regarding associations between financial integration and market volatility in Europe, with the help of different methodologies and the most recent data after the crisis. This study contributes to the literature on financial integration and its impacts by analyzing the changes during and after crisis and combining the results of different methods. This thesis has also focused on CESEE region to observe the leverage effect and the contagion spread from developed parts.

The first major contribution of the thesis is the detection of some basic patterns and trends in banking and observing the integration in the banking sector by employing a well-known technique. As financial integration is getting higher, there should be convergence in the banking system ratios. It is eminent to understand how the banking system getting closer to each other during the last decade. The differences in the ratios may consist of a problem in the integration and avoid the existence of a single market. Cluster analysis allows to classify mixed population into more homogenous groups (Murtagh F and Contreras P, 2012; Blasius J and Greenacre M, 2014). The use of cluster analysis does not have any restriction or a training stage based on a collection of data to identify the complex relationships. Therefore, cluster analysis is an appropriate tool to compare banking sector ratios because of the complex nature of data.

This thesis contributes to the literature also by analyzing the effects of contagion among stock markets by using the wavelet method. This analysis is contributing to the literature by employing a new technique to explain and visualize the imbalances and impacts of shocks in financial time series data. As the wavelet tool displays the leverage effect by comparing crisis and non-crisis periods, the study can be used to support the idea that integration is adversely affecting the connected markets. According to the results of the analysis, the contagion is high especially during a crisis within European financial markets. whereas positive improvements have less impact on markets.

Lastly, an analysis investigates the volatility spillovers in the CESEE by using the mGARCH methodology. Therefore, this part of the thesis provides a new vision for financial integration and explains the risks for developing countries.

1.7 Structure of the Thesis

In the second chapter financial integration is explained with its advantages and disadvantages. Later, the European Union and monetary union are evaluated with a focus on Central, Eastern, and Southeastern Economies (CESEE). The third chapter of the thesis is providing an analysis of the European banking sector to understand the integration levels of banks. The fourth chapter of the study illustrates the financial contagion and its effects especially with a focus on the Greek Crisis. The fifth chapter is explaining the spillover effects of German, the US, and the UK markets on CESEE. All in all, this thesis aims to explain the fragilities of integration of financial markets of developing countries in Europe. The research envisages providing the suggestion for portfolio optimization and diversification. The last chapter concludes and discusses financial integration and its pros and cons in CESEE.

CHAPTER 2

FINANCIAL INTEGRATION

2.1 The Fundamentals of Financial Integration

European Central Bank (ECB) adopts the following definition for the integration: According to the ECB's definition, financial instruments or services can be fully integrated when all potential market participants

- (i) are subject to a single set of rules in case of the same financial instruments or services,
- (ii) can have access equally to this set of financial instruments or services, and
- (iii) are treated equally when they operate in the market (ECB, 2007).

Studies since the early 1970s on financial liberalization policies against financial repression have supported serious deregulation of financial systems in most of the world countries in the 1980s. The theoretical foundations of the financial liberalization process are included in Mc Kinnon (1973) and Shaw (1973). The financial pressure approach is referred to as the "Mc Kinnon-Shaw Approach", especially because of its work criticizing restrictive practices in the financial markets of developing countries. Financial liberalization is often shown as a result of deregulation practices that governments have removed or significantly reduced control and restrictions on the banking financial system to attract international financial activities of developed countries to their countries and is expressed as the process of opening economies to international capital flows (Balassa, 1989). As a natural result of the transformations within the international financial system, it enables liberalization practices to increase the efficiency of financial markets. In contrast, the financial system in developing countries is shaped according to the structural features required by the development problem. In this context, financial liberalization policies in developing countries do not only consist of a series of transformations in financial markets and institutions but depending on the transformation in the development strategy; it includes radical transformations throughout the economic structure. In this way, a country that directs the flow of international funds to its domestic markets will be able to continue its development process. Financial liberalization practices are among the planned and introverted development and industrialization strategies of developing countries. Describing the transition to market-centered open growth and development strategies, Mc Kinnon-Shaw Approach is essentially the adaptation of neo-classical finance theory to developing countries.

Neo-classical finance theory, in perfectly competitive market conditions, assumes that investors, households, and firms have rational behaviors aimed at profit maximization. The main proposition of the Mc Kinnon-Shaw Approach is that removing all restrictive elements on the financial system will accelerate economic growth by providing financial deepening and efficient resource allocation. However, there are some differences between the issues highlighted between Mc Kinnon and Shaw. While Mc Kinnon (1973) focuses on the relationship between investments financed by auto financing sources and interest rates, Shaw (1973) emphasized the importance of the relationship between external financial sources and financial deepening. In this context, the main criticism is directed at Tobin's portfolio theory. According to Tobin's theory, households distribute their savings between non-substitute money and productive capital goods. Return of capital goods; as long as it is higher than the interest rate of money; The share of productive capital goods held in the portfolio will be higher. As a result, keeping the return of money lower than the return of productive capital goods will accelerate the growth of the economy by increasing the investments with a high capital/labor ratio. For this reason, interest rates are controlled by ceiling practices in the financial system. According to Mc Kinnon and Shaw, the existence of interest controls will slow economic growth by preventing savings from turning towards the financial system and aggravating the problem of financing investments. In contrast to the Keynesian models, the Mc Kinnon model has complementary relationships between money and efficient investment goods. For these reasons, both Mc Kinnon and Shaw argue that all restrictions that will put pressure on the financial system should be removed and the market factor should be prominent in the fund transfer mechanism.

According to Stiglitz (2000), highly financial integrated economies to the rest of the World are considered to have successful economic policies as well as sound political and economic discipline. On the other hand, corruption, political and market instability may lead capital to run away and corruption can act as a barrier to sustainable economic growth because investors prefer secure investment environments. Whereas, to promote growth and offer prudent intermediation service, to distribute financial resources efficiently, to encourage savings, to allocate risk, to provide a trading platform for financial products and services, and to enable good corporate governance, an efficient and effective financial system is needed (Levine, 1997).

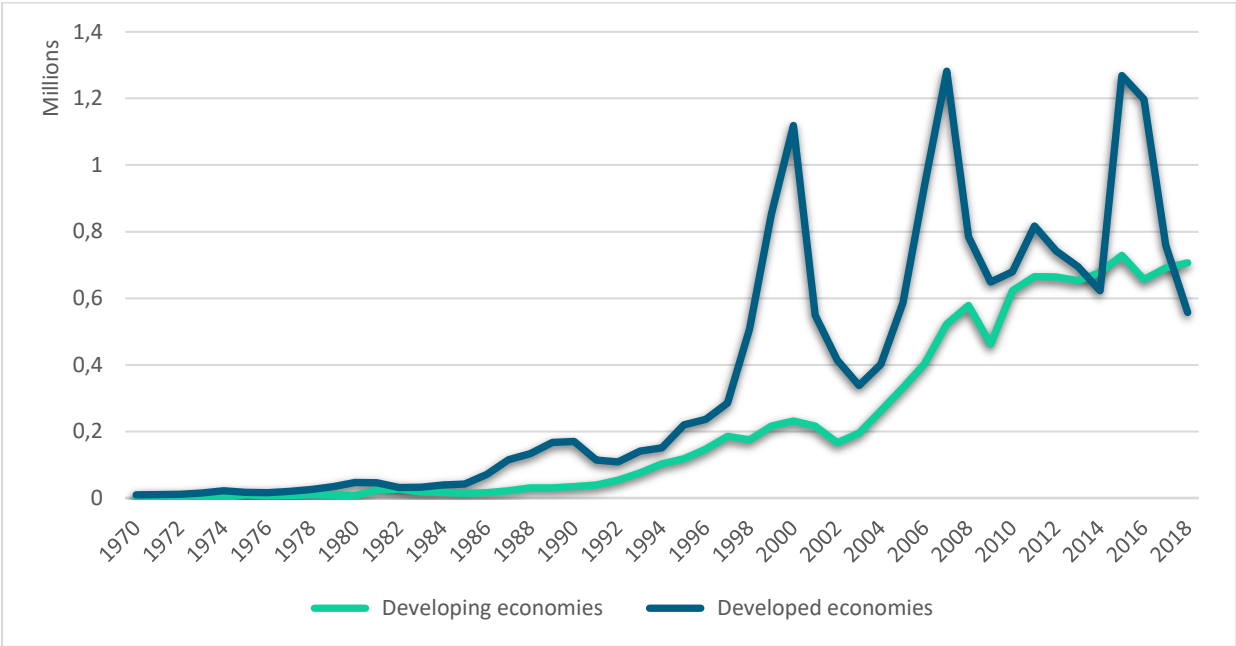
Financial integration has gained a pace after the gold standard period of 1880-1914. During this period cross-border capital flows have increased dramatically. After World War I, a

reconstruction period took place in the Bretton-Woods era. Starting from the beginning of the '70s, a new wave of international financial integration has been observed. The integration of financial markets around the world rose significantly amid the late 1980s and 1990s. The countries that need higher rates of return and the opportunity to diversify portfolio risks have caused the increase in the globalization of investments. Meanwhile, in many countries, inflows of capital have been encouraged by canceling limitations, deregulating domestic financial markets, and progressing their financial environment and prospects through the introduction of market-oriented changes. Many emerging and transition economies in East Asia, Latin America, and Eastern Europe have expelled restrictions on international financial movements, at the same time that they were easing regulations on the operation of domestic financial markets and budgetary restraint is removed. These changes in domestic financial markets have led to a significant increase in the private capital flows to emerging countries. However, this has extended to the increased incidence of financial volatility and currency crises in the second half of 1990 (Torre et al., 2002).

According to many writers, financial integration can be measured by the degree of freedom in cross-border financial transactions in a given economy (Schularick and Steger, 2007; Vermeulen, 2010). Prasad et al. (2003) and Volz (2004) have, similarly, identified financial integration as a process through that the domestic financial market is linked or intertwined with global financial markets. As one of the most popular strategies of cross-border financial investment tools, the level of FDI has been increasing rapidly since financial integration has come up.

Since 2000, increased FDI in developing countries has reached a growing pace with small pauses mainly caused by crises, since short-term international investments are more volatile in case of sudden changes in rates of return. FDI, used as de facto measure of financial globalization by some scholars, is compared to show the increasing connection between economies. FDI data. Graph 1 illustrates the increase in inward foreign investment in developed and developing countries. Starting from the '80s, developing countries have received a growing amount of investment and reached the level of developed countries recently.

Graph 1: Foreign direct investment: (Inward flows) (In millions)



Data: Unctad, 2020

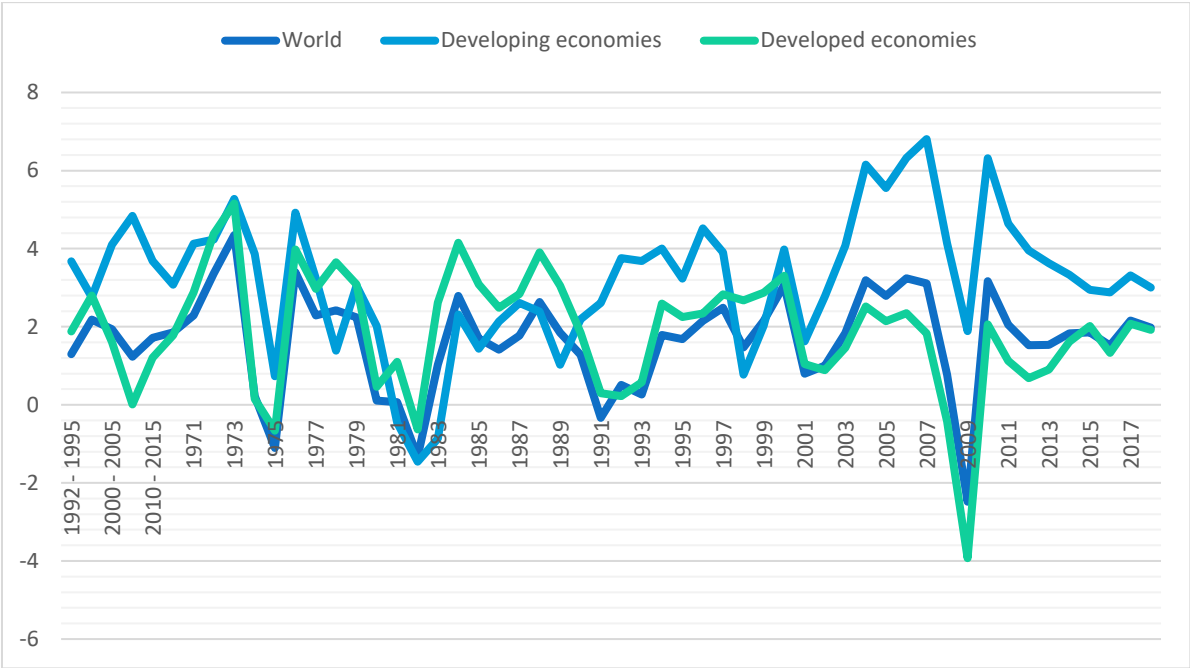
While FDI's and other cross-border financial movements are growing, the gross national income of countries has gained pace. The total GDP of the world has drawn a similar pattern of the rise as trade and integration grows. On the other hand, the annual growth of GDP in the world has stayed positive with a few years' exceptions. However, in developing countries, the average growth rate has never fallen below zero since 1983, even during the recent financial crisis. It is eminent to observe the resemblance of the lines in the last 20 years when the international trade and financial integration is the highest.

Apart from FDI, emerging economies can draw on a range of external sources of finance, such as portfolio equity, long-term and short-term loans (private and public), Official development assistance, remittances, and other official flows. It is believed that as the largest source of external finance, FDI's are the most resilient to economic and financial shocks. According to UNCTAD data, between 2013 and 2017, FDI accounted for 39 percent of external finance on average for developing economies. On the other hand, for the Lower Developing Countries, Official development assistance has a bigger share than FDI's (UNCTAD, 2018).

FDI is observed to be the less volatile source of external financing tools, whereas short-term loans are susceptible to sudden stops and reversals. Portfolio equity is very fast flows especially in developing countries where the capital markets are less developed.

Mishkin and Eakins (2012) claimed that financial markets promote economic efficiency by diverting funds from people who do not need that at that moment to those who need funds. Therefore, when the financial markets function well, high economic growth can be supported. On the other hand, when the financial markets perform less efficiently, those remain desperately poor. The activities in financial markets also have direct may impact personal wealth, the behavior of businesses and consumers, and the cyclical performance of the economy.

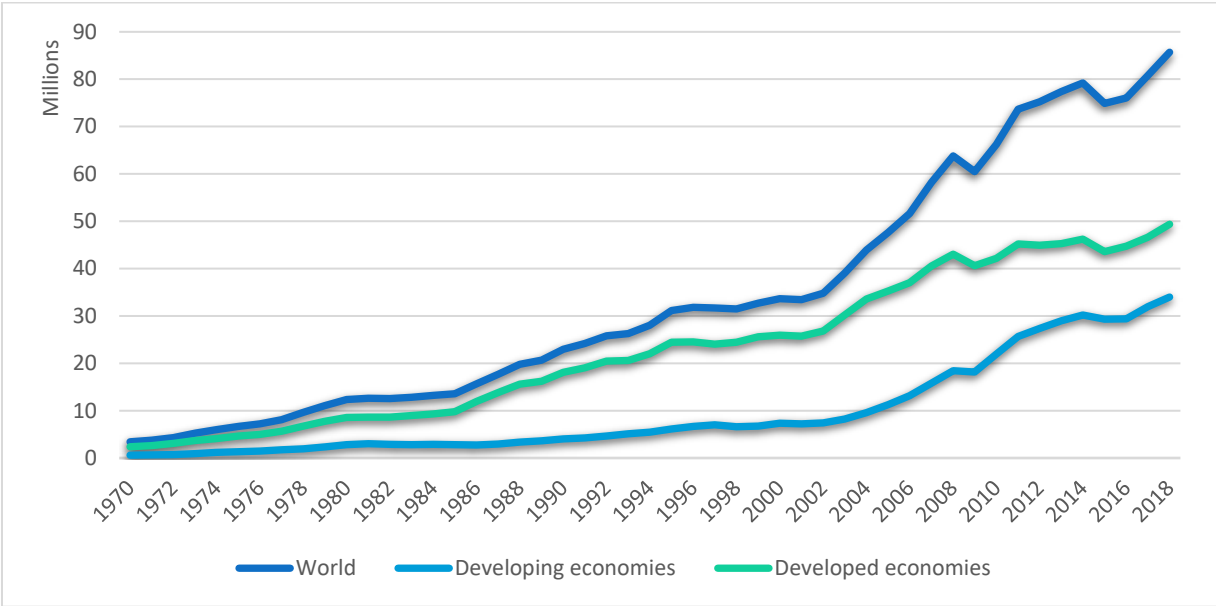
Graph 2: Annual Gross Domestic Product: Total, growth rates



Data: Unctad, 2020

Gross Domestic Product can be taken as an aggregate measure of production, income, and expenditure of an economy. Therefore, increasing GDP can lead to a higher level of wealth and better living standards in a country. Total GDP (as well as GDP per capita) in developing countries has increased significantly starting from the 1970s. It shows a steady rise until 2000 when it gains a pace and converges to the level of developed countries.

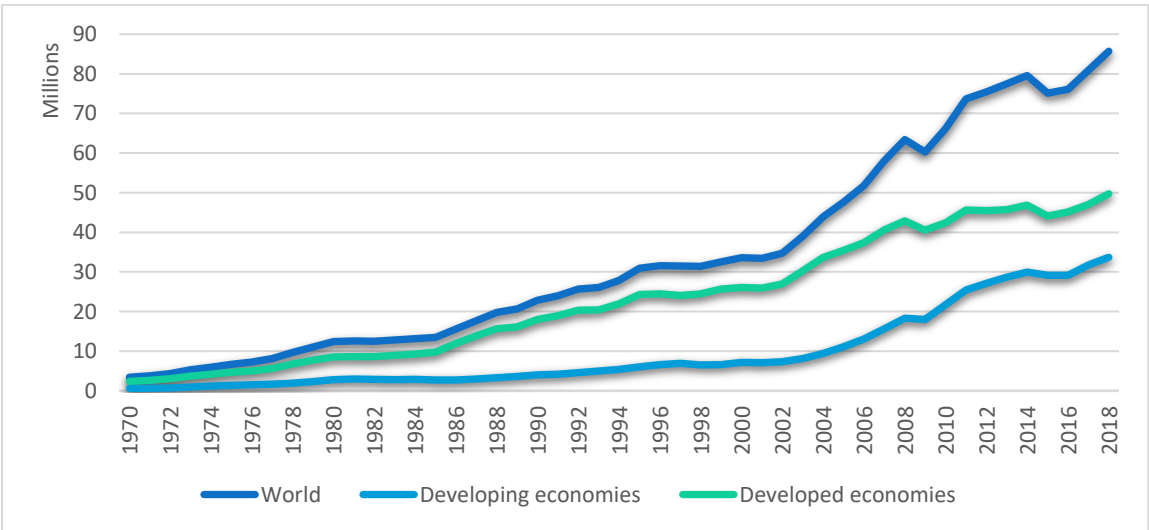
Graph 3: Annual GDP: Total, current prices



Data: Unctad, 2020

It is observable from Graphs 3 and 4 that, although there is no certain convergence between developed and developing economies gross national incomes, both clusters of countries, therefore the world in total, have created more income every year.

Graph 4: Annual Nominal GNI, total



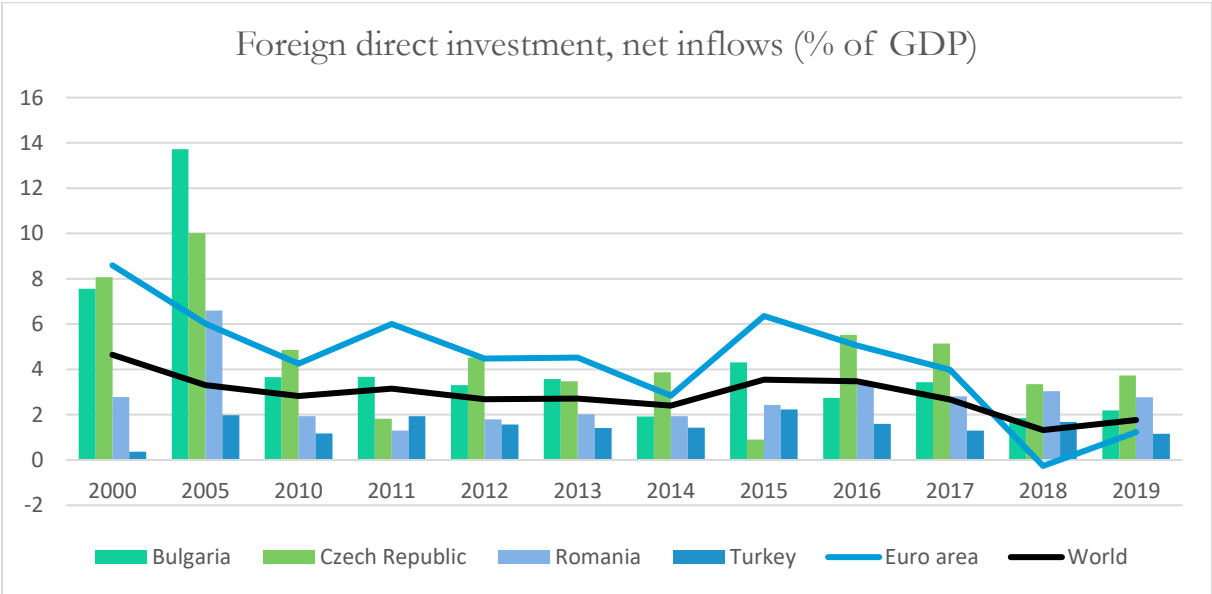
Data: Unctad, 2020

In recent years, developing countries have grown faster than rich countries. However, some of the developing countries are growing very fast, while others are shrinking as they do not. For developing countries to achieve desired results in terms of larger foreign trade, investment, and

higher growth, it is thought that the movements towards liberalization of trade should be completed with an appropriate investment environment.

Previous graphs provide an overview of the changes in the economies during the high integration of financial markets. The following graph demonstrates the level of international linkage in the real sector in the last two decades. Net inward Foreign Direct Investments to GDP ratio can be expressed as an indicator to measure the degree of international financial integration (Park, Y.S., 2003). The results of this ratio show a steady decrease in the degree of international financial integration with a shift only in 2015. Euro area has a higher ratio than the rest of the world throughout the observed period except the last two years. This can be interpreted as a higher financial integration in the Eurozone. However, the net inflows of FDI to GDP ratio is decreasing to a low level opposite to the expectations. Countries with less than 5 percent of net inflow to GDP ratio are categorized as low integrated countries. On the other hand, net inflows of foreign direct investment to GDP ratio of CESEE countries have been slowing down while the financial integration is expected to be greater.

Graph 5: Financial Integration in Euro Area and CESEE



Data: Unctad, 2020

2.1.1 Benefits of Financial Integration

The main aim of financial integration is to raise competition and transparency to boost efficiency in all markets. Many scholars in history claimed that financial integration can be a

boost to the economic success of financial markets, as the allocation of resources to profitable activities is possible in a more competitive environment. It is also asserted that the competition among financial markets and allocative efficiency in the economy can be increased by the liberalization of the financial system.

David Ricardo has developed the theory of comparative advantages and designed it in international markets. According to the theory, under free trade, when two countries can produce two different tradable commodities, each country may increase its overall consumption by exporting the goods for which that country has a comparative advantage. Under the assumption of a variety of labor productivity between both countries, this country shall be importing the other goods from the other country.

International financial integration is expected to decrease the cost of financial services by eliminating barriers to entry and enhancing financial competition on a global level. Free capital movements with pre-determined exchange rates or single currencies may lower the domestic cost of funds. International financial integration can provide portfolio diversification for both borrowers and investors (Park, Y.S., 2003).

Goldsmith (1969) has reached such results in his research that;

- As "financial relations" increase, economic growth also increases.
- The "financial relations rate" in developed economies is higher than the "financial relations" rate in developing economies.
- As economic growth increases, financial markets become institutionalized.
- The banking system is the starting point for financial development.
- The main phenomenon underlying the positive contribution of financial development to economic growth is that financial development increases the effectiveness of capital flows.

It is argued that financial openness often provides significant potential benefits. Access to world capital markets increases investor portfolio diversification opportunities and provides higher risk-adjusted return potential. There are also potentially great benefits for the recipient country. It is claimed that access to world capital markets provides countries with the opportunity to borrow money to meet consumption when bad shocks are encountered and potential growth and welfare gains arising from such international risk sharing are large. At the same time, however, fluctuations in the case of openness and reversals in capital flows are high. Both

national and international financial liberalization is associated with costly financial crises. The most important issue in this context is to determine the prerequisites for policies that will enable countries to increase returns while minimizing risks associated with financial openness. The benefits and costs of financial integration can be analyzed for individual investors or for countries that have started the integration process (Agenor, 2001).

Financial globalization has provided many benefits and risks to developed and developing countries alike, however, the impacts on economies mostly differ on cases. Although there are some risks, analyses and experiences illustrated that countries can benefit from financial globalization in many different ways. Analytical discussions that advocate financial openness raise four key issues: the benefits of international risk sharing in meeting consumption; positive effect of capital flows on national investment and growth; ensuring macroeconomic discipline; the effectiveness of the national financial system, in addition to being more stable, concerning the arrival of foreign banks (Agenor, 2001).

Covering consumption: Access to world capital markets makes it easy for a country to borrow on volatile periods of markets and to borrow it in good times. Capital flows allow individuals to meet their consumption needs over time, thereby increasing prosperity.

National investment and growth: According to the World Bank Policy Report Research in 2006, improving the legislation to protect creditors and inclusion of institutional investors enhance and promote market growth. Access to the international pool of resources brought by financial openness also affects national investment and growth. In many developing countries, saving capacity is limited due to the low-income level. As long as the marginal return on investment is at least equal to the cost of capital, the net flow of foreign resources reinforces national savings, increases the level of physical capital per worker, and helps the country that receives foreign investment to increase economic growth and improve living standards.

Apart from this direct effect of FDI on growth, it also has significant long-term indirect effects. FDI particularly facilitates the transfer or dissemination of managerial and technological know-how in the form of various capital inputs and improves the talent composition of the workforce as a result of the “learning by doing” effect, formal education investments, and intra-vocational training (MacDougall, 1960; Berthélemy and Démurger, 2000; Borensztein, De Gregorio and Lee, 1998; Grossman and Helpman, 1991). Although the increase in competition in the product and factor markets resulting from FDI can reduce the profits of local firms, the spillover effect

can reduce input costs through links to the supply sector, increase profits and increase national investment (Markusen and Venables, 1999).

Ensuring macroeconomic discipline: It is suggested that free capital flows enable countries to follow more disciplined macroeconomic policies by rewarding good policies and punishing bad policies (Obstfeld, 1998). To the extent that the increase in policy discipline can be transformed into an increase in economic stability, it can also increase the economic growth rate.

Increasing the efficiency and financial stability of the banking system: Those who favor financial openness argue that by reducing costs and excessive profits in monopolistic or cartelized markets, thereby increasing the depth of national financial markets and increasing the degree of effectiveness of the financial intermediation process. The benefits of the arrival of foreign banks are listed as follows (Levine, 1997, Caprio and Honohan, 1999):

- Improves the quality and availability of financial services in national markets by increasing bank competition and enabling more complex banking techniques and technology to be applied;
- It serves to accelerate the development of the national bank supervision and legal framework in cases where local foreign banks are audited in a consolidated manner with the parent bank;
- Provides a country's access to international capital, directly or indirectly, through parent banks;
- In times of financial instability, it contributes to the stability of the national financial system in cases where depositors shift their funds to foreign institutions, rather than transferring their funds abroad, with the idea that they are working more smoothly than national banks. Besides, foreign banks can improve the overall structure of national banks' loan portfolios, because they are less exposed to government pressures to lend “preferential” people.

2.1.2 Disadvantages of Integration

The recent crises have led economists and policymakers to have a new vision that integration in financial markets may also generate significant costs. While the countries are bounded with the international financial system, there have been adverse shocks coming through increased integrity. These threats may harm domestic stability and countries may become prone to crises. These problems may spread from one market to another by contagion and negative spillovers (Agenor, 2001). Financial globalization can entail some important risks that are listed below.

Increased Debt: According to the World Bank Global Economic Prospects report in 2020, four waves of debt accumulation have occurred in the last 50 years. The last wave started in 2010, has caused the largest, fastest, and most broad-based increase in debt among the others. However, today's interest rates are lower than the rate in previous waves of broad-based debt accumulation ended with widespread financial crises.

Governments should use policy options to reduce the possibility of crises and ease their effects, by building sound monetary and fiscal frameworks, instituting robust supervisory and regulatory regimes, and following transparent debt management practices. After the financial liberalization, the public authority, which increased the interest rates for the solution of the financing problem, chose to borrow at higher interest rates to prevent the outflow of funds and the costs of borrowing increase. As a result of rising loan costs due to rising interest rates, entrepreneurs start to be crowded out when making investment decisions. High-interest rates also harm entrepreneurs trying to make their investments with their resources. Because one of the most important issues emphasized in investment decisions is that the expected profit from investments is greater than or equal to the interest rates. The report suggests countries apply policy alternatives to diminish the probability of financial crises and reduce their effect, aims to build sound financial systems, found a strong supervisory and regulatory regime, and take transparent debt management measures.

Asymmetric Information Problem: The economic theory assumes that capital markets have effective and free movement and does not consider the assumption that there are distortions such as asymmetric information. In addition, he admits that there is no moral hazard and herd psychology for foreign investors. However, according to the results obtained from many studies, it is stated that foreign investors are the key factor in the developing markets in a constructive or destructive direction (Mc Lean and Shrestha, 2001).

The concentration of capital flows and difficulty of accessing: Evidence shows that periodic excess capital flows tend to concentrate on a small number of countries. However, although many countries were relatively small in absolute terms, they provided proportionally significant capital flows. Moreover, access to these markets is asymmetrical. Many developing countries (including oil-producing countries) can borrow from the world capital markets only in "good" times and face credit limitations in "bad" times. So access is periodic. It is clear that in such cases, the benefit from accessing the claimed world capital markets is fictitious. Seasonality can have a negative impact and increase macroeconomic imbalance: eligible / favorable shocks

attract large-scale capital flows and encourage consumption and over-adjust against negative shocks due to sudden capital flight from long-term spending (Agenor, 2001).

Elimination of macroeconomic stability and Improper distribution of capital flows domestically: It can be said that globalization creates macroeconomic fluctuations by creating a difference between production and consumption. However, although the direct effects of global integrations on output are uncertain, it may cause an increase in diversity on the basis of production by the introduction of external capital into developing or less developed countries. On the other hand, integration can support the increase of specialization in production due to its comparative advantages. As a result, the specificity of industries can make economies more fragile in the face of shocks (Razin and Rose, 1994). On the other hand, after financial integrations, economic growth becomes irregular due to capital flows. When the capital inflows were intense, the growth rate was at high levels, and with the onset of capital outflows, the economy shrank (Aizenman et al., 2013).

There is evidence that developing countries have short-term capital flows that are periodic. While the economic growth is in a rapid period, such flows tend to increase, and in periods when it slows down. On the contrary, the periodicity of medium and long-term debt to GDP shocks is weaker. It is not worth mentioning that the developing country has its own demand changes because of periodic behavior. However, in practice, it often results from external, supply-related factors such as the sudden change in the country's trade conditions, which increases the risk of lenders and thus enhances the impact of the shock. Two main reasons are explaining the periodic behavior of short-term capital movements. First, shocks tend to be bigger and more frequent in these countries, reflecting the relatively narrow production base of developing countries and their greater dependence on the export of primary goods. Second, asymmetric information problems trigger herd behavior, because partial-informed investors withdraw their capital together and at the same time in response to a negative shock, whose economic consequences in the country are not fully understood (Agenor, 2001).

The risk of foreign banks entering, spreading, and fluctuating capital flows: Although there are several benefits to foreign banks, there are some drawbacks. First, while foreign banks operating in non-commercial sectors generally open limited loans to small firms, they concentrate on larger and stronger ones (usually producing merchandise). If foreign banks pursue a strategy of lending to companies with the highest credibility (and to a lesser extent to individuals), their presence will not contribute much to the overall increase in the efficiency of the financial sector. More importantly, they greatly limit the credit extended to small firms,

thereby creating a negative impact on employment and income distribution. Second, the entry of foreign banks with lower operating costs puts pressure on local banks to merge to compete. At the end of this concentration (which may also take the form of foreign banks buying local banks), banks that are “too big to fail” form that monetary authorities fear that the loss of a single large bank to the payment difficulties will seriously affect the financial markets. While such problems can be eliminated by methods such as a reliable surveillance system and restrictions on mergers that appear to greatly increase systemic risks, this raises unnecessary expansion of the area and the cost of the official safety net. The “too big to fail” problem can increase moral problems: national banks who know that a security network exists do not pay enough attention to lending and examining potential loan claims. Concentration can also create monopolistic power, which can have an impact on the overall effectiveness of the banking system and the availability of credit. Third, the entry of foreign banks may not ensure the stability of the national banking system, because their existence alone does not lead to less systemic banking crises (Agenor. 2001).

Contagion and negative spillovers: There are several studies related to contagion and spillover spreading among financial markets. The literature used for the study examining the effect will be more detailed and presented in the section of the specific research in Chapter 4. Contagion effects can create new issues and difficulties to manage external assets and liabilities as well as it may increase the complexity of the operations of banks and corporations (Gnath et al. 2019). According to Allen and Gale (2000); by contagion, a liquidity shock can diffuse to other economies. They claim that the completeness of the structure of interregional claims will affect the contagion among markets. Kumar and Persaud (2001) studied pure contagion and described it as an increase in cross-market correlations in case of a shock. They claimed that the shifts are correlated with an aversion to risk of the investors' appetite. When there is an increase in the investors' appetite for risk, risky assets are demanded more while their value increases. On the other hand, when there is a fall in the investors' appetite for risk, there will be a steep fall in the demand for risky assets and therefore the price of these assets will decrease immediately.

Evans et. al. (2008) found that the banking industry's main indicators of bank profitability or earning patterns are converging on each other, whereas their asset-liability related ratios are diverging. Gilmore et al. (2008), in their analysis, showed that co-integration is strong, but convergence to Western Europe is limited especially after EU membership.

In the literature, stock market co-movements are examined many times with various methods. Some studies on contagion in Europe (De Nicolo and others, 2005; Brasili and Vulpes, 2005;

Gropp and Moerman, 2003) illustrated that there is a shock in the banking sector causing by some smaller EU countries. Morana and Beltratti (2008) illustrated that co-movements of markets are higher between 1973 and 2004. Hanousek et. al. (2009) showed that developed economies strongly influence Eastern European countries' stock markets. Connolly et al. (2007) studied the US, UK, and German stock and bond markets and illustrated that the coherence is greater when there is low volatility. Gjika and Horvath (2013) and Shahzad et al. (2016) similarly analyzed that correlation between markets is higher during the recent financial crisis.

Longin and Solnik (2001) employed an analysis of the equity market correlation. The findings of their study are rejecting the idea that market volatility is correlated to equity market movements, however, there is a rise in equity market correlation in bear markets. Campbell et al. (2002) support that correlation in the international equity returns is higher in bear markets. Royen (2002) suggests that the Russian crisis was characterized by both contagion and large aggregate outflows and that contagion appears to be regional. Forbes and Rigobon (2002) show a high level of market comovement in all periods. Bekaert et al. (2005) identify contagion during crisis periods and find time variation in the world and regional market integration. Candelon et al. (2008) suggest that the increases in the comovement of stock markets are more of a sudden nature (i.e. contagion) instead of a gradual one (i.e. financial integration). Madaleno and Pinho (2012) found that geographically and economically closer markets have a higher correlation.

Mendoza et. al. (2009) analyzed financial integration and development in the markets, and concluded that due to international financial integration, large and persistent global imbalances may occur particularly when there are differences in the degree of domestic financial development among countries.

2.1.3 Financial Crises and Liberalization of Emerging Markets

There is no common opinion on the effects of financial globalization on economic growth performance. According to the neo-liberal approach, the integration of financial markets contributes positively to economic growth. On the other hand, there are also approaches claiming that financial globalization has adversely affected the economic performance of countries in the last two decades, especially after the crises since the 1990s.

Although there is no complete consensus in the definition of the financial crisis, it is claimed that there are three types of crisis. The currency crisis, banking crisis, and external debt crisis.

The currency crisis arises as a result of short-term speculative funds starting to leave the country due to the loss of trust in national currency. Bank attacks and withdrawal of deposits or deterioration in banks' asset structure can be considered as the beginning of the banking crisis. The banking crisis is caused by the financial panic that started when savings owners want to withdraw their deposits due to the loss of trust in the financial system in a country. As for the existence of banking crises, Demirgüç-Kunt and Detragiache (1998) suggested three indicators should exist. The first is the outflow of deposits, which takes governments to take measures to protect the banking system. Other indicators are that the cost of rescue banks reaches 2% of GDP and the NPLs increase to 10% of bank assets (Rajan et al, 2008). If a country does not pay its external debts, an external debt crisis occurs. External debt crises disrupt the economic development processes of developing countries and increase their economic problems (Ural, 2003).

Liberalization practices have brought serious risks along with the result that financial markets operate in a more efficient and unprinted environment without interference. Internal and external financial deregulation practices such as the removal of interest controls, the reduction of compulsory reserves, facilitation of entry into the market for both domestic banks and foreign banks, and the liberalization of capital movements, may increase the interest rate of the banking system (foreign exchange rate, liquidity and liquidity and may be significant). Therefore, the weakness of the macroeconomic environment and lack of legislation in a given country may cause fragility and financial crises (Demirguc-Kunt and Detragiache, 1997).

When the development of the concept of financial liberalization and the dimensions of integration practices are analyzed, the increased risk structure of the financial system is better understood. Along with the financial liberalization process, foreign capital inflows from high real interest rates were encouraged in developing countries. The capital inflow was also supported by government policies implementing the fixed exchange rate system by fixing national currency to the dollar. High real interest rates, which develop due to financial liberalization, constitute the major causes of the financial sector's liquidity crises in developing countries (Mishkin, 1999). Financial liberalization policies, known as the McKinnon-Shaw hypothesis, are not always positive. For example, practices for the liberalization of the national capital markets, which gained weight following the financial pressure process in Latin America, failed in the 1980s. The elimination of financial pressure and the institutional arrangements were made, and the weight of financial liberalization policies made financial markets vulnerable to the crisis. In addition, developing countries' transition to financial liberalization without

providing the necessary macroeconomic conditions may bring harm to the country more than it can benefit (Eren and Süslü, 2001).

Short-term capital flows are made attractive only by offering high-interest rates (Akyuz, 1995). This situation increases the risk of crisis. Moreover, with the liberalization of capital movements, the idea that foreign savings will be an important resource for domestic investments and growth in cases where domestic savings are insufficient has not been valid for developing countries. Because, in developing countries, macroeconomic policies are strong, healthy, realistic, and do not prevent problems. At the same time, supervision and depth in the financial system are not sufficient. Some researchers claim that the most fundamental reason for the financial crises experienced in the 1990s is the unlimited liberalization in the capital movements. Globalization efforts intensified since the 1990s caused the traditional (direct investment) functions of capital movements to change. Capital movements, which have become speculative in the short term, descend from private channels to private channels, causing enormous volatility on the economies of the country (Yeldan, 2001). The transition of a developing economy to financial liberalization without providing the necessary macroeconomic conditions (equivalent budget, price stability, fair income distribution, production of goods with high added value, controlled banking sector, the financial sector with depth, an economic structuring that provides real growth), it brings more harm than good. Macroeconomic volatility in emerging countries is getting higher by the contagion spread by developed market failures (Jeanne, 2003). A higher degree of openness is also triggering the volatility level of emerging markets (Heathcote and Perri, 2004).

Financial crises often emerge as a response to the increasing globalization of a productive economy with poor financial balances, poor financial institutions and shallow markets, and a low industry and agriculture (Kazgan, 2001). While short-term capital comes to a country to take advantage of interest arbitrage, turning to high real interest rates, provides excessive profit in the short term and also causes overvaluation of national currency. This environment, which creates an external dependent artificial growth environment and disrupts the balances between real interest and exchange rates, may eventually cause a crisis. When entering the crisis, the monetary authority functions of the central banks are increasingly restricted and thus the national currency is out of control.

Developing economies may be exposed to negative reactions from national and foreign investors, especially because of their structural weaknesses. In addition to this, countries with a solid structure can also have a crisis as a result of capital flows due to deficiencies in

international financial markets and the impact of external factors. On the other hand, the economies integrated into the world markets may also be exposed to contamination. The spread of crises from one country to another occurs when there is a scarce of deep, financial, or capital markets, and the process of spreading occurs in the form of herd psychology or panics (Schmukler et al, 2004).

Since financial integration became a phenomenon, the number of research and papers related to the analysis of the market movements has increased enormously. They focused on this area to provide a better explanation of the effects of the integration. The main literature related to this topic will be presented later before the relevant research in Chapter 4.2.

2.2 The European Union and Financial Markets

Today, the world economy is evolving in every field. With the phenomenon of globalization, closed economies are losing their importance and regional integration is increasing. In this context, the European Union (EU), one of the largest economies in the world, is of great importance for economic progress. In the European Union, the transfer of the sovereignty of the nation-states to the community, which is divided into a supranational structure, emphasizes the importance of the establishment of this community. The integration of financial institutions plays an important role in the establishment of the EU. The banking sector, which also includes the integration of financial institutions, has the largest share in the EU financial sector due to its close relations with all other sectors. Institutional and structural studies related to the integration of financial institutions, especially banks in the European Union started in the 1970s. The history of the banking sector integration in the EU can be divided into two different periods. The first period covers the period from the 1970s until the signing of the 1993 Maastricht Treaty. Integration between Member States credit institutions in this period was aimed at establishing a financial single financial market. Various treaties, directives, and new regulations have been implemented among EU institutions to establish the Financial Single Market. The most important directives for credit institutions are the decision of the Council of Europe (73/183 / EFC) in 1973 to ensure the freedom of banks and other financial institutions and organizations in terms of service provision and to remove restrictions and to be subject to equal control and regulation for foreign and local banks. it is connected. The second term started with the Maastricht Treaty signed for the establishment of a single market after 1993. The studies on financial integration in this period are directed at establishing a single market at the financial unity level, performing transactions such as the Single Money and Single Payments System,

and legally establishing a regular system for legislative, executive, and judgment among credit institutions.

The formation of a common financial market with the European Union gave the right of banks, insurance companies, and investment firms to establish companies, open offices, and operate within the European Union. The European Financial Markets are part of the international financial markets along with the developed and developing financial markets today. The European Single Financial Market, which was created as part of the economic and monetary integration within the European Union, differs significantly from other international markets with its features. The Single Financial Market is well integrated with itself, as well as in integration, interaction, and competition with international financial markets.

Then, The Second Council Directive dated 15 December 1989 and numbered 89/646 / EEC, and the developments regarding the integration of service areas of banks and other financial institutions and organizations in the Member States and the related banking and other financial institutions as a result of other directives following this directive, the integration process of the institutions has been completed and a single banking license given in the member states (single banking principle) and the implementation of the so-called home country control principle by the implementation of the supervision and control of these credit institutions are advanced in the integration of credit institutions. In the period starting on January 1, 2002, the coin and paper Euros were circulating as the only legal currency in the Member States which was accepted as the common currency. At the end of February 2002, national currencies lost their legal status and were removed from circulation. The Member States, which accept the Euro as the only legal currency of the Member States, is responsible for determining and implementing monetary policy in the Eurozone, the European Central Bank (ECB), which is established under the European Union Treaty and focuses on the European System Central Banks (ESCB), in other words.

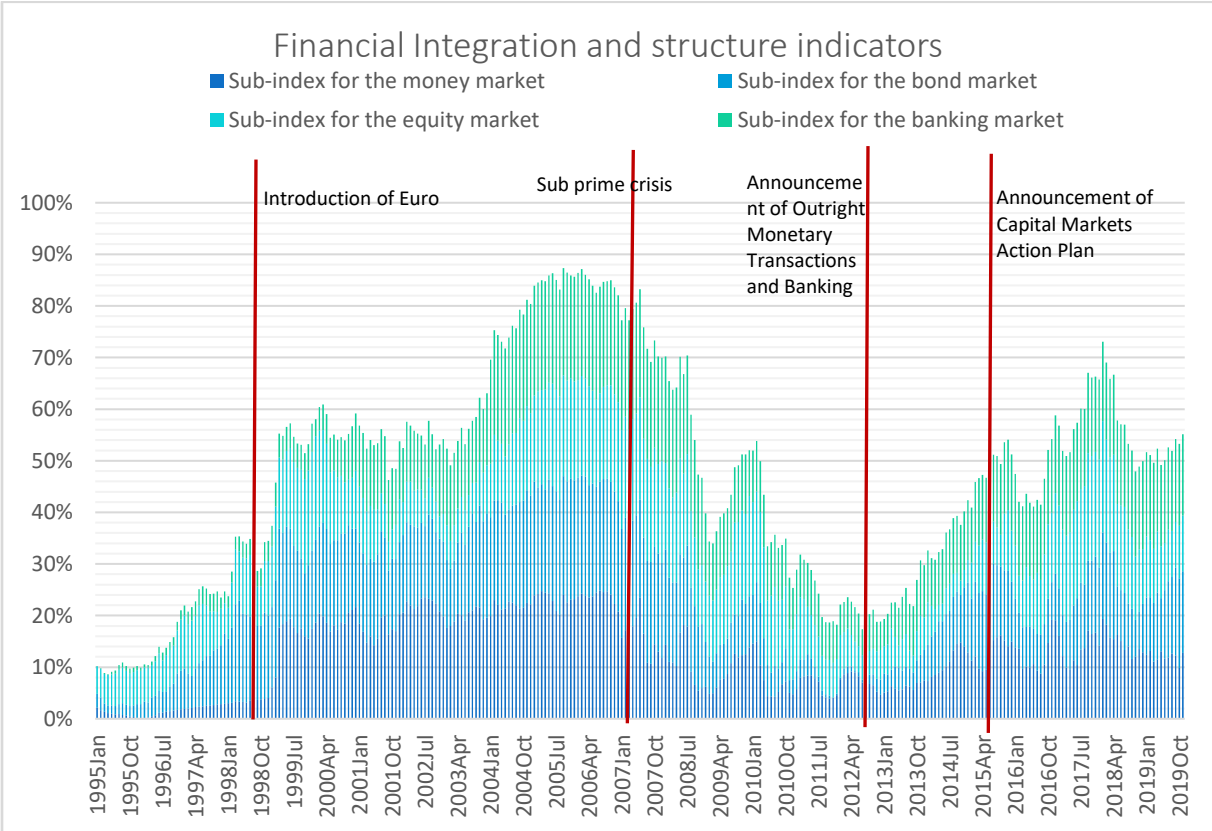
The basis of the need for integration as follows: Firstly, an integrated financial system was needed for the effective functioning of monetary policy in the Euro Area. Secondly, sharing of financial risks, diversification of these risks, ensuring financial stability, and consequently increasing liquidity in financial markets can only be achieved through financial integration. Thirdly, the proper functioning of the payments system in the Euro Area, for example, the fact that the transactions of liquidation of receivables and debts in financial exchanges are carried out quickly and reliably required the establishment of an integrated banking market. The main

reasons for the establishment of integration in the EU banking sector are to make the targeted European Financial Single Market competitive.

To contribute to financial integration and development, the European Central Bank aims to complete the banking union, establish the capital markets union (CMU), and audit the financial supervisory architecture. According to the ECB's Financial integration in Europe report in 2018, financial integration has increased the resilience in markets against adverse shocks over time in many ways. However, cross-border short-term debt holdings are rising and it is creating a danger for the markets. In the same report, it has been mentioned that risk diversification is still low in the Eurozone. ECB suggests equalizing the insolvency frameworks to raise the benefits on the banking and capital markets integration.

The following graph illustrates the financial integration in the last twenty-five years' period. The yellow line in the graph shows the price-based integration. As seen from the graph, the introduction of the Euro in 1999 and the Announcement of the capital markets union action plan in 2016 positively affects the integration. On the other hand, during crisis periods financial integration diminishes.

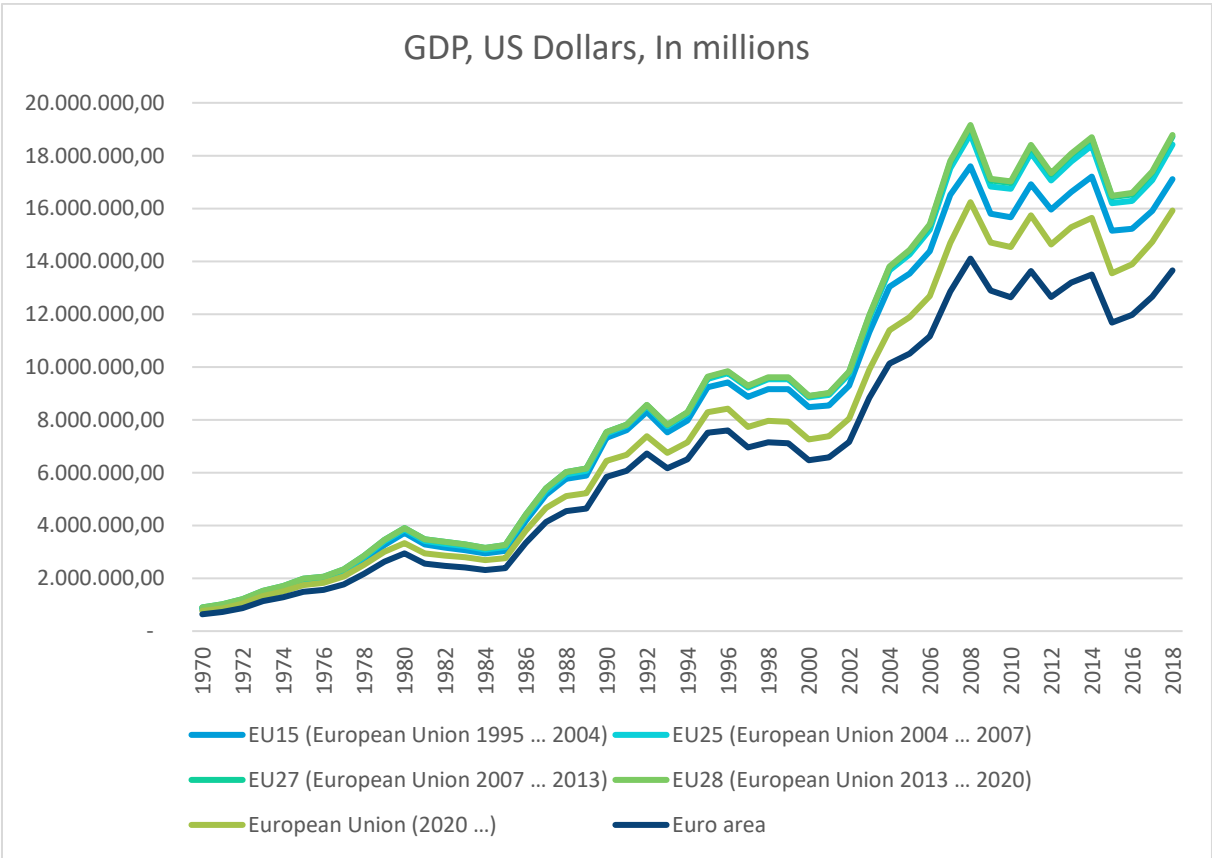
Graph 6: Price-based financial integration composite indicators



Data: ECB, 2020

Graph 7 explains the GDP levels of the Euro Area and the European Union according to the UNCTAD classification. As an indicator of welfare, GDP in the area has been growing significantly especially between 1999 and 2008. 1999 is the year when the Euro is introduced and 2008 is the year the debt crisis hit the continent. Since then, in the last 13 years, the fluctuations are high and it causes downfalls in the level of total GDP.

Graph 7: GDP in the Euro Area



Data: ECB, 2020

2.2.1 Monetary Union

Friedman (1953) has remarked that flexible exchange rates are required to avoid shocks and to absorb them. On the other hand, fixed exchange rates may increase macroeconomic volatility and cause losses in welfare. However, Ingram (1973) asserted that a monetary union may boost financial integration across member countries. Therefore, increased financial integration may allow a better allocation of capital and higher welfare.

Financial liberalization in the European Union (EU) and the introduction of the euro in EU member countries lead to an increase in the level of financial integration. Using a common currency provides that foreign currency risk disappears completely so that the cross-border investment could have risen while the costs of hedging are fully eliminated (Bénétrix, 2008). The single EU financial market continues to evolve, based on the principles of minimum regulatory compliance, origin country control, and reciprocity in key issues. The mechanism for the creation of this single market is the directives issued by the European Commission. These directives are implemented through harmonized national laws of member countries. The European Commission's directives on banking, insurance, investment services, information sharing, and cross-border investment funds all form the framework for integration. The Second Banking Directive allows an EU bank to perform securities anywhere in the EU, to the extent allowed by the country of origin of the organization. All EU member states allow banking and securities activities within the same group and most under one legal entity. As a result, a remarkable consolidation is observed with the integration which is advanced in Europe. The establishment of the European Monetary Union has accelerated this situation.

It is possible to say that the economic integration process in the European Union is based on two legs in the form of the domestic market and financial (European Monetary Union, Euro) integration. However, the need to take financial integration as a third pillar has become prominent, especially after the transition to the Euro, so that these feet can be firmly placed on the ground. Introducing the Euro has removed the exchange rate risk among members of the union. The euro significantly increased competition by providing greater price transparency in the EU financial system. Competition lowers transaction costs and provides the highest possible return for investors and the lowest possible capital cost for borrowers. The introduction of the euro has catalyzed increased integration in the euro area. The increase in efficiency brought by the integration to the financial markets in the euro area is beneficial not only for those living in this region but also for borrowers and investors who can access the Euro region financial markets even though they do not live in this region. Euro level integration of stock markets This means that issuers in the euro area can first reach a large number of investors in a wide and open market. This creates a way for new and relatively small companies to finance young and innovative companies from stock markets that specialize in fundraising (ECB, 2020).

Financial integration in the European community has been implemented as a coordinated regulation process spread among the member states over time. The aim is to establish a legal framework that will enable greater integration without requiring each member country to give

up its public policy interests on safety rules, market stability, and consumer protection. In this context, the Single Market Program, which will constitute the European economic system, is based on home country control, competition in the field of regulation, and compliance with minimum standards.

According to the origin country control principle, primary surveillance is left to the direct control of national authorities. Competition in the field of mutual recognition and regulation among the member states has been recognized. However, it has been agreed that cross-border services and activities of the branches in the host countries should be arranged according to the country's rules of origin, while the participant's national laws need not be fully compliant. Integration has provided several benefits such as opening up to regional markets and a large extent international competition, increased efficiency in financial intermediation, more efficient use of capital, development of the financial sector, and better fiscal discipline. obtained in the host country with the "Single Passport" which enables the fulfillment of the origin country without authorization other than the authorization of the country. However, the program provided a heterogeneous integration between both sectors and countries. While the wholesale banking sector deepened the integration process, retail banking remained divided and became more local. Securities markets deepened integration, while insurance sub-sectors remained limited due to legal barriers (ECB, 2020). European experience showed that the following issues are necessary for financial integration.

Beyond sectoral effectiveness, clearly defined long-term goals, including economic development and global competitiveness,

- A feasible and reliable implementation of minimum harmonization of legal frameworks and cross-border financial activities, public administration, particularly in the joint audit of tax practices, bank and insurance regulations, and securities markets. The adoption that it requires reform for the Single Passport system; and
- Decision on significant financial harmonization and economic cooperation to avoid financial crises that hinder effective financial integration

The European Central Bank (ECB) and Eurosystem pay particular attention to the financial integration process in Europe, as the financial system plays a key role in the implementation of monetary policies. An effective and widely integrated capital market ensures the continuous and effective implementation of monetary policy. A high degree of financial integration is required for the ECB's other core tasks, such as ensuring proper functioning of payment systems

or maintaining financial stability. The most important reason for supporting the integration process is that the European economy will increase its growth potential without causing inflation. As integration increases, savings are more effectively distributed to the most profitable investment plans, while dispute and transaction costs are minimized. There are two lessons on integration that can be taken from the path that has been taken to date. First, integration can only be achieved by effectively removing barriers to cross-border financial activities. Second, the legal framework itself is not sufficient for effective integration of the market. This, however, creates the potential for different players, public or private sector.

2.2.2 Central, Eastern and South-Eastern Europe (CESEE) Financial Markets

Despite the economic convergence in the EU since 1999 (ECB, 2015), different stages of economic and financial development can be observed in some Member States.

There are some characteristics in common for CESEE economies. First, CESEE countries share a joint legacy of being command economies that embarked on a transition process to market economies in the 1990s. Second, all of them are open economies but smaller in size of economy relatively to the western part of Europe and CESEE countries have strong economic relations with larger EU economies. Third, all of them have either joined the EU already or are EU candidates or potential candidates with the prospect of joining the EU at some point in the future. In CESEE a strong improvement can be observed lately in institutional quality and human capital. The more economic policies are mostly outward-oriented, and there have been favourable demographic developments and the quick reallocation of labour from agriculture into other sectors (Zuk and Savelin, 2018).

The European (CESEE) Member States including Bulgaria, Croatia, Czech Republic, Estonia, Hungary, Latvia, Romania, Lithuania, Poland, Slovakia, and Slovenia are still lagging. On the other hand, a strong investment in many of these Member States is still necessary. And these countries have the potential to gain significant benefits from the CMU because the capital needs to be increased to continue structural reforms, invest in infrastructure, and increase productivity and growth in per capita income. A more developed capital market is essential for financing investments from both developed and foreign sources.

Many studies focused on the correlation between the development of financial markets and GDP growth or income. It has been concluded by many authors that financial sector development enhances economic growth. The positive impact of financial development on

economic growth appears to be more pronounced for economies with a lower level of economic development compared to those with higher levels of development (such as Rioja and Valev (2002) or Shen and Lee (2006)).

Karahan et al. (2020) employed the Westerlund panel cointegration test and Dumitrescu–Hurlin panel causality test to understand the financial market integration in Eastern Europe. They used the data from 2000 to 2016 in 15 Eastern European countries to investigate the relationship between domestic saving and investment. The results of their analysis illustrated that saving and investment have a long-run relationship and there is a causality running from saving to investment. They concluded these results as the empirical evidence of a strong positive relationship between national saving and investment in the Eastern European area. Therefore, the results supported the idea that the financial markets of the Eastern European countries are not perfectly integrated into the world capital market.

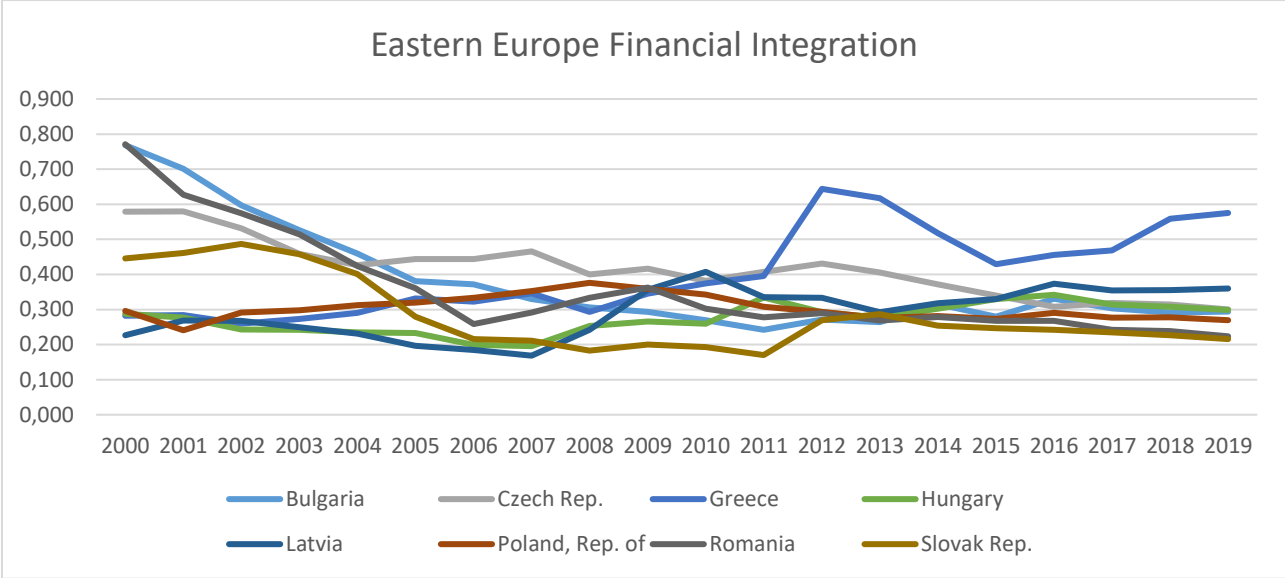
Lane and Milesi-Ferretti (2003) analyzed the financial integration concerning the increase in the foreign assets and liabilities relative to GDP. They related the growth in foreign asset and liability positions to potential “drivers” of financial integration. They used a volume-based measure of international financial integration where FA refers to stocks of foreign assets and FL refers to the stocks of liabilities, IFIGDP stands for international financial integration:

$$IFIGDP_{it} = \frac{FA_{it} + FL_{it}}{GDP_{it}}$$

In this analysis, the aggregated stocks of assets and liabilities in domestic currencies are proportioned to the Nominal Gross Domestic Product in domestic currencies. Data in the following graphs are collected from the International Financial Statistics (IFS) of IMF.

Over the past decades, financial integration into the world economy has not been following a growth path for most of the countries in the Eastern part. These two graphs show that financial integration in the Eastern European part has fluctuations and comparatively less steady. Most countries in this less-developed part of Europe have similar financial integration levels or even less.

Graph 8: Eastern Europe Financial Integration

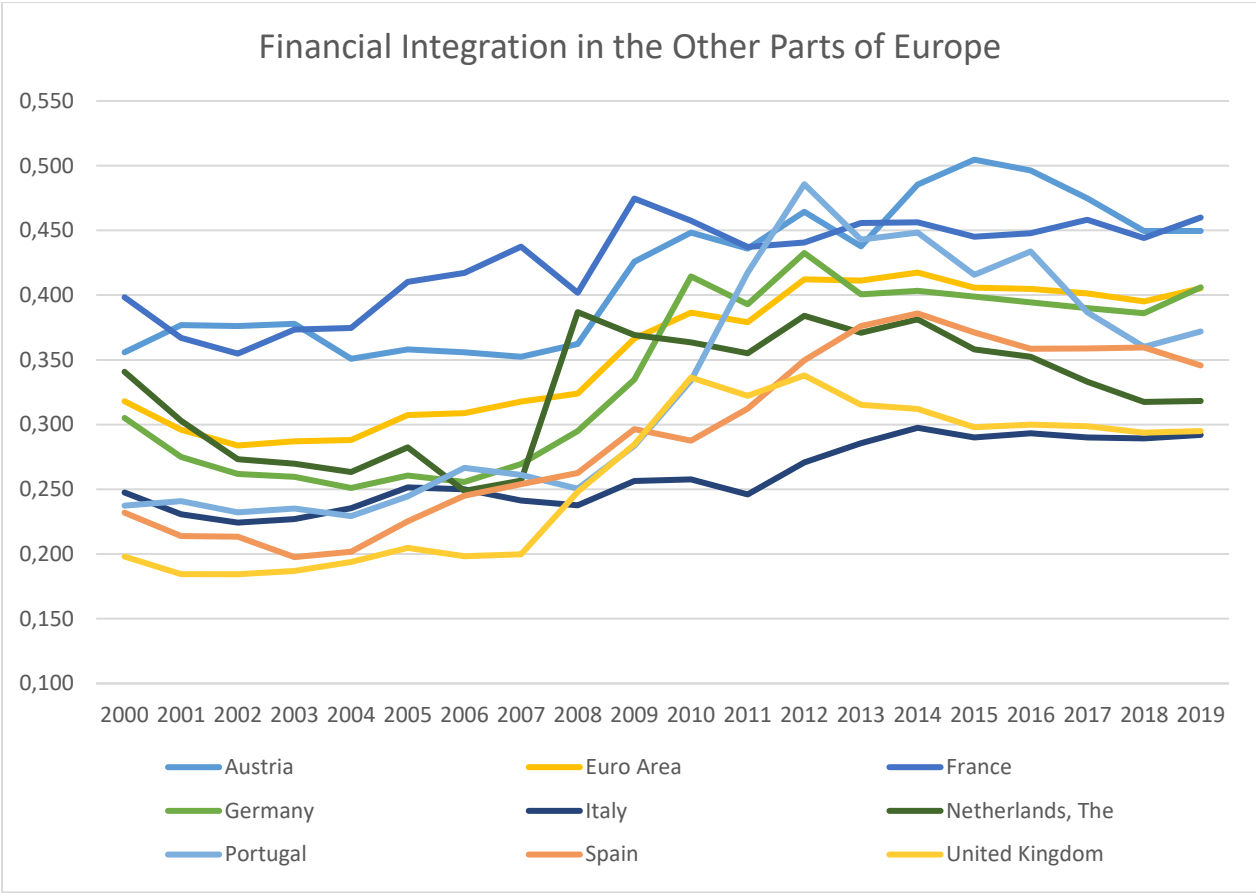


Data: IMF, 2020

As it could be seen from the graph, the average financial integration ratio in this period for the Euro area is between 0.3 and 0.4 respectively in 2000 and 2019. The ratio has increased by around 30 percent over this period for the Euro area, with a marked acceleration between 2004 and 2012.

However, this increase in financial integration has not been uniform across countries. This ratio for Eastern European economies is currently lower than the average with a few exceptions in the observed period. On the other hand, more developed countries in Europe have mostly been following a growth path at a steady pace.

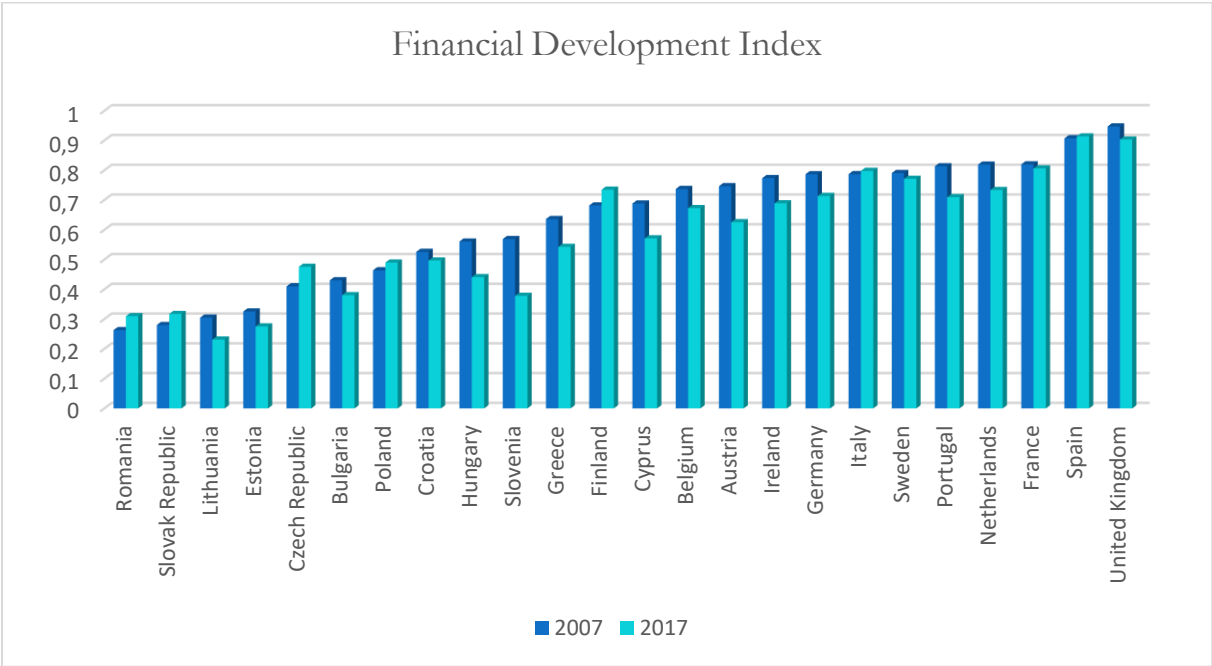
Graph 9: Eastern Europe Financial Integration



Data: IMF, 2020

The following graph provides a comparison of the financial development index in Europe over the last ten years. In this summarized index, multidimensional data of nine indices, including Financial Institution Index and Financial Market Index, is used. For better visualization, the countries are in line according to their index values in 2007. The graph clearly shows that countries in the CESEE region were on the left part of the graphic due to their low index value in 2007. After ten years with high integration in the EU, there is no convergence opposite to the expectations in the values. Moreover, the financial development index value of many countries has slightly deteriorated in the last decade.

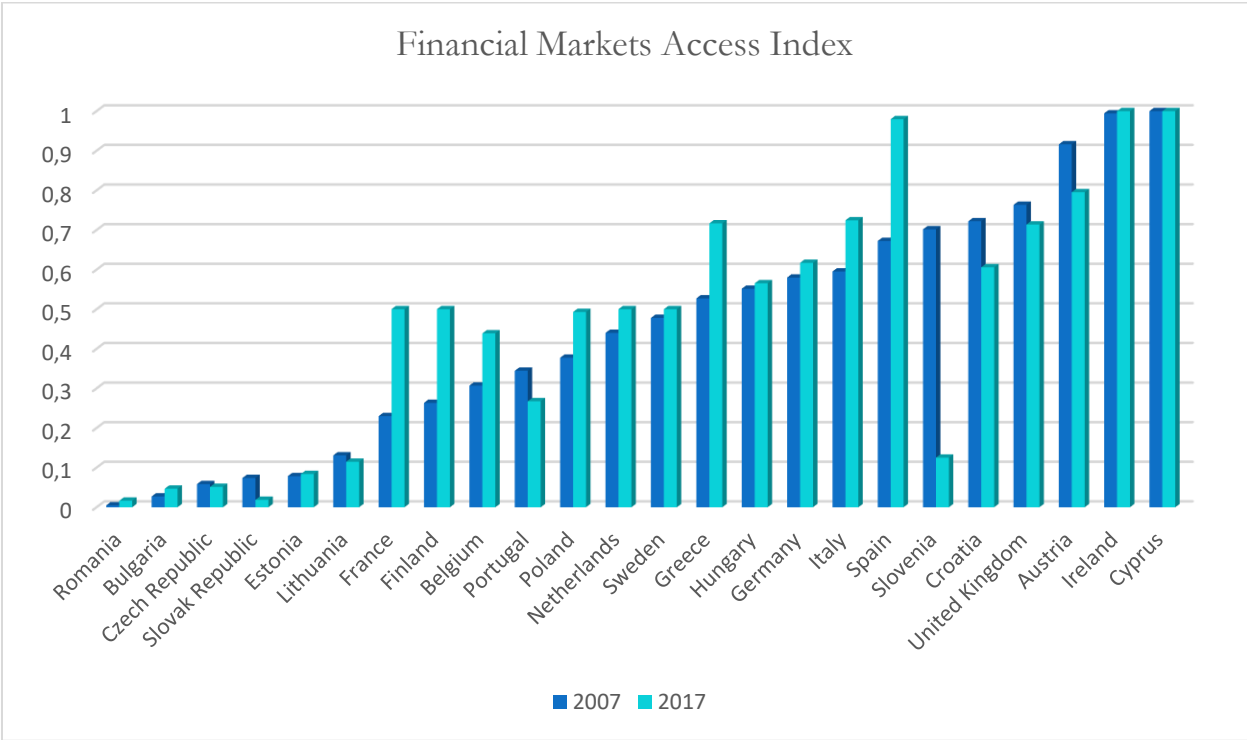
Graph 10: Financial Development Index in 2007 and 2017



Data: IMF, 2020

Market access is calculated as a share of market value outside the top 10 largest companies and the total number of debt issuers (domestic and international, NFCs) (IMF, 2018). Financial Market Access Index is an indicator of market integration prepared by Eurostat. The following graph allows us the changes in market access in the last ten years. Although there are new members of the EU, the market access index appeared to be irrelevant to participation. Developed economies in the EU stayed at a similar level and maintained the level of access to financial markets. However, an increase in the market access index is very limited for lately participated countries such as Bulgaria, Romania, and Slovakia. Due to the difficulty of comparison and size, some countries are neglected in the following graphs.

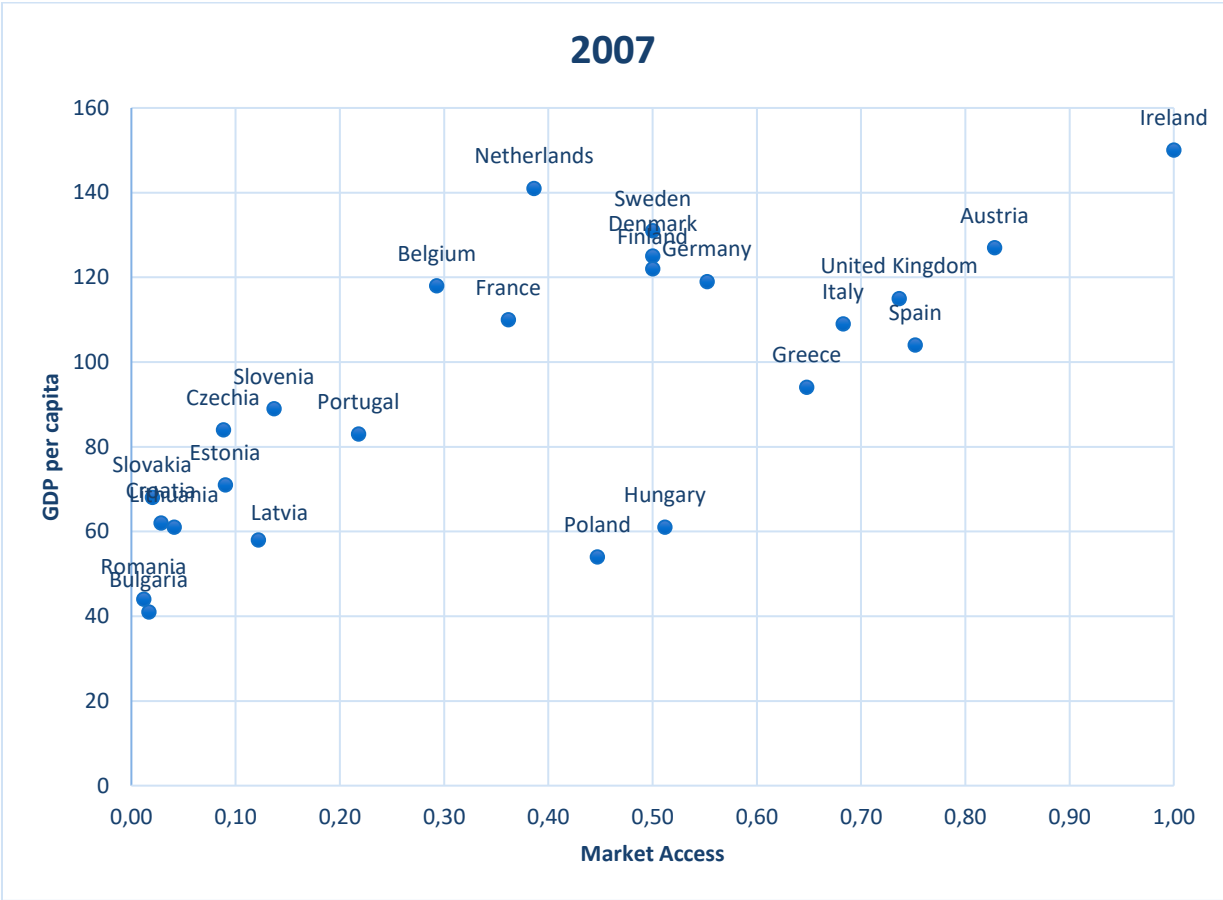
Graph 11: Financial Market Access Index in 2007 and 2017



Data: IMF, 2020

Well-integrated as well as developed capital markets can contribute to employment and growth through a variety of channels. It seems that the larger and more accessible financial markets increase the income level of the country. In graphs 8 and 9, the central and eastern European countries are lagging western European countries. When the capital markets are functioning well this increases the investment opportunities and provides a better diversification for investors across the EU. Moreover, there is a rise in access to venture capital for borrowers and allows more competition. Unblocked capital flows in a single market enable financial resources to reach the most profitable investments. Cross-border integration increases the size of the relevant market, allowing scale effects based on lower costs, higher market liquidity, and lower search costs to run market infrastructures. In contrast, large and integrated financial markets increase the opportunities for portfolio diversification and risk-sharing among households, firms, and economies in general (European Commission, 2018).

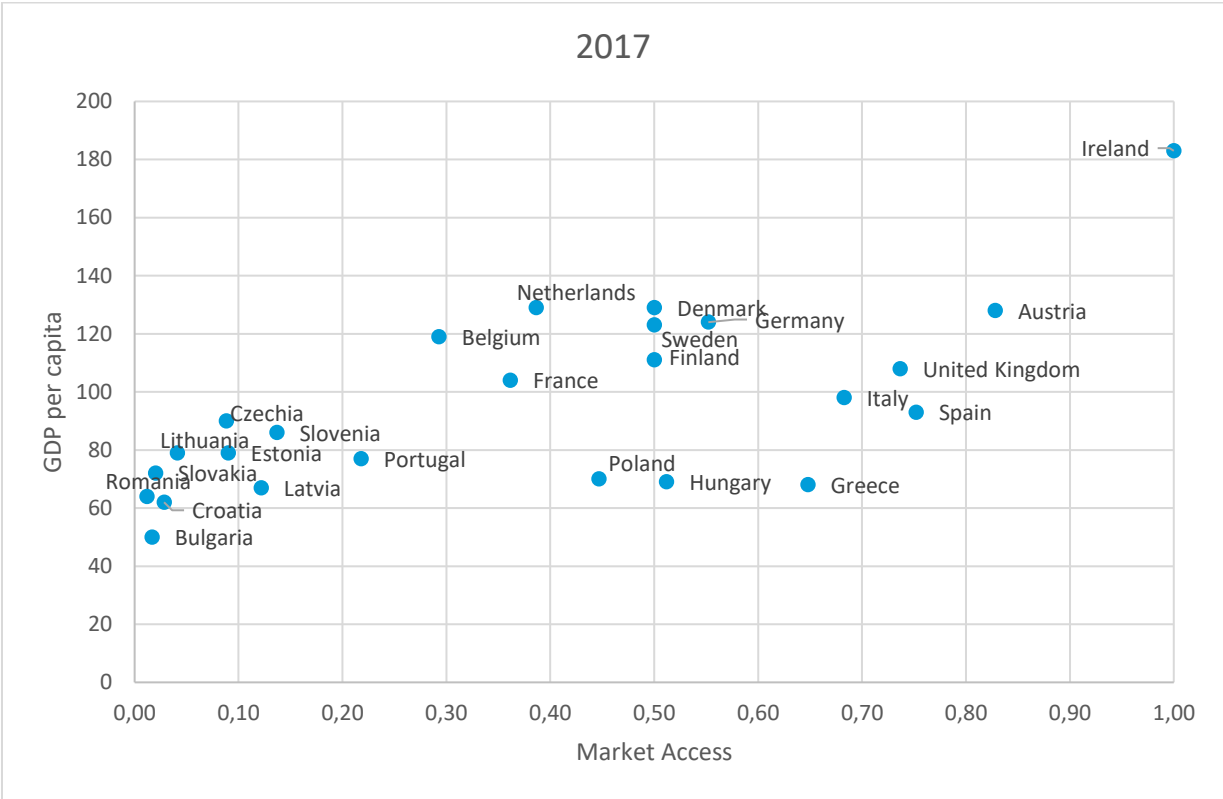
Graph 12: GDP per capita in PPS and Financial Market Access in 2007



Data: IMF, 2020

The graph above illustrates the Market Access and GDP level of some EU members in 2007. Again, some members are excluded because of the size of the market and the number of transactions. It can be observed that countries with lower market access have produced less GDP in 2007. Central and South-Eastern economies are well behind the level of GDP per capita of western members of the EU. 2007 is the year when the sixth enlargement has occurred with the participation of Romania and Bulgaria. The latest member, Croatia, is also located on the left among the CESEE.

Graph 13: GDP per capita in PPS and Financial Market Access in 2017



Data: IMF, 2020

The same graph is prepared for 2017 to evaluate the changes after participation. According to the graph above, there is no clear evidence for convergence between union members. Although it would be expected that the EU membership shall increase the level of market access and also GDP per capita, the benefits of the participants have not been realized. The CESEE Member States appear to be less integrated with larger capital markets in the EU and maybe more dependent on locally developed markets before taking the next step towards further integration.

The review of the literature about the integration of the banking sector in the EU is broad and will be presented before the relevant analysis in Chapter 3.2.

CHAPTER 3

THE CLUSTER ANALYSIS OF THE BANKING SECTOR IN EUROPE

This chapter is an updated version of the research Ercan and Sayaseng published in the paper of Ercan and Sayaseng (2016). The cluster analysis helps to turn large amounts of observed data into a reduced-size meaningful structure. This analysis aims to include a representative sample of the Banking Sector of European countries into smaller, homogenous groups, to evaluate the clusters of countries that have similar patterns according to their sector ratios. The cluster analysis of European banks helps to identify the complex relationships between banking sector ratios, without any restriction. The consolidated banking sector data is not homogenous among countries in Europe. However, these differences and common characteristics of clusters have rarely been studied in the literature especially after a crisis. The evaluation of the possible convergence or divergence in the ratios can be regarded as complementary to the other parts of this thesis.

3.1 Literature Review

Cyclical financial crises have revealed the danger of systemic risk due to contagion effects given the interconnectedness of modern banking systems. Systemically it is essential to identify the key and important banks, as it is one of the critical objectives of systemic risk assessment and a necessary precondition for the formulation of macroprudential policy. González-Hermosillo (2008) relates the degree of vulnerability of individual financial institutions with the degree of stress in global market conditions. Their studies presented that if investors' risk appetite is low or global liquidity is tight, small shocks can have large effects on global financial markets and vice versa. The macro-prudential policy aims to provide safeguard and the overall stability of the financial system; this has proven that there are potential loops holes in the banking system in the wake of the recent financial crisis. Regulators have learned the hard way that dependence on the banking sector undermines the benefits of diversification and may lead to a 'fragile' system (Brunnermeier et al., 2009). This has proven to be a major issue in the wake of the recent financial crisis. The debate on macro-prudential policies and potential warning signals of the crisis have been explored by many researchers and regulatory bodies, many of the models constructed before the crisis have proven to be ineffective, and many have raised questions whether the contagious is the matter of clustering of the banking system.

This chapter aims to fill the gap in the literature by applying an alternative method to study financial and economic integration after the crisis in Europe. The hierarchical clustering structure of the 26 EU areas is analyzed based on the consolidated banking indicators from the Central European Bank (ECB). The analysis covers the observations from 2008 to 2018 with some exclusions due to missing data and size. The analysis focuses on the banking sector and tries to evaluate the hypothesis that questions the banking sector ratios of the EU countries show similarities only among neighbor countries in cooperation and there is a change in the clusters of banking sector ratios of countries after the crisis.

First, the literature review has been done to present previous ideas about the use of cluster analysis in the banking sector. The study briefly reviews the literature using cluster analysis in the EU. Then we describe our data and methodology using the hierarchical clustering analysis technique. Our model provides a unique set of grouped categories or clusters by sequentially pairing variables from the selected data. The next section discusses the main results and presents the clustering of the financial-banking sectors. In the final section, the chapter concludes the results, which provide meaningful insight into the structuring and interconnectedness of the EU banking sector.

There have been extensive researches about the failure in the financial institution area since the late 1960s. A variety of multivariate methods and other techniques have been applied to solve the bankruptcy prediction problem in banks and firms. At the same time, some of the literature researches try to measure the movements between the EU banks. Their findings support that EU-wide macroeconomic and banking-specific shocks are significant and that some risks have increased since Euro is in use. De Nicolo and others (2005); and Brasili and Vulpes (2005). Gropp and Moerman (2003) focus on contagion to identify 12 systemically important banks in Europe and show that significant contagious influence emanates from some smaller EU countries. Evans et al. (2008) report that the banking sector deregulation at the national level and the opening markets to international competition caused convergence for the banking industry's main indicators of bank profitability or earning patterns, but not their asset-liability related ratios. Decressin et al. (2007) mention that financial institutions should yield better risk profiles by increasing diversification both of their internationally and across different business lines. However, if the diversification is made by institutions in the same way, this can lead to bigger shocks or increase fragility.

Detecting potential risks and vulnerabilities in national financial systems and resolving instabilities if and when they arise are likely to require a strong cross-border perspective. Gropp, Vesala, and Vulpes (2002) used cluster analysis for euro area banks to analyze the banking sector fragility and demonstrated its usefulness as a complement to traditional balance-sheet-based analysis of risks. For large, complex financial institutions of both the United States and Europe, Hawkesby et al. (2003) applied agglomerative hierarchical cluster analysis to the data to explore the network structure of the companies. Alam, Booth, and Thordason (2000) found that the clustering algorithm and self-organizing neural networks approach provide valuable information to identify potentially failing banks.

Cluster and factor analysis of structural economic indicators for selected European countries (Kurnoga et al., 2009), used cluster analysis on three structural economic indicators: GDP per capita, total employment rate, and comparative price levels to classify Croatia and EU 27 Member States according to the structural economic indicators. According to the results of Ward's method and three chosen structural economic indicators, Croatia was classified along with the following EU Member States: Bulgaria, Hungary, Poland, Romania, Slovakia, and Malta.

Forte and Santos (2015) used a hierarchical clustering method with squared Euclidean distance to examine the FDI performance of Latin American countries. The cluster with better FDI performance (Chile, Panama, Uruguay, and Costa Rica) also performs better in terms of variables such as market size, trade openness, and human capital.

Dardac and Boitan (2009) used cluster analysis, as an exploratory technique to create a representative sample of Romanian credit institutions in smaller and homogenous clusters, to assess the similar patterns of credit institutions according to their risk profile and profitability. They used have computed 8 financial indicators (ROE, ROA, loans to deposits ratio, capital and reserves to total assets, Cash holdings, securities holdings to total assets, Customers' deposits to total liabilities, net profit to total income) from banks' balance sheet, to assess the intermediation activity's main characteristics, regarding the profitability, costs and risk exposure.

3.2 Data

The sampling data is comprised of consolidated data from 26 countries in the European Union (EU) zone. The data covers the sampling period from 2008 to 2018 which included the following countries: Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Germany, Denmark, Estonia, Spain, Finland, France, United Kingdom, Greece, Hungary, Ireland, Italy, Lithuania, Luxembourg, Latvia, Netherlands, Poland, Portugal, Romania, Sweden, Slovenia, and Slovakia. Croatia has been excluded from the study due to the late addition to the EU as well as lack of available consolidated data. The study excluded some countries from the sampling population of the EU countries, and this is due to the fact that these countries were shown as the outlier for all the results.

The selection of variables is naturally an important factor in the composition of clusters. As the aim of the analysis is broad enough, as is the case here, the number of candidate instruments increases. In parallel with this condition, five banking indicators that are commonly used in the literature are selected to cluster the banking system. Solely, the ratios are taken as references to provide a meaningful comparison among countries due to the size differences in economies.

The selected variables are Leverage ratio, Return on Asset, Tier 1 capital, Capital requirement ratio, Equity to asset ratio. Sørensen and Puigvert Gutiérrez (2006) suggested using the variables in cluster analysis to cover the main financial activities of the banking sector. Therefore, these five ratios have been selected as the main indicators of profitability, leverage, and liquidity. However, some variables are excluded due to the lack of data and comparison disadvantages at an international level.

The variables are comprised of annual banking sector indices available from the European Central Bank (ECB) for the sample period of six financial years (2008 to 2018). These open sources banking sectors indices are constructed by the European Central Bank, these indices are contrasted based on the domestic banks, stand-alone banks, foreign banks, and controlled subsidiaries of foreign countries branches of each EU country. For the missing values in the data set, the estimated value replacement approach in SPSS is adopted (see Appendix for Chapter 3).

Table 1: The variables

Variables	Descriptions
Leverage Ratio	Percentage of bank's lending (debt) to the value of its ordinary share of Equity in percentage
Return on Assets	Bank's annual earnings divided by total assets, sometimes referred to as return on investment
Tier 1 capital ratio	Core equity capital to its total risk-weighted assets
Capital requirement ratio	Standard capital requirement for banks
Equity to asset ratio	The ratio of total assets of the banks in proportion to the bank's Equity

Source: Akgüç (2012)

3.3 Methodology

Cluster analysis is a technique that identifies the complex relationships between variables without imposing any restriction. Therefore, the input dataset doesn't need the distinct specification of an explanatory variable (the dependent variable) and respectively, of predictor ones (independent variables). There is no difference between the levels of importance of the variables, the aim of the analysis is not to predict a certain value, but, to provide some clear view for the presence of specific patterns of correlations among variables, to include the different variables or cases into more homogenous groups (Dardac and Boitan, 2009). Cluster analysis can be used to explore the hierarchical structure of a system, and that does not provide only an intuitive picture of the linkages of the system but also displays a meaningful cluster. Cluster analysis which groups (clusters) so that objects from the same cluster are more similar, concerning a given attribute, to each other than objects from different clusters is a common technique for statistical data analysis in many fields, such as machine learning, pattern recognition, and bioinformatics (Khashanah and Miao, 2011)

Cluster analysis is a useful method for examining complex relationships among national characteristics and international linkages without imposing any a priori restrictions on these interrelationships. Cluster analysis became a very popular tool to analyze a large amount of complex data, such as in the analysis of the banking sector (Sørensen and Puigvert Gutiérrez, 2006).

The preference for using cluster analysis in this research is mainly coming from its appropriateness. The cluster analysis, apart from many other methodologies, does not have any restriction or a training stage based on a collection of past data selection to identify the complex relationships. Therefore, cluster analysis can be a convenient tool to compare banking sector ratios because of the complex nature of data. This study employs a Hierarchical Cluster Analysis in SPSS to identify the clusters in EU Banking Sector. Leverage, ROA, Tier 1, Capital requirement, equity/asset ratios have been selected as the variables to observe the similarities of the countries. For 2015-2018, the equity to asset ratio has not been included in the analysis due to the changes in the data source. This analysis consists of assessing whether the crisis has promoted the similarity in the pattern of the banking sectors in the euro area countries. In this respect, we use a hierarchical cluster analysis by considering three sub-periods: a "crisis" period (2008-2010), an "after-crisis" (2011-2013), and a normalization period (2013-2018). Hierarchical Cluster analysis provides a unique set of grouped categories or clusters by sequentially pairing variables, clusters, or variables and clusters. Starting with the correlation matrix, all clusters and unclustered variables are tried in all possible pairs at every step by using Cluster analysis in SPSS. The pair with the highest average inter-correlation within the trial cluster is chosen as the new cluster. On the other hand, in the other types of cluster analysis, a single set of mutually exclusive and exhaustive clusters is formed whereas hierarchical method all variables are clustered in a single group starting from a larger cluster by getting tighter in each step (C. Bridges, 1966).

In our analysis algorithm starts by considering that each country forms its cluster, in the following stage, the countries with similar data are grouped into the same cluster. The next phase is adding a new country or forming a two-country cluster. The process continues until all the countries are in the same cluster. Finally, the outcomes summarized in a cluster tree called a dendrogram, which represents the different steps of agglomeration described above. Cutting branches off the dendrogram allows us to determine the optimal number of clusters, and therefore the degree of heterogeneity of our sample. The first step of the analysis consists of measuring the distance or dissimilarity between every pair of countries, defined here by the

Euclidean distance:

$$d^2 = (i, l) = \sum_{k=1}^K (x_{ik} - x_{lk})^2$$

Variables have been standardized to avoid the variances in scale, which lead to a greater impact on the clustering of our data. The Euclidean distance is measured from the variable from each of the EU Countries. The grouping and the linkage of the cluster are formed based on the distance matrix computed. Though there are several techniques to determine the linkage of the cluster, we have adopted the most commonly used method of Ward (Ward, 1963), this method is computed based on the multidimensional variance, including total variance and decomposed variance: The total variance can be decomposed into the between and within the variance:

$$\sum_{k=1}^K \sum_{q=1}^Q \sum_{i=1}^{I_q} (x_{iqk} - \bar{x}_k)^2 = \sum_{k=1}^K \sum_{q=1}^Q I_q (\bar{x}_{qk} - \bar{x}_k)^2 + \sum_{k=1}^K \sum_{q=1}^Q \sum_{i=1}^{I_q} (x_{iqk} - \bar{x}_{qk})^2$$

x_{iqk} as the value of variance for the variable K for the country within the cluster q

\bar{x}_{qk} the mean of the variable K for the country within the cluster q

\bar{x}_k Overall mean of variable K, and I_q is the number of the countries in the cluster q

Based on this decomposition, a good agglomeration will minimize the within-cluster variance and maximize the between variance. Minimal increase in variance means that the linked clusters are relatively similar. The term, Euclidean distance can be written as:

$$\Delta(p, q) = \frac{I_p I_q}{I_p + I_q} d^2(c_p, c_q)$$

- I_p number of countries in the cluster p
- I_q number of countries in the cluster q
- c_p and c_q the centroid of the clusters p and q

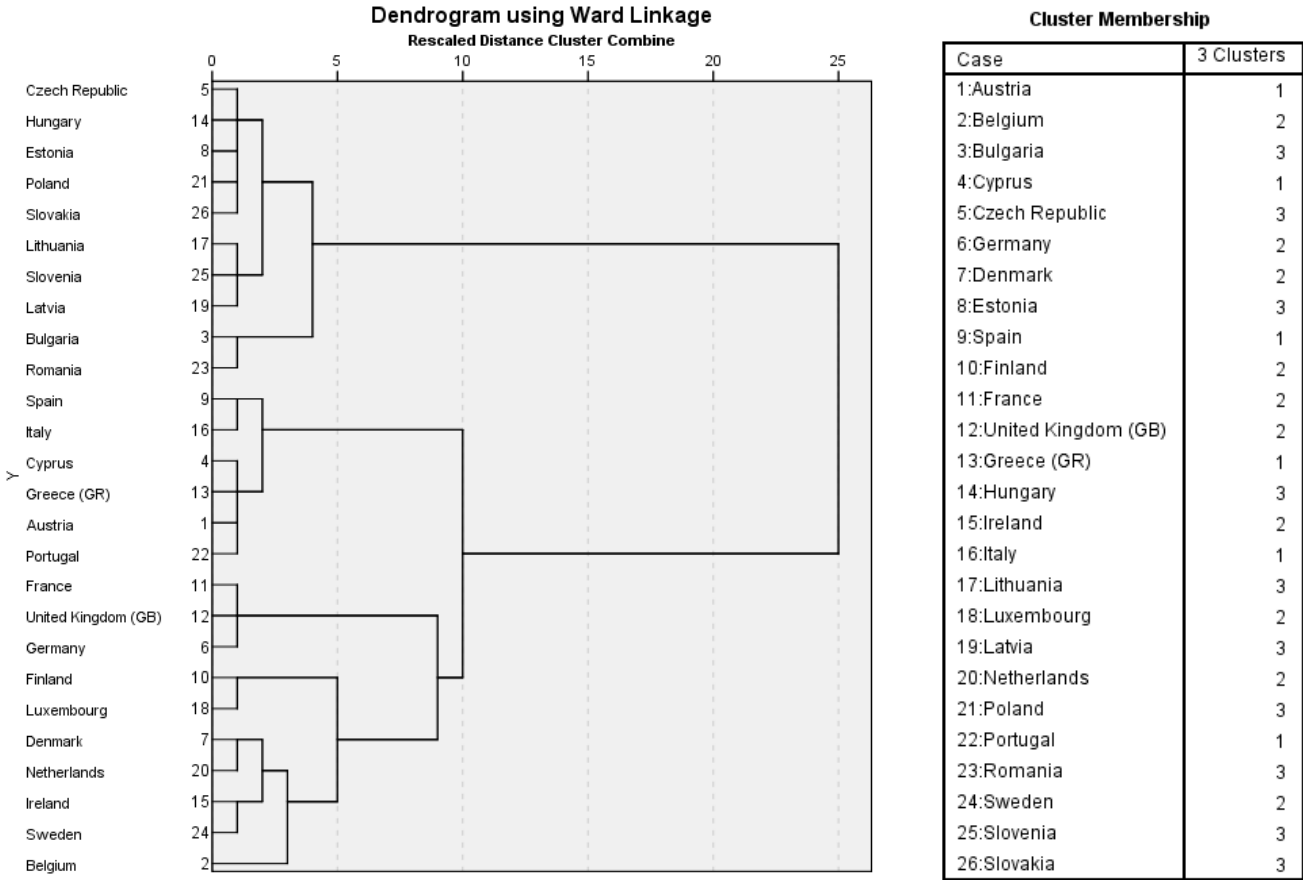
The Ward algorithm is the linking of two clusters, the increase of $(\Delta(p, q))$ is the smallest. Repetitively, the centroid of each cluster is based on the country assigned to the cluster. Hence the distance matrix is recomputed, and the algorithm is repeatedly computed until all the countries are agglomerated into a single cluster. In this case, to provide information from

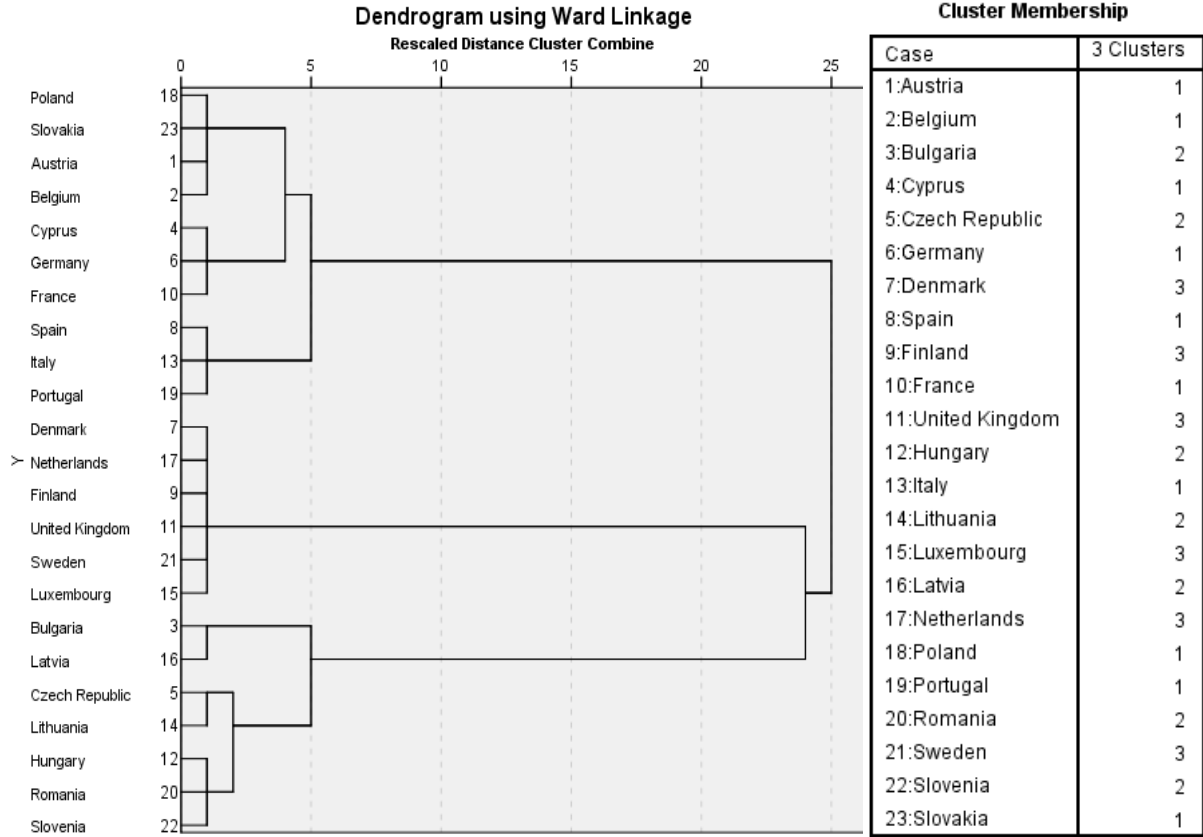
selected financial indicators, the clustering is performed between 2008 and 2018 in SPSS. For each variable, the missing value is replaced with the estimated means. Results of the hierarchical clustering are discussed in the next section.

3.4 Results

The dendrograms for the 2008-2018 periods are providing a comprehensive visualization for the clusters of the European banking sector. In each dendrogram, the vertical axis represents countries in the EU, and the horizontal axis illustrates differences between countries. Vertical lines in the dendrogram indicate the linkage of two countries or clusters. Countries that are similar to each other are combined at a lower distance, whereas countries that are showing differences are combined higher up the dendrogram. Therefore, if the link between the countries is at a higher point, it means that the dissimilarity between countries or clusters is greater. As an example, the dendrograms for 2008 and 2018 are shown below (See the rest of the dendrograms in the appendix).

Graph 14: Cluster Results of SPSS for 2008 and 2018





Source: Author's own

Table 2 has been produced from the dendrograms, to illustrate the clusters of the banking sectors of European economies. According to the table, each color shows a different cluster. The fact that there are no perfect clustering results, especially with a bigger data set, our results have exhibited that some of the clusters are close to each other. Therefore, the number of the set of clusters is limited to three to determine the most relevant grouping and a method to cluster the larger set of data.

The clusters are shown with different colors to make it easier to realize the differences. Blue cluster is generally including south European countries and Austria. Red cluster mostly contains bigger economies of the EU, such as the UK, Germany, and France. And the green cluster includes generally Eastern European countries and Baltic countries.

Although there are some changes in the members of groups, the countries in the 3 clusters are similar for observed years. Financial integration in the EU is expected to bring a similar pattern for the finance sector, as mentioned in the second chapter. A single set of rules and even access to markets are emphasized by the ECB as the main factor of financial integration. However, as

can be observed from graphs in the appendix and Table 2, countries in the same region stayed in the same cluster, and no big changes have been observed.

The cluster in which Greece was placed has shown a change after 2010, and their ratios become similar to the blue cluster, which includes the biggest economies in the EU zone. But in general, Western countries and Eastern countries have their own groups, and the changes between these groups can hardly be seen.

Last but not least, as we observed, there are no important changes in the distribution of clusters over the years. This explains that the integration of the banking sector ratios in the EU is very limited. Even though there are new mergers, the heterogeneity of the banking sector stayed almost stable between 2008 and 2018.

Table 2: Summary of the results

Normalization		After Crisis		During Crisis	
2018	2015	2013	2011	2010	2008
Austria	Austria	Austria	Austria	Austria	Austria
Belgium	Cyprus	Cyprus	Cyprus	Cyprus	Cyprus
Cyprus	Spain	Hungary	Hungary	Estonia	Greece
Germany	Hungary	Italy	Italy	Greece	Italy
Spain	Italy	Portugal	Portugal	Hungary	Portugal
France	Portugal	Slovenia	Slovenia	Italy	Spain
Italy	Belgium	Spain	Spain	Lithuania	Belgium
Poland	Germany	Belgium	Belgium	Latvia	Germany
Portugal	Denmark	Germany	Germany	Portugal	Denmark
Slovakia	Finland	Denmark	Denmark	Romania	Finland
Denmark	France	Finland	Finland	Slovenia	France
Finland	UK	France	France	Belgium	UK
UK	Netherlands	UK	UK	Germany	Ireland
Luxembourg	Sweden	Greece	Greece	Denmark	Luxembourg
Netherlands	Bulgaria	Ireland	Ireland	Spain	Netherlands
Sweden	Czech	Luxembourg	Luxembourg	Finland	Sweden
Bulgaria	Ireland	Netherlands	Netherlands	France	Bulgaria
Czech	Lithuania	Sweden	Sweden	UK	Czech

Hungary	Luxembourg	Bulgaria	Bulgaria	Ireland	Estonia
Lithuania	Latvia	Estonia	Czech	Luxembourg	Hungary
Latvia	Poland	Lithuania	Estonia	Netherlands	Lithuania
Romania	Romania	Latvia	Lithuania	Sweden	Latvia
Slovenia	Slovenia	Poland	Latvia	Bulgaria	Poland
	Slovakia	Romania	Poland	Czech	Romania
		Slovakia	Romania	Poland	Slovenia
		Czech	Slovakia	Slovakia	Slovakia

Source: Authors own

3.5 Conclusion

As mentioned in the previous chapters, the EU financial market is aimed to be a single market where the competitors are trading in similar conditions and rules. However, the non-homogenous structure of a market may create problems to provide fair competition, especially for the developing countries' markets. Therefore, this chapter of the thesis questions the level of cross-border and international integration of the EU banking sector to understand the reasons for clusters by comparing the countries' sector ratios. Hierarchical cluster analysis is employed to seek differences between the clusters inside the European financial market, specifically in the banking sector. The obtained results help us to observe that there are some dissimilarities between the EU countries in terms of banking structure. Although working under the same authority and similar governing policies, the regulators aim to create a fair and competitive market for all financial institutions. Some of the very important ratios of the EU banking system have proven to be differentiated in many countries. The findings of our analysis support that the countries in the same neighborhood and with higher economic partnership tend to stay in the same cluster. As an example, Sweden and Denmark; Portugal, Spain, and Italy; Cyprus and Greece; Latvia, Lithuania, Slovenia, and Czech Republic; Romania and Bulgaria clustered in their own groups throughout 2008 to 2018. The characteristics of their banking system are, therefore, similar based on the financial ratios.

The results of the cluster analysis for 2008, 2013, and 2018 are shown in the figures below. The illustration of the maps provides better visualization of the analysis. The observed clusters from 2008 to 2013 did not show very big differences except for Hungary and Greece. The clusters, namely Southern, Northern and Eastern, are grouped similarly with their geographical locations

parallel with the results of the analysis. Later in 2018, the clusters show some changes as the ratios of Germany and France are getting closer to the Southern Europe ratios. Poland from the Eastern cluster has joined also this group as the country is becoming more integrated with the EU.

Figure 1: The Map of Clusters of the Banking Sector Ratios of the EU Countries in 2008

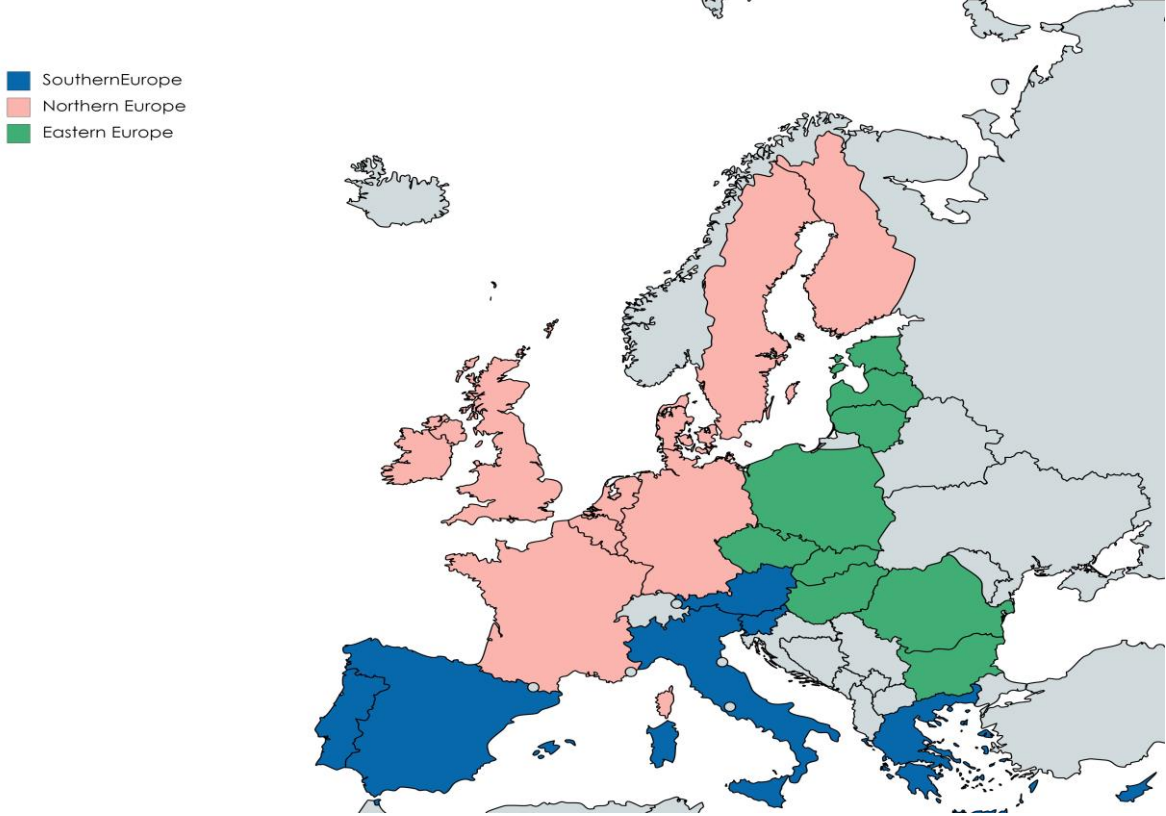


Figure 2: The Map of Clusters of the Banking Sector Ratios of the EU Countries in 2013

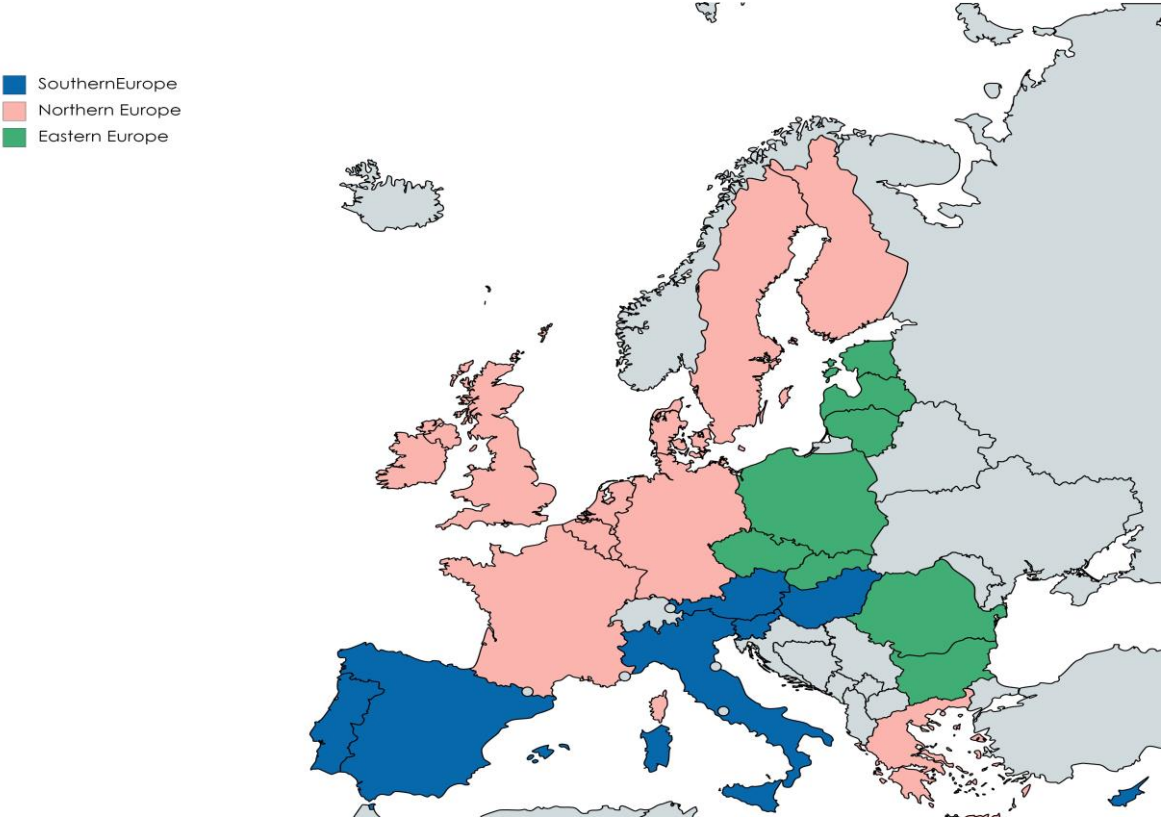
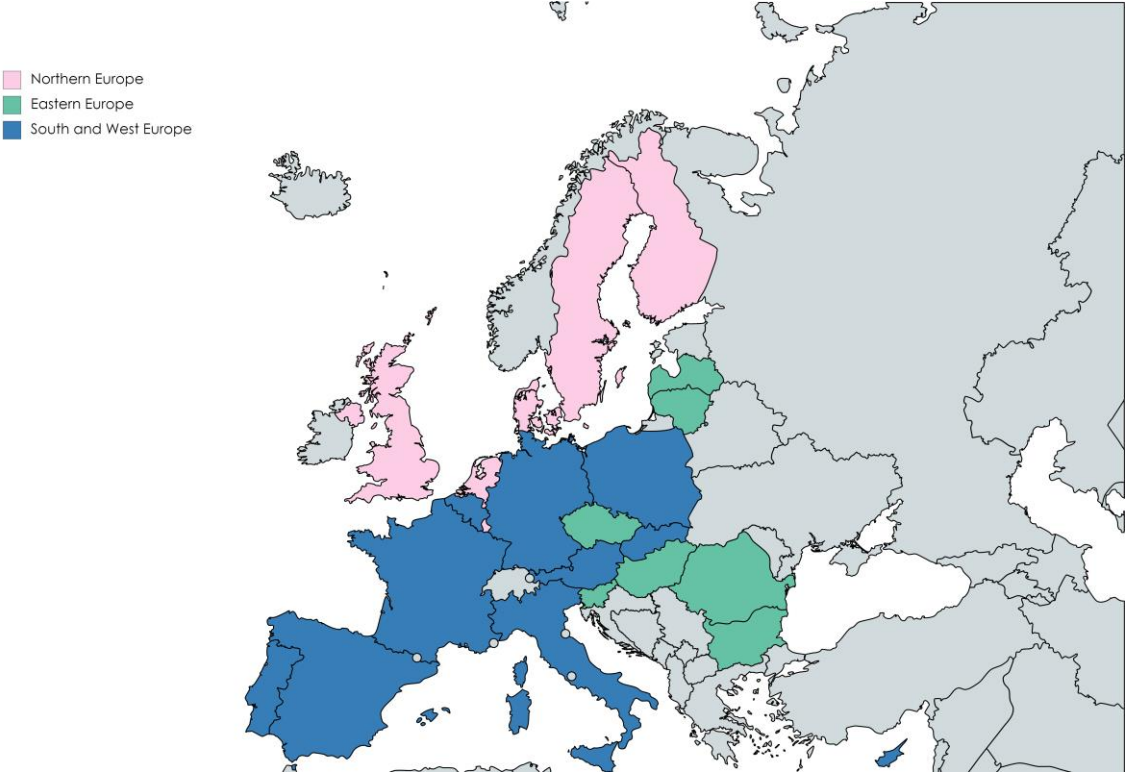


Figure 3: The Map of Clusters of the Banking Sector Ratios of the EU Countries in 2018



The foreign ownership of the banks in many countries may affect the clusters. Although some banks try to follow country-specific policies, generally the ratios are similar to the mother country ratios for foreign-owned banks. On the other hand, the results illustrated that the level of development and cooperation between countries can be a reason for the clusters of the banking sector as the similar level of developed countries is mostly clustered together with a few years' exceptions.

Southern European countries have had problems during and after the mortgage crisis started in the US and diffused in Europe. Especially Greece has faced serious difficulties in the aftermath of the crisis. There have been changes in the banking policies and mergers due to the problems, and this can be the main reason for the cluster change.

Decreasing et al. (2007) stated that geographic diversification leads to different investment strategies, as some banks are heavily invested in the new member states, while others follow a worldwide or more domestically oriented strategy. Similar to the conclusion of this study, the findings of our research could be imminent for the policymakers of the current and extended EU member and the candidate countries, suggest that being a part of the EU does not mean that all the countries show similar changes or characteristics.

From this analysis, it is well observed that transitions between clusters are not very common for countries. A homogenous structure of a single banking market is not observed and this can lead to unfair competition, especially for the developing countries' markets. Although financial integration is expected to create a market where the conditions are similar, the financial ratios of the developing countries' banks do not converge to the developed rivals. This doesn't bring advantages of the convergence even after joining the union

Based on the results of the conducted analysis, the hypothesis, despite the integration, the banking sector ratios of the EU countries show similarities among neighbor countries in cooperation could be accepted. And the hypothesis, there is a change in the clusters of banking sector ratios of countries after the crisis, is rejected according to the results of the analyzed period of the banking sector ratios. The transition between clusters is very limited and the clusters are mainly grouped by the neighboring countries which are cooperating together.

CHAPTER 4

A WAVELET COHERENCE ANALYSIS: CONTAGION IN EMERGING COUNTRIES STOCK MARKETS

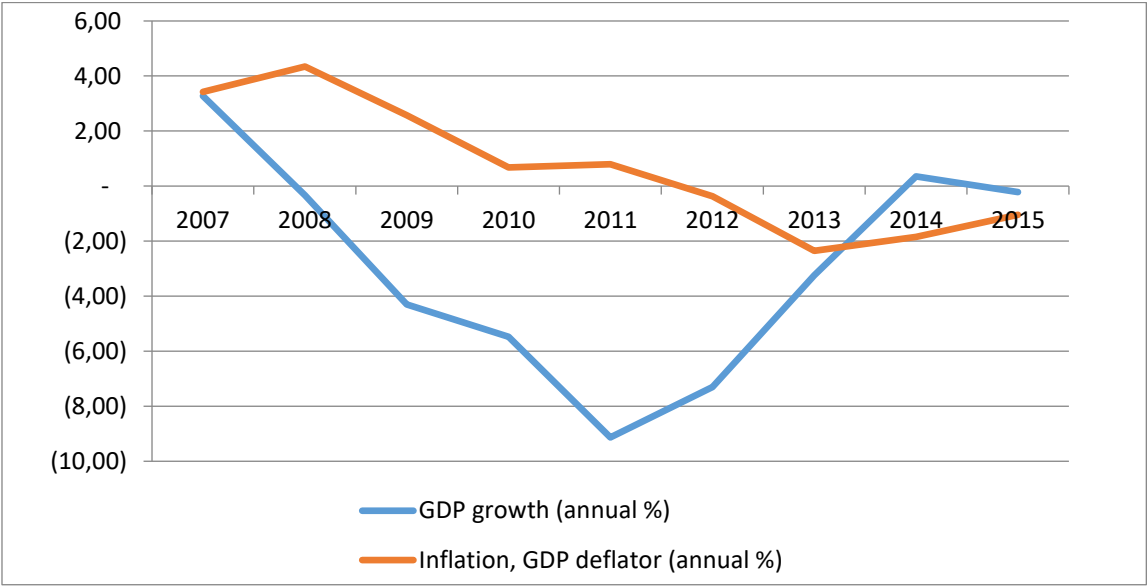
This chapter presents the research and the results of Ercan and Karahanoglu published in the paper of Ercan and Karahanoglu (2019). A novel but very promising approach, the wavelet analysis provides a single set of multiscale correlations over time. The wavelet methodology is an analysis of both the time horizon of economic decisions and the strength and direction of economic relationships between variables. These variables may differ according to the time scale of the analysis. Therefore, wavelet analysis can be a useful analytical tool in such analysis (Pinho and Madaleno, 2009).

4.1 Literature Review

Many European Union member countries have high levels of public debt, and this is unsustainable in the long term. Having the largest public debt and one of the largest budget deficits in the European Union member countries, Greece is at the epicenter of the crisis (Belkin et al. 2011). On October 16, 2009, the Greek Prime Minister George Papandreou in his first parliamentary speech disclosed the country's severe problems, and immediately after, on November 5, 2009, the Greek government revealed a revised budget deficit of 12.7% of GDP for 2009, which was the double of the previous estimate. Since then, the sovereign spreads rose sharply for most of the euro area countries, causing the biggest challenge for the European monetary union since its creation (De Santis. 2012). At the beginning of 2010, Greece risked defaulting on its public debt just because the global financial crisis during 2008 and 2009 strained public finances, and following disclosures about falsified statistical data pushed up Greece's borrowing costs.

As illustrated in Graph 15, GDP growth dramatically decreases while inflation slows down. In this graph, the annual percentage growth rate of GDP at market prices is based on constant local currency. It shows the effects of the recession over the period. Particularly in 2011, GDP growth has reached its lowest. In 2014, finally growth rate return to a very low but at least a positive value.

Graph 15: GDP Growth and Inflation in Greece after 2007



Source: World Development Indicators, World Bank 2017

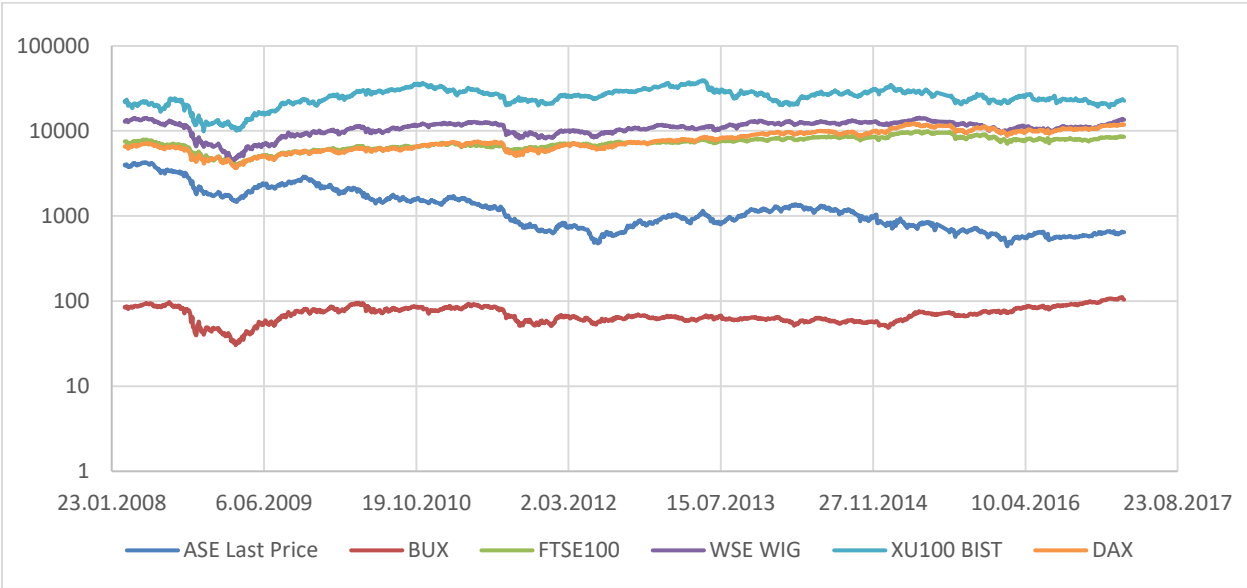
In the financial research field, the relationships between the GDP growth, CPI and Bond Market as well as the stock market was the main subject of scientific analysis. Some researchers have found the direct relation between the bond and stock market with GDP growth as well as CPI index (Stock and Watson,1989; Chordia,2003; Vassalou;2003), whereas the others are more concentrated on pair relationships between these variables (Banz, 1981; Hull et al., 2001; Beck and Levine, 2004; Huang et al., 2008; Humpe and McMillian, 2009). Moreover, the effect of one countries crisis on the bond market, as well as the stock market volatilities on other countries' macroeconomic variables, were another main theme of writers (Aghion et al., 1998; Grieco, 1997; Katzenstein, 2005). More specifically, the continent as well as the European trade and political union EU has been suffered from the long-standing crisis ongoing in relatively small economies like Greece. As those crises through the European continent have not only economic but also political results through the European continent, such effects should be analyzed carefully. Although some researcher gave tried to enlighten the effect of that crisis on the EU stock and bond market, they generally used some linear models or some intuitional analysis far from being computational which don't give us the exact or concrete facts (Kentikelenis,2011; Fetaherstone,2011; Kouretas,2010; BeirneandMarcel,2013).

Considering the previous scientific works, it is well seen and understood that GDP growth, CPI stock market, and bond markets interact very strongly. Besides, it is also shown in previous analysis that there are more and strong economic relationships between some countries, a

ground-shaking change in one would affect the other one or others directly. Because of that reason, in order to understand the Greek crisis, the effect on the EU as well as on the related economies, many analysts showed great effort.

By summing all the related analysis and reasoning as well as the deficiencies on those works together, it is realized that such an analysis could be a center of valuable scientific research. The connection between stock markets is increasing continuously. And also, the openness of stock exchange markets gets higher. Notably, in emerging countries, demand from international markets aiming portfolio diversification leads to growth in liquidity. However, this integration and co-movement are also causing the failure of portfolio diversification. The crisis started in 2007 and spread to European markets showed us diversification might be low during crises, because of the rise in the interconnection of markets during this period (Baruník and Vácha, 2013).

Graph 16: Log Scale of Stock Exchange Markets Historical Data Display



Source: Bloomberg, 2017

In Graph 16, the log scale of closing prices of ASE has been compared with the other stock exchange market closing values. ASE shows a continuous decline after 2008, whereas the other countries' markets gained some increase after the hit of the Mortgage crisis. The reason for using the log-returns is due to its comparative advantages. The resemblance of FTSE and DAX is not very surprising because of the high correlation between these indexes.

The Athens Stock Exchange general index fell below 500 points in May 2012. The decline slowdown and reached a steady pace after 2012 when Government Bonds spread against US T-bills peaked, implying that the risk premium of the country was the highest as shown in Graph 17.

Graph 17: Greece government bond spread - 10 years' historical data display



Data: Bloomberg, 2017

In the last decade, the Greece Government 10-Year Bond Yield has reached an all-time high by 38.967 on March 9, 2012, and also recorded a low of 3.21 in June of 2005. Credit default swaps (CDS) enables sellers to take on, or buyers to decrease the default risk on a bond as the pricing of CDS equals purchasing price of a buyer and demanding price from a seller, protection against the default of an issuer's debt. Therefore, the CDS spreads are displaying the market rates' creditworthiness. In the case of increased risk, the CDS spreads widen.

This part of the thesis aims to investigate the financial contagion during and after the Greek crisis to observe the impact on CESEE. Financial contagion may affect portfolio risk management, the formulation of monetary, fiscal policy, strategic asset allocation, and pricing. The primary contribution of this part to the literature is analyzing the effects of contagion among stock markets by using a different method called wavelet. This method has been used in different fields as a research technique. However, it has recently been introduced in finance. The following chapter of this research is explaining the studies in which stock market co-movements are examined. In the third chapter, the wavelet methodology is introduced. In the

fourth section, data is examined, and in the fifth section, the results of the study are provided. The last section provides us with a comprehensive conclusion of the study with a comparison of the previous research.

Since financial integration became a phenomenon, the research related to the analysis of the market movements has increased enormously. The vast research focused on this area helped the literature to provide a better explanation of the effects of the integration. The results of some studies exhibit that there is a convergence between markets and the coherence among markets can be higher, especially when the volatility more spread. However, some studies do not support this idea.

Egert and Kocenda (2007) studied some Eastern and Western Europe stock market co-movements with high-frequency data. Their research includes Czech, Hungarian, Polish, German, French, and UK stock markets and covers the years 2003, 2004, and 2005. Their findings explained that the correlations for daily stock index values are much higher than for high-frequency data.

Connolly et al. (2007) studied the US, UK, and German stock and bond markets to illustrate co-movements during high and low volatility periods. The findings of the study illustrate that coherence is greater when there is low volatility. On the other hand, stock-bond co-movements tend to be positive (negative) following low (high) implied volatility days.

Gilmore et al. (2008) investigated the co-integration in the Central and Eastern European stock markets. Their findings showed that although the co-integration is strong, the signs of convergence to Western Europe are diminishing, especially after EU accession.

Candelon et al. (2008) studied investors' interests according to the portfolio diversification point of view. They observe that the short-term investors are likely to focus on the co-movement of stock returns at higher frequencies; therefore, on short-term fluctuations, however, concentrate on the long-term investors are on the long-term fluctuations.

Morana and Beltratti (2008) investigated the stock market movements of the US, the UK, Germany, and Japan. Their findings also supported increasing co-movements between 1973 and 2004. Hanousek and Kocenda (2009) also studied Central and Eastern European stock markets. The findings of the study support the idea that Eastern European countries' stock markets are strongly influenced by developed economies.

Madaleno and Pinho (2012) employed Coherence Morlet Wavelet to investigate international stock market indices co-movements. They used data from 4 indices: FTSE100, DJIA30, Nikkei225, and Bovespa. Their findings support that coherence among indices is high but not at the same level across scales. They also mention that local events affect that market quickly, but there is a significant time delay for the impact on other market indices. Moreover, they also draw attention to the high correlation in markets that are geographically and economically closer.

The Czech stock market and the STOXX50 index have been analyzed by Gjika and Horvath (2013). The correlations between markets were observed to be higher during the recent financial crisis. Shahzad et al. (2016) support the idea that co-movement of the markets during the global financial crises shows a sudden increase, especially in the short term. Their results for the long-run dependence illustrate that European stock markets have higher interdependence with the Greece stock market.

In the literature, stock market co-movements are examined many times with various methods. The contagion effect or interconnection between markets has been increasing according to some studies, whereas some writers cannot reach the same results.

4.2 Methodology - Wavelet Coherence

The wavelet multi-scale decomposition is an important tool to explore the complex dynamics of financial time series (Bekiros and Marcellino, 2013). This part of the thesis used Wavelet Method to show if there is a certain sign for a co-movement between markets during and after the Greek Debt Crisis. Therefore, it eventually sets out the benefits or harm of integration in the financial markets by using this methodology.

A data-adaptive time-frequency analysis of nonlinear and nonstationary processes can be easily performed with a wavelet. Wavelet coherence exhibits common time-varying patterns of two different signals throughout the observed period. The wavelet method has some superiority regarding its use in non-stationary time series. Moreover, the co-movement of time series can be shown in a single graph while the frequency or period is different. While the wavelet technique as a dynamic method displays the relationship, which has evolved, the other methodologies are more static. On the other hand, the other methodologies that are used to compare time series have some limitations with the distribution and the results provided with these methodologies are not as identifying as wavelet technique. Since the markets makers may

operate on different time horizons, and therefore take positions dissimilarly depending on their various time preferences (daily, weekly, and monthly), the “wavelet” decomposition into sub-time series and their localization of the interdependence between time series becomes the most suitable econometric technique to study the co-movement of stock markets (Aloui and Hkiri, 2014).

Pearson's correlation coefficient (a linear correlation) is one of the most preferred methods to measure stock market co-movements. As an asymmetric, linear dependence metric (Ling and Dhesi, 2010), it is convenient for measurement of dependence when there is a normal distribution (Embrechts et al., 1999). On the other hand, the correlations between time series can be nonlinear or time-varying (Xiao and Dhesi, 2010). Moreover, the dependence between stock markets in bull market conditions can be different from the dependence of a market in bear market conditions (Necula, 2010).

As we also presented in Harun et al. (2021) various types of wavelet techniques were used in different scientific areas due to their applicability for nonstationary processes. For example, it was also used in financial analyses when papers focused on relation of interest rates and exchange rates (Hamrita – Trifi 2011), the relation of interest rates and stock exchange returns (Moya-Martínez et al. 2020), or the association between mortgage and GDP in Spain (González et al. 2012). The methodology was also applied for analyzing stock market returns, the relation of commodity prices, or indexes (E.g. Reboredo et al. 2017; Pal – Mitra 2017; Jiang – Yoon Min 2020). Due to possible problems of non-stationarity, the use of wavelets is beneficial in analyzing financial data where frequency behavior changes within time. The wavelet coherence analysis is a robust method for both stationary and non-stationary data when time series are influencing each other. The phase of the wavelet cross-spectrum can be used to identify the relative lag between the two-time series (Mathworks 2020), and we can uncover possible interactions without losing the time information. However, as a limitation, it is usually mentioned that the result is difficult to be quantified due to the complexity of resulted patterns if the ground truth is unknown. (Zhao et al. 2018). In our analysis Wavelet Coherence Analysis is applied to see the coherence between conventional banking interest rates and participation rates.

In the literature, there are various methods to measure the level of stock market co-movements: correlation coefficients (e.g. Longin and Solnik, 1995; Koedijk et al., 2002), Vector Autoregressive (VAR) models (Gilmore and McManus, 2002; Malliaris and Urrutia, 1992),

cointegration analysis (Patev et al., 2006; Gerrits and Yuce, 1999), GARCH models (Tse and Tsui, 2002; Bae et al., 2003; Cho and Parhizgari, 2008) and regime-switching models (Garcia and Tsafack, 2009; Schwender, 2010). None of the studies have been used to examine time-scale co-movements between CEE and developed stock market returns in such an explanatory method.

All in all, the use of wavelet analysis brings some advantages to detect seasonal and cyclical patterns, structural breaks, trend analyses, fractal structures, and multiresolution analyses. Wavelet analysis measures the relationship between volatilities, and spillover, which indicates the lead-lag relationship. And finally, the wavelet technique allows the reader to observe changes in the correlation throughout the period (Crowley, 2005).

4.2.1 Wavelet

To analyze the contagion after the Greek crisis, the co-movements of six stock exchange markets have been studied for an 8-year term. For this study between countries' time series, a bivariate wavelet technique called wavelet coherence is employed, and the Matlab 2016a wavelet tool is used for the analysis. Daily closing prices of stock market indices of six countries, Greece (ASE), UK (FTSE100), Germany (DAX), Hungary (BUX), Poland (WIG), and Turkey (BIST100) are used in this analysis between 06. March.2009 and 28. Feb.2017.

Wavelet Coherence is a very advantageous technique when the co-movement between two-time series is studied (Grinsted et al., 2004). In this research, continuous wavelet analysis tools are used, mainly wavelet coherence, to measure the degree of local correlation between time series in the time-frequency domain and wavelet coherence phase differences. To provide a better explanation for the wavelet coherence analysis, wavelet a real-valued square-integrable function, $\psi \in L^2 (R)^1$, is defined as;

$$\psi_{uj}(t) = \frac{1}{\sqrt{j}} \psi \frac{t-u}{j} \quad (1)$$

$\frac{1}{\sqrt{j}}$ in this equation implies a normalization factor providing a unit variance of the wavelet ($\| \psi \|^2 = 1$). U and j are the control parameters in the equations, where u is a location parameter, and j is a scale parameter. Defining how the wavelet is stretched, the scale has an inversed relation to frequency. Therefore, a lower scale causes a more compressed wavelet, which can

be seen as higher frequencies of a time series. The admissibility condition needs to be satisfied. The admissibility condition ensures reconstruction of a time series from its wavelet transform.

$$C_{\psi} = \int_0^{\infty} \frac{|\Psi(f)|^2}{f} df < \infty \quad (2)$$

The condition in the second equation implies that the wavelet does not have a zero-frequency component, and so the wavelet has zero mean.

4.2.2 The continuous wavelet transform

$W_x(u, j)$ can be obtained as shown in the equation (3) with the projection of a specific wavelet $\psi(\cdot)$ onto the examined time series $x(t) \in L^2(R)^1$, i.e.,

$$W_x(u, j) = \int_{-\infty}^{\infty} x(t) \frac{1}{\sqrt{s}} \psi\left(\frac{t-u}{j}\right) dt \quad (3)$$

It is eminent that the continuous wavelet transform can decompose and then subsequently perfectly reconstruct a time series.

$$x(t) = \frac{1}{C_{\psi}} \int_0^{\infty} \left[\int_{-\infty}^{\infty} W_x(u, j) \psi_{u,j}(t) du \right] \frac{dj}{j^2} \quad s>0 \quad (4)$$

Moreover, this transform allows information about the time and frequency of the original series. This transformation measures the size of the local correlation between time series. Equation (4) ensures the possibility of recovering $x(t)$ from its wavelet.

$$\|x\|^2 = \frac{1}{C_{\psi}} \int_0^{\infty} \left[\int_{-\infty}^{\infty} |W_x(u, j)| du \right] \frac{dj}{j^2} \quad (5)$$

4.2.3 The Wavelet Coherence

Definition of the cross wavelet power of two-time series $x(t)$ and $y(t)$ is as follows:

$$W_{xy}(u, j) = W_x(u, j) \cdot W_y^*(u, j) \quad (6)$$

In this formula, $W_x(u, s)$ and $W_y(u, s)$ represent continuous wavelet transforms of time series $x(t)$ and $y(t)$. The star (*) signifies a complex conjugate, parameter u allocates a time position, and parameter j symbolizes the scale parameter. A low wavelet scale denotes the high-frequency part of the time series—a short investment horizon (Torrence and Webster, 1999)

Whenever the time series exhibit a high common power, the cross-wavelet power reveals areas in the time-frequency space. In the co-movement analysis, we search for areas where the two-time series in the time-frequency space co-movement, but do not necessarily have high power. A useful wavelet technique for finding these co-movements is wavelet coherence.

Torrence and Webster (1999) defines the squared wavelet coherence coefficient as

$$R^2(u, j) = \frac{|S(j^{-1}W_{xy}(u, j))|^2}{S[j^{-1}(W_x(u, j))^2]S[j^{-1}(W_y(u, j))^2]} \quad (7)$$

In this formula, S represents a smoothing operator. The coefficient $R^2(u, j)$ lies in the interval $[0, 1]$. When there is a low correlation, the R^2 becomes closer to zero, whereas a stronger correlation is shown with the values closer to one. Therefore, R^2 explains the local linear correlation between two stationary time series at each scale and is analogous to the squared correlation coefficient in linear regression. The following formula is showing the phase differences according to Torrence and Webster (1999) definition:

$$\theta_{xy}(u, j) = \tan^{-1}\left(\frac{\Im\{S(j^{-1}W_{xy}(u, j))\}}{\Re\{S(j^{-1}W_{xy}(u, j))\}}\right) \quad (8)$$

\mathcal{F} is an imaginary and \Re is a real part operator in this formulation. Black arrows in the wavelet coherence figures with significant coherence display the Phase differences. Once the two analyzed time series move together on a particular scale, the arrows direct to the right showing the positive correlation. On the other hand, if the correlation is negative between time series, then the arrows lead to the left. Then the arrows point to the left.

4.3 Data and Statistical Issues

This study investigates the financial contagion because it may harm the global economy about portfolio risk management, the formulation of monetary and fiscal policy, and strategic asset allocation and pricing. This chapter aims to show if there is a certain sign for a co-movement between markets during and after the Greek Debt Crisis. To analyze the contagion during and after the Greek Debt Crisis, the co-movements of six stock exchange markets have been examined for an eight-year term. Daily closing prices measured in domestic currencies of stock market indices, ASE, BIST100, WIG, FTSE100, DAX, and BUX are used in this analysis between 06. March.2009 and 28. Feb.2017. Stock price data is provided by Bloomberg.

For the consistency of the data, some exclusions have been implied. Differences caused by the different trading days and holidays in countries resulted that some days have to be excluded.

However, 1981 days' data were suitable for this analysis. This part of the thesis used EUR values of the stock exchange markets to avoid the imbalances that occurred by depreciation or appreciation of the currencies during the term in the non-Euro zone. Description of the data is conducted by the following tables employing statistics analysis.

Table 3: Descriptive statistics

	N	Mean	Median	Std. Deviation	Variance	Skewness	Kurtosis	Min.	Max.
ASE	1981	1,325.4	1,047.2	817.8	668,747.3	1.6	2.3	440.9	4,276.6
BUX	1981	70.5	67.3	14.9	220.7	0.1	(0.3)	30.4	111.6
FTSE100	1981	7,187.8	7,274.0	1,201.9	1,444,650.0	(0.3)	(0.1)	3,872.3	9,929.4
WSE WIG	1981	10,843.1	11,123.9	1,900.0	3,610,027.0	(1.0)	1.0	4,336.6	14,300.2
XU100 BIST	1981	25,236.2	25,600.2	5,528.2	30,561,434.0	(0.4)	0.3	9,899.6	39,279.0
DAX	1981	7,819.5	7,291.2	2,088.4	4,361,313.0	0.2	(1.1)	3,666.4	12,231.3

Source: Author's own

Descriptive statistics of the data enable us to see the high volatility during the studied term. Because of the differences in the index values of the markets, the comparison of the standard deviation and min-max values of the data is not meaningful. Therefore, it is convenient to check the coefficient of variation (CV), which is known as the relative standard deviation (RSD). In the table above the highest Standard Deviation / Mean ratio belongs to Greece by a large margin. It is approximately 61.7%, whereas the other markets have this ratio of around 20% or even less. This is a good illustration to show big fluctuations which have occurred in the 8 years.

Table 4: Correlation Matrix

	ASE	BUX	FTSE100	WSEWIG	XU100BIST
ASE	1				
BUX	0.1618	1			
FTSE100	-0.4473	0.24	1		
WSEWIG	-0.0352	0.484	0.8074	1	
XU100BIST	-0.3196	0.1974	0.4615	0.5548	1
DAX	-0.5383	0.2829	0.9348	0.6811	0.2964

Source: Author's own

Table 4 shows us the correlation of the stock exchange market. As we can see, DAX and FTSE100 indices are highly correlated. WIG is also highly correlated with FTSE and therefore with DAX. The correlation between the Athens Stock Exchange and other markets is negative except the Budapest Stock Exchange. This table gives us hints about the relations among the markets. But it doesn't enable us to observe if there is an increase in the correlation.

4.4 Results and Discussion

The following figures in the graph set are showing the wavelet coherence between the stock market indices of Greece and other countries. Arrows indicate the phase difference, and it enables us to understand the details about delays of oscillation of the two examined time series. In figures, arrows have different meanings. Primarily, it shows that there is a correlation between the time series. But to understand the relation more in detail, the direction of the arrow should be observed. For the positive correlation between series, Matlab uses the arrows to point to the right. On the other hand, arrows are directed to the left when there is a negative correlation, and the time series are anti-phase. And finally, the arrows are pointing up to show that the first time series leads the second one, an arrow pointing down indicates that the second time series leads the first one.

The figures are arranged to show the data regarding periods rather than frequency because it is more suitable for our research. 0.75 Magnitude Squared Coherence is used for the analysis. Wavelet coherence values close to one indicate high correlation (denoted by warm color in the figures), while values close to zero (white color in the figures) indicate low or no correlation. The areas where the wavelet coherence is significant are bordered with a dashed white contour.

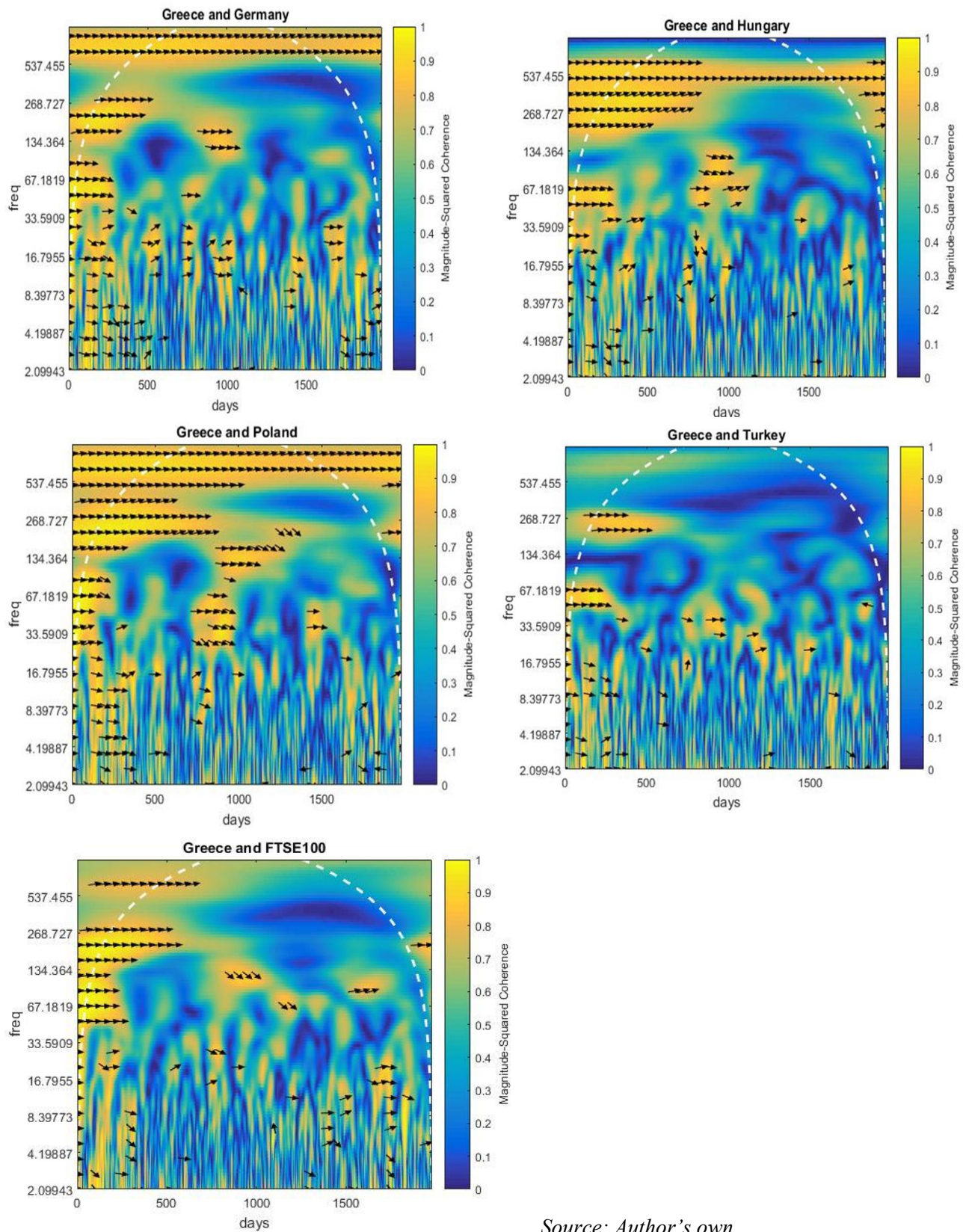
The squared wavelet coherence coefficient can be regarded as a local linear correlation measure between two-time series in the time-frequency space.

In this analysis, due to the limitations of the same working days in the markets, every year has approximately 250 observations. Therefore, the "500 days" period in the graph indicates the two years. As observed from the graphs, ASE and other stock exchange markets coherence under the condition of 0.75 Magnitude Squared seemed to be weak. This magnitude level is relatively very high and ignores the weak correlations. For this reason, warm colors in the graphs are very limited, especially after two years.

In 2009 and 2010, coherence is relatively high, and there is a positive correlation between ASE and all markets because the arrows are towards the right. But there is no dominant leading effect of any series. However, although there is coherence, especially in the first year, later coherence disappears.

There is a high coherence during 2012 (see the coherence around 1000th day in the Graph set). ASE has coherence BUX, DAX, and WIG on this period again. But as the observations suggest, the coherence is diminishing, especially after the first hit of the Mortgage crisis in Europe starting from 2009 till the end of 2010. Especially, the correlation of Eastern European stock markets and ASE has shown a decrease after 2012, when the government bond spreads reached the peak point. It is also surprising that FTSE100 and BIST100 have a very weak correlation with the Athens Stock Exchange Market data.

Graph 18: Graph of Wavelets



Source: Author's own

4.5 Conclusion

This chapter of the thesis aims to analyze the impact of integration on CESEE markets, especially during crises and high volatility periods. Moreover, this analysis allows the reader to see the relationship between financial integration and economic volatility. Finally, this part of the thesis illustrates the effects of financial integration during crises in Eastern European countries and compares them with the non-crisis periods.

For this analysis between six countries' time series, a bivariate wavelet technique called wavelet coherence is employed. The area under the white arc of the Wavelet Coherence graphics shows significant movements. While warmer colors imply higher coherence, blue is showing no correlation. The arrows show the lag between indices.

This analysis contributes to the literature by observing the leverage effect, similar to the findings of Baruník and Vácha (2013), Gjika and Horvath (2013), and many others. This study supports the idea that during the crisis period, diversification is low in European markets, because of the increase in the interconnection of markets during this period. It can be concluded as the presence of negative effects of integration for selective countries in the form of contagion in the EU.

This chapter supports the previous studies in the literature by using a different mean of calculation. As wavelet coherence tool results in Graph 18 show that at the beginning of 2009 and during 2012, coherence is high between the markets, whereas when the severity of crises slowed down coherence is diminished. Also, in the last year period, there is a visible high coherence between FTSE and ASE. This high positive correlation appeared after mid-2016 when the UK voted for Brexit, which also caused sanctions in the stock markets. Istanbul Stock Exchange market showed no coherence at almost any time. This is a sign of high interconnection of the markets within the EU. As a non-member of the union Turkish Stock Exchange did not show co-movements. It can be observed that unlike high volatility times, during non-crisis periods in other words when there is low volatility in the markets, the impact or interactions among markets are limited.

Employing wavelet analysis enables the detection of seasonal and cyclical patterns, structural breaks, trend analyses, fractal structures, and multiresolution analyses in a graph. This methodology also allows the reader to identify the relationship between volatilities, and

spillover, which indicates the lead-lag relationship, and observe changes in the correlation throughout the period.

By employing the wavelet theory, this research has aimed to explain the leverage effect among stock exchange markets during the Greek debt crisis. The wavelet method has been used in many fields to illustrate the coherence between two elements. However, using wavelet theory to explain the co-movements of time series with financial data is relatively new. Especially the explanation of the leverage effect between low and high volatility period is introduced in the literature with this analysis.

All in all, the results of this study exhibit that during a crisis an increased integration in the financial markets rises the risk spread from other countries. And also, positive signs in an economy do not affect other economies as well as negative movements. Therefore, the gains from integration have been observed to be less than the downturns. This can be called a leverage effect which means the negative movement in volatility is stronger than the positive one. These results are valid only for the observed period and observed variables in studied stock exchange markets. Therefore, for the analyzed period and countries in CESEE, financial integration is observed to be more disruptive than beneficial.

According to the results presented above, we can conclude that the hypotheses, impact of integration is stronger especially during crises and high volatility periods and, there are observable negative effects of integration for selected countries in the form of contagion in the integrated region could not be rejected. Due to the fact that the coherence among markets is higher when the volatility is high, whereas the stock markets are not highly correlated during good times.

For further analysis, different time periods and events may be selected to improve the results. As the technique is very useful to analyze the time series, it can be very useful to use wavelet to explain various relationships and co-movements of time series in finance.

CHAPTER 5

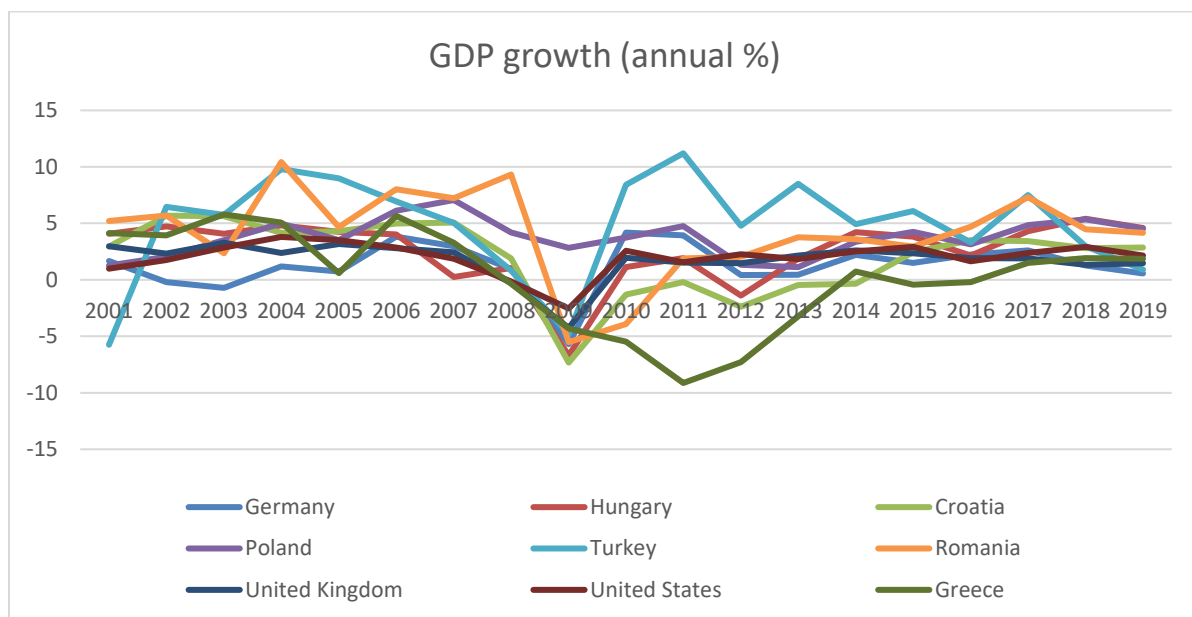
VOLATILITY SPILLOVER EFFECTS ON THE CENTRAL AND SOUTHEASTERN EUROPEAN STOCK MARKETS FROM THE US AND THE UK

This research focuses on providing a detailed summary of financial integration between Central, Eastern, and South-Eastern European countries with advanced economies. The chapter aims to shed further light on the impact of time-varying volatilities, as well as potential market shocks and spillover effects coming from Germany, the UK, and the US equity markets, which is based on several reasons.

5.1 Literature Review

As Graph 19 illustrates the annual percentage growth rate of GDP at market prices based on constant local currency in the last two decades. GDP is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products (Kumar and Kattookaran., 2016). Calculations are based on constant 2010 US dollars. Except for the crisis in 2001 in Turkey, there is a significant growth in all economies until 2008. As it can be observed from the graph, recovery was easier in developed economies, whereas emerging markets continue to struggle. With exceptions, the GDP growth rates followed a similar path in all economies analyzed in this analysis.

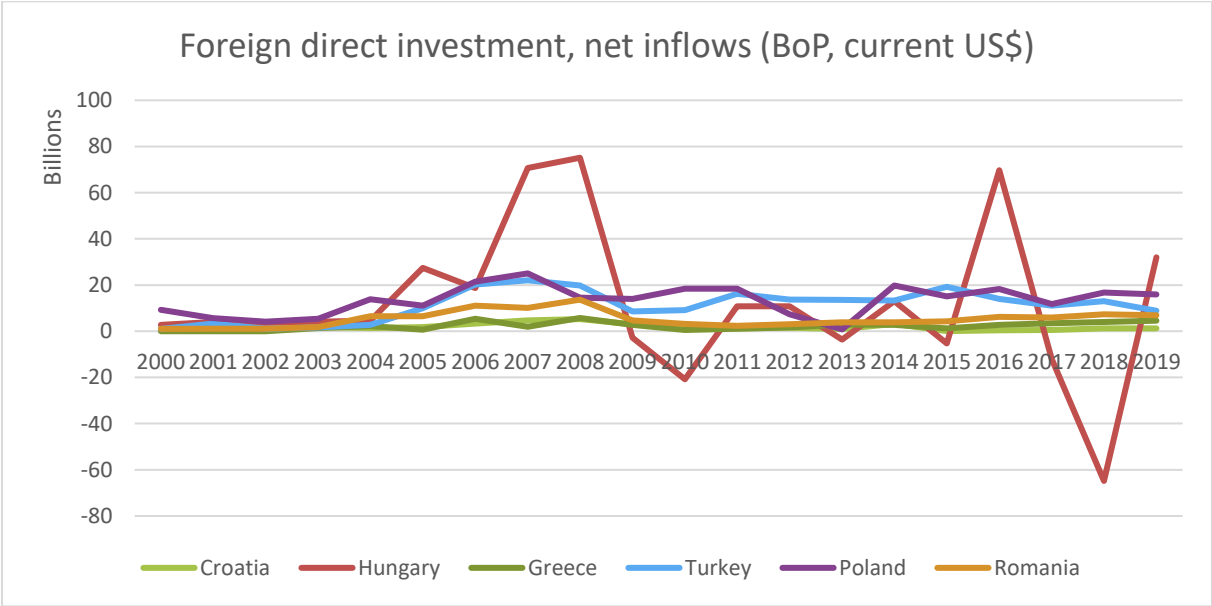
Graph 19: GDP Growth



Source: World Bank national accounts data

According to Bubbico et al. (2017), investment in Central and Eastern Europe has increased, yet it is more volatile than in the last twenty years. The financial crisis in these years caused a slow capital flow and hence lowered growth rates. The countries in this region traditionally foreign capital inflows to finance investments and continue their growth. The crisis in 2008 caused a substantial slowdown of net private capital inflows.

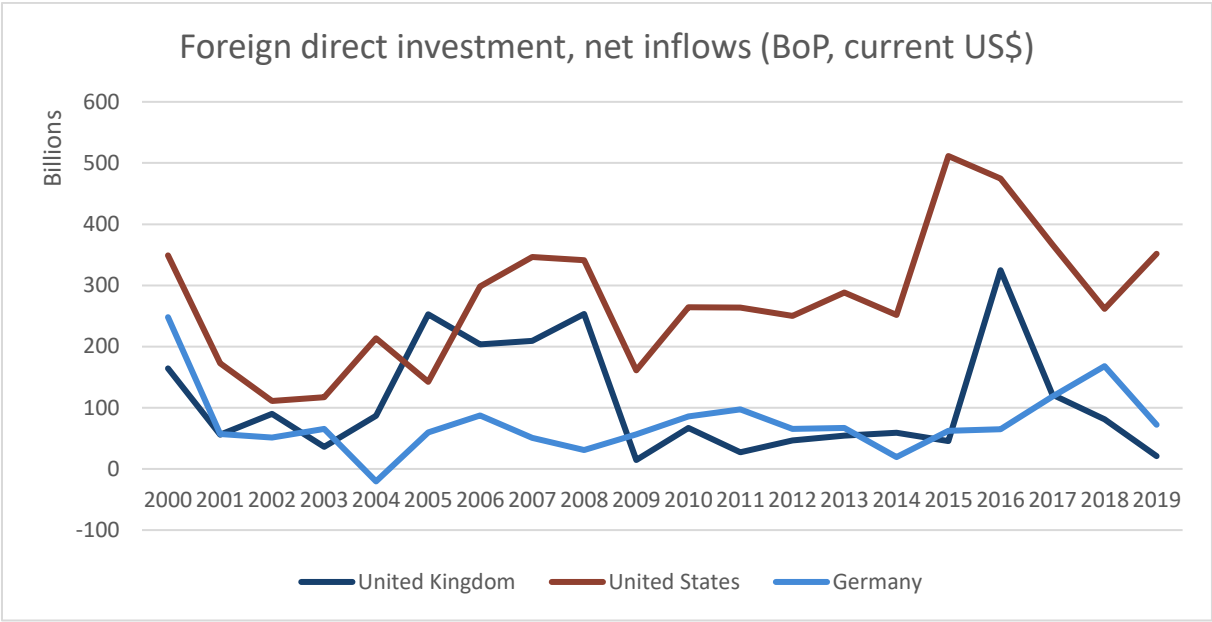
Graph 20: FDI (CESEE, bn \$)



Source: World Bank national accounts data (2020)

The 20th graph illustrates the foreign direct investment in 6 countries over the last two decades. Before the hit of the crisis, countries in Central and South-East Europe, especially EU members, received significant capital inflows. Flowing capital allowed economies to increase consumption and sustain investment; this led exports to increase. Although Croatia and Romania follow a similar path, while Turkey has been performing slightly better due to political and economic reasons after the domestic banking crisis in 2001. On the other hand, the Hungarian economy has been invested significantly between 2006 and 2008 and in 2015. However, there is a dramatic decline in 2009 and 2016-2017. As we can observe from Graph 21st, although net inflows of FDI in the US and the UK are stable, the investments into Europe and Central Asia are more volatile in comparison. Hungarian economy inflows seemed to very similar to the rest of Europe and Central Asia in the analyzed period. This similarity is a signal of the impact of high integration of the markets. Hungarian economy seemed more fragile for FDI's when we compare with the other economies in the region.

Graph 21: FDI (Other, bn \$)



Source: World Bank national accounts data (2020)

The following part of this study summarizes the previous literature related to this topic. 3rd part explains the data and model used in the analysis, and the 4th part elaborates the findings of the study. The last section explains the hedging strategies and provides a conclusion.

Autoregressive Conditional Heteroscedasticity (ARCH) model and the Generalized ARCH (GARCH) models are used to describe the time-varying variances of economic data in the univariate case. Engle (1982) illustrated that the typical characteristics of financial time series could be modeled, using an autoregressive conditional heteroscedasticity (ARCH) model. Later, Bollerslev (1986) extended by a generalized version (GARCH). To capture the simultaneous volatility clustering and to gain essential insights into the co-movement of financial time series, univariate GARCH models have been extended to the multivariate case.

Bollerslev (1990) examined the changing variance structure of the exchange rate regime in the European Monetary System. There was an assumption of the time-invariant correlation. To find the optimal debt portfolio in multiple currencies, Kroner and Claessens (1991) employed mGARCH. Lien and Luo (1994) explained the multi-period hedge ratios of currency futures with mGARCH. Karolyi (1995) also studied the international transmission of stock returns and volatility with mGARCH.

Yang et al. (2004) analyzed the US, Japanese, and ten Asian emerging stock markets' long-run relationships and short-run dynamic causal linkages, with a focus on the 1997-1998 Asian financial crisis. Their findings support that in Asia during crisis markets are more co-integrated.

Guidi and Ugur (2013) analyzed the integration of stock markets of South-East Europe (SEE) during the 2000s. They employed various methodologies to show that that SEE markets might be affected by external shocks. The results of the analysis prove that the correlations of UK and US equity markets with South-East Europe market change over time. They also explained that hedging benefits from diversification are still possible.

Mighri and Mansouri (2014) analyzed stock exchange index returns by the DCC-mGARCH model and searched for the contagion effects between the US and major developed and emerging markets. Their analysis between 2007, and 2010 proved that contagion is increased during the crisis period.

Guidi and Ugur (2014) analyzed the stock markets of Bulgaria, Croatia, Romania, Slovenia, and Turkey. They employed a static co-integration to analyze the existence of time-varying co-integration with their developed counterparts in Germany, the UK, and the USA. Their findings illustrate the possibility of portfolio diversification. However, there is an increasing co-integration during financial crises.

Carnero and Eratalay (2014) analyzed the performances of GARCH models. The results of the study show that when the distribution of the errors is Gaussian, it is preferred to estimate the parameters in multiple steps. Mensi et al. (2014) examined the spillover effect between BRICS and the US stock markets. Between 1997 and 2013, they employed the DCC-FIAPARCH model to capture the volatility spillovers and detect potential structural breaks and assess the portfolio risks. They found that except Russia, the other countries are heavily affected by the global financial crisis.

Syriopoulos et al. (2015) studied the stock markets of BRICS and the US to model the spillover effects and time-varying correlations. They employed bivariate VAR (1)-GARCH (1,1). They identified significant return and volatility between US and BRICS stock markets using a constant conditional correlation-GARCH model. They differentiated the industrial sector and financial sector in their analysis. Rejeb and Boughrara (2015) studied the volatility relationship between markets during crises and normal times by the VAR model. They found a spillover effect across markets, and their findings support the idea that financial liberalization increases the risk of contagion.

Bala and Takimoto (2017) compared to stock returns volatility spillovers between emerging and developed markets (DMs). They employed multivariate-GARCH (mGARCH) models and variants to investigate the impact of the global financial crisis (2007-2009) on stock market volatility interactions. The results of the study support the idea that correlations, which increase during financial crises among emerging markets (EMs) are lower than the correlation correlations among DMs. It was detected that own-volatility spillovers are higher than cross-volatility spillovers for EMs. It was suggested that shocks had not been substantially transmitted among EMs compared to DMs.

Buriev et al. (2017) analyzed investment opportunities for Turkish investors MENA countries exposed to the Arab spring from 2005 to 2015. The findings based on MGARCH-DCC and Wavelet techniques suggest that the Turkish investors shall not invest in Egypt but may have moderate benefits from Lebanon up to the investment horizons of 32 – 64 days and longer.

Joyo and Lefen (2019) studied the co-movements and the portfolio diversification of some developed and developing countries. They employed DCC-GARCH to analyze the time-varying correlation and volatilities of the stock markets of Pakistan and its top trading partners, China, Indonesia, Malaysia, the United Kingdom, and the United States. Their findings support that integration is high between the stock markets of Pakistan and its trading partners, especially during the financial crisis of 2008. On the other hand, the integration among stock markets slowed down after the crisis period. Furthermore, the results showed the slow decay process. Therefore, it is a positive sign for Pakistani and international investors to diversify their portfolios among the stock markets of Pakistan and its trading partners.

Instead of using the CCC model for real-life time series Engle (2002) and Tse and Tsui (2002) suggested a more dynamic and time-variant correlation estimate. As a result, the authors introduced two new models: the 'Dynamic conditional correlation multivariate generalized autoregressive conditional heteroskedasticity (DCC-mGARCH)' and the 'Varying conditional correlation multivariate generalized autoregressive conditional heteroskedasticity (VCC-mGARCH)'.

Using this technique, the volatilities and correlations between asset returns that shift over time can be analyzed especially when the correlation process is independent of the number of series that are to be estimated, which renders in a large computational advantage when estimating large covariance matrices. Moreover, the DCC-mGARCH is superior to other models when there are structural breaks among variables Therefore, in this part of the thesis, a DCC-

mGARCH model is employed on the same countries' stock exchange data to provide a comparison between the results of the previous section.

5.2 Data and Methodology

Engle's article (1982) was an important step in the estimation of time-varying conditional variance models. Engle (1982) proposed modeling of conditional error variance as follows

$$E(\varepsilon_t^2 | \Omega_{t-1}) = \sigma_t^2 = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 \quad (1)$$

Here, Ω_{t-1} denotes the information set at a moment of t-1 and σ_t^2 denotes the conditional variance of error terms.

$$\sigma_t^2 = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 \sigma_{t-1}^2 \quad (2)$$

The model above is known as the Generalized Autoregressive Conditional Heteroscedasticity Model (GARCH) model is developed by Bollerslev (1986). Since only the lag levels of the previous period are used for error values and volatility values in this model, it can be called GARCH(1,1). A general GARCH model is written as GARCH (p,q) and can be presented as follows:

$$\sigma_t^2 = \alpha_0 + \sum_{i=1}^p \alpha_i \varepsilon_{t-i}^2 + \sum_{i=1}^q \beta_i \sigma_{t-i}^2 \quad (3)$$

Finally, we will examine the long-term reactions among the time-varying return volatility of various variables. Such models are called Multivariate GARCH. With the help of this model, the risk relations of various financial variables at certain periods can be tested. This model is presented as follows;

$$\mathbf{y}_t = \Lambda + \Phi \mathbf{y}_{t-1} + \varepsilon_t \quad (4)$$

Here, \mathbf{y}_t denotes a time series vector of $N \times 1$, ε_t stands for an error term vector of $N \times 1$, and Λ and Φ show $N \times N$ coefficient matrices. In this case, the conditional variance of the error terms can be shown as follows:

$$\text{Var}(\varepsilon_t | I_t) = \mathbf{H}_t \quad (5)$$

In the equation above, \mathbf{H}_t denotes conditional variable variance, which is an $N \times N$ variable variance-covariance matrix. The problem with such models is that \mathbf{H} is positive definite. There are certain suggestions about the realization of such models. One of these belongs to Baba,

Engle, Kraft, and Kroner (1990). Another method is suggested by Bollerslev (1990), and this method is used in his work. According to this method, two volatility values are variable in time, but the correlation coefficient between these is assumed to be constant.

For example, let h_{iit} show the h_{ijt} value of the matrix H_t at the time of t . The value of the conditional variance between i and j does not vary in time.

Mathematically, this condition is shown as;

$$h_{ijt} = \rho_{ij} (h_{iit} h_{jjt})^{\frac{1}{2}} \quad (6)$$

where, $j=1,2,\dots,N$; $i=j+1,\dots,N$

This provides a simplification of the model. So, the matrix H can be diagonalized and written as;

$$H_t = D_t \Gamma D_t \quad (7)$$

Here, D_t and Γ values are the parameters that are obtained by diagonalization of the volatility matrix, H . By using these findings; the maximum likelihood function can be written as follows:

$$L(\theta) = -\frac{TN}{2} \log(2\pi) - \frac{1}{2} \sum_{i=1}^T \log |D_t \Gamma D_t| - \frac{1}{2} \sum_{i=1}^T \varepsilon_i' (D_t \Gamma D_t)^{-1} \varepsilon_i \quad (8)$$

$\hat{\rho}$, an estimator of the long-term autocorrelation coefficients of the observed series is obtained as follows;

$$\rho_{ij} = \frac{\sum_{t=1}^T \varepsilon_{it} \varepsilon_{jt}}{\left(\sum_{t=1}^T \varepsilon_{it}^2 \right)^{\frac{1}{2}} \left(\sum_{t=1}^T \varepsilon_{jt}^2 \right)^{\frac{1}{2}}} \quad (9)$$

Required parameters can be estimated by the maximization of the non-linear function in the above equation. Here, one of the important parameters is the value of the correlation coefficients, since ρ gives the relationship between the long-run risk structures of the financial assets. Previous studies on this subject were used in determining the changing risk relations between various foreign currencies and in examining the interactions of regional stock markets.

The vector autoregressive stochastic process of the returns can be presented in the following form (Karunanayake et al., 2009):

$$r_{iit} = \mu_{0i} + \sum_{j=1}^n \mu_{ij} r_{ijt-1} + \varepsilon_{it} , \quad (10)$$

Where

μ_{0i} is the intercept, μ_{ij} represents the conditional mean of stock return, that is, the influence from the past return of asset i (on-mean spillover) while $i=j$, or is the influence from past returns of asset j towards asset i (cross-mean spillover from asset j to asset i) while $i \neq j$; and ε_{it} is own innovations (shocks) of asset i.

Then, the conditional variance-covariance matrix H has n dimensions (where n is the number of assets analyzed) with diagonal elements representing the variance and non-diagonal elements – the covariance:

$$H_t = \begin{pmatrix} h_{11} & h_{12} & h_{13} \\ h_{21} & h_{22} & h_{23} \\ h_{31} & h_{32} & h_{33} \\ \dots & & \\ h_n & h_n & h_n \end{pmatrix} \quad (11)$$

Engle (2002) developed the DCC-GARCH model to addresses the time-varying volatilities and correlational among the assets. This model is based on Gaussian distribution, which might be inefficient for heavy-tailed distribution. Bollerslev et al. (1992) imply that GARCH(1,1) is to be sufficient to yield efficient and significant results. Hansen and Lunde (2005) supported the idea that it is difficult to outperform the simple GARCH(1,1) model.

One of the most common models used in GARCH is the GARCH(1,1):

$$\sigma_t^2 = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \alpha_2 \sigma_{t-1}^2 \quad (12)$$

The equation above explains that it is possible to interpret the currently fitted variance, σ_t^2 , as a weighted function of a long term average value, which is dependent on α_0 , the volatility information during the previous period ($\alpha_1 \cdot \varepsilon_{t-1}^2$), and the fitted variance from the model during the first lag ($\alpha_2 \cdot \sigma_{t-1}^2$). Furthermore, the parameters in this model should satisfy $\alpha_0 > 0$, $\alpha_1 > 1$, and $\alpha_2 \geq 0$ in order for σ_t^2 to be ≥ 0 .

5.2.1 Descriptive Statistics

In this study, Athens Stock Exchange (ASE), WIG (Warsaw Stock Exchange), German Stock Exchange (DAX), Bucharest Stock Exchange Trading Index (BETI), Budapest SE Index (BUX), Zagreb Crobex (CRBEX), Dow Jones Index (DJI), Financial Times Stock Exchange

(FTSE) and Istanbul ISE National 100 (XU100) are examined for the period from 2000 and 2019. Because of the national holidays, the data is limited with 3695 dates when all the markets were open. US dollar values of indices are used to avoid fluctuations, especially in emerging markets.

In table 5, the correlation between stock exchange market daily returns is presented. The correlation among the selected country stock markets is positive; it illustrates that stock markets move in the same direction. On the other hand, the correlation among the stock returns is in the range from 0.21 to 0.57, which is below 0.80 showing low co-movements and absence of multi-collinearity (Vo and Ellis, 2017). FTSE is more correlated with the stock markets in this study when it is compared to DJI. The correlation between DJI and BETI stock returns is the lowest, while the correlation between DJI and FTSE is the highest. It indicates that the correlation between developed countries is higher, while the correlation between emerging and developed countries is lower.

Table 5: Correlation Table

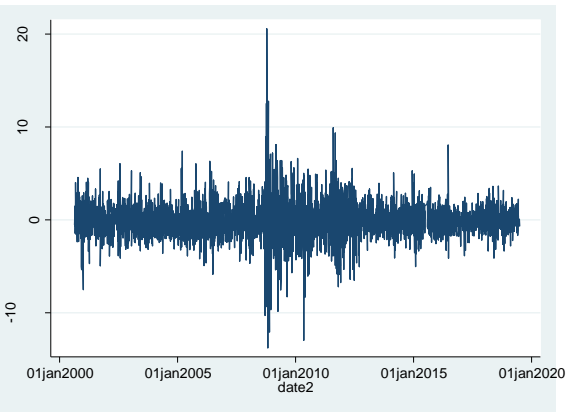
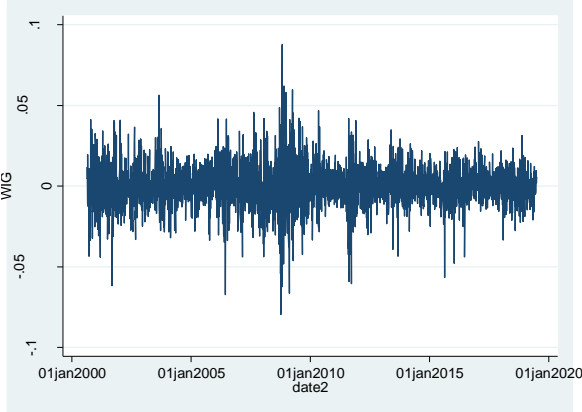
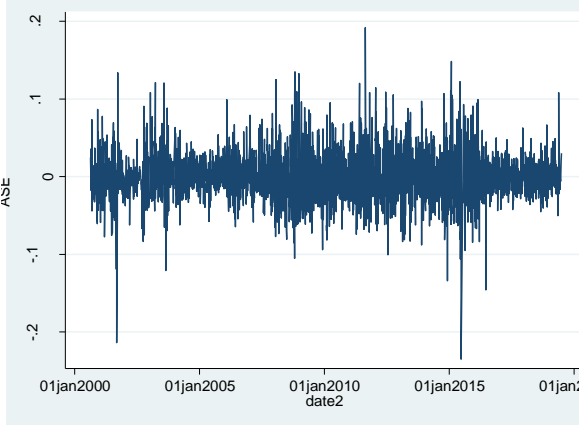
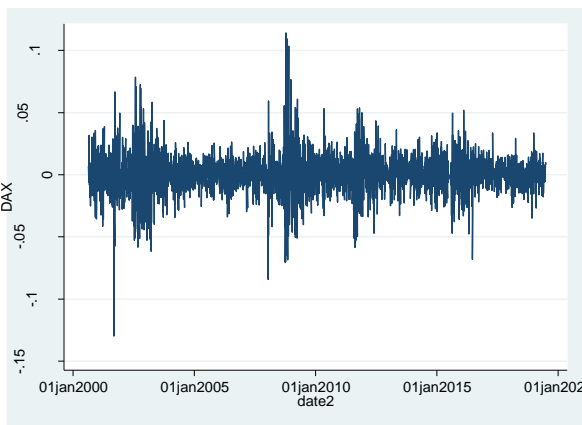
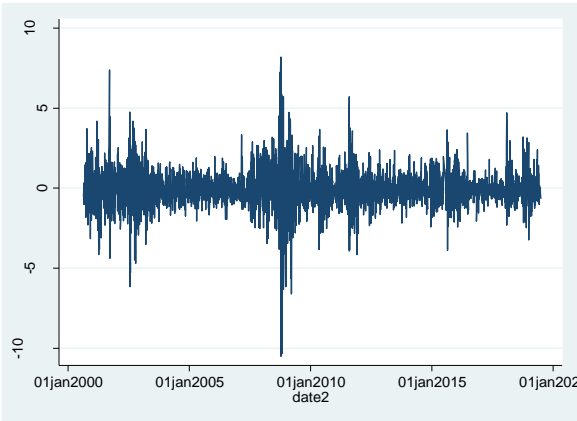
	dji	ftse	xu100	beti	crbex	bux	ase	wig
dji	1							
ftse	0.5611	1						
xu100	0.2909	0.4002	1					
beti	0.2378	0.437	0.2774	1				
crbex	0.2643	0.4432	0.2665	0.4717	1			
bux	0.4087	0.5805	0.4125	0.4543	0.4507	1		
ase	-0.2161	-0.3043	-0.2153	-0.2244	-0.1797	-0.2558	1	
wig	-0.3731	-0.5139	-0.4031	-0.3526	-0.3109	-0.5365	0.3259	1
dax	-0.6069	-0.7347	-0.3512	-0.2887	-0.2732	-0.4629	0.3363	0.5388

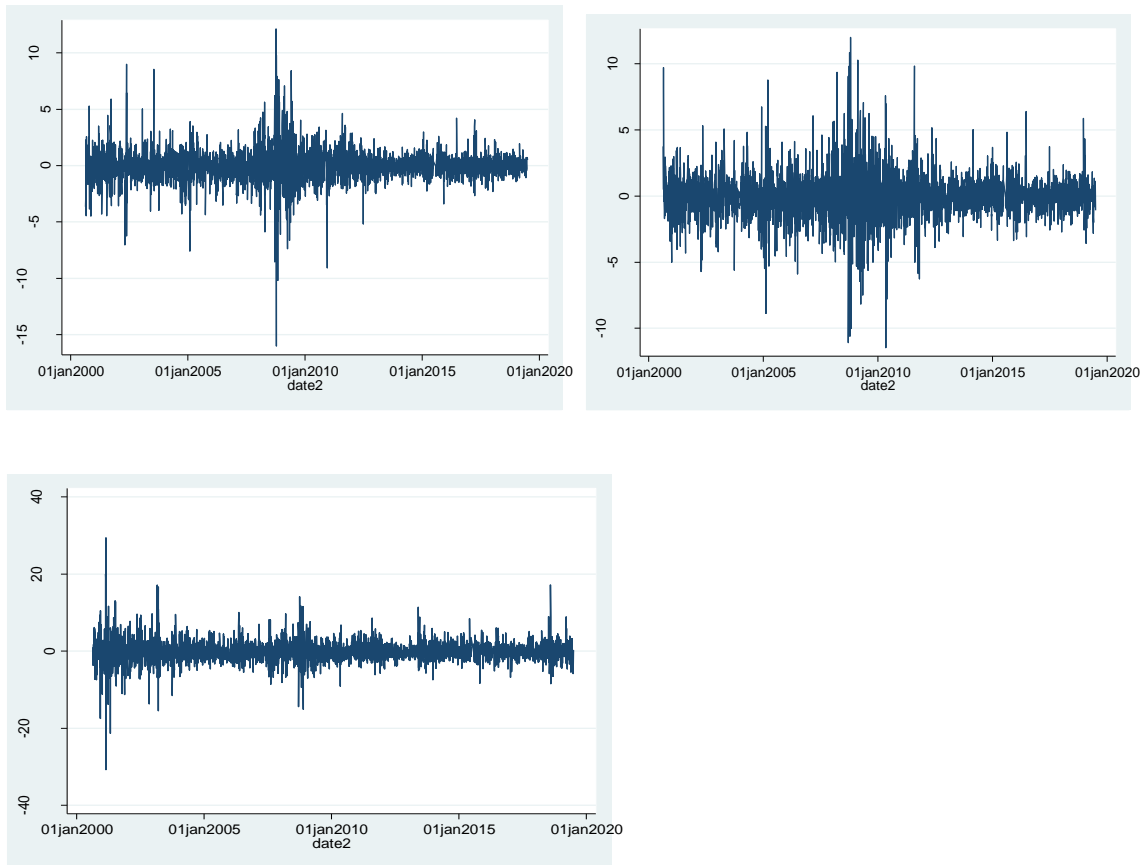
Source: Author's own

5.2.2 Daily Stock Prices and Log Returns

Following graphs of the log daily returns of stock exchange markets are mean reverting with volatility clustering. It can be observed that around 2008 the volatility is high in all economies. The return volatility of Turkey in 2001 is high because of the banking crisis. There is another high volatile term in 2011 caused by 9/11. All in all, the results of preliminary tests make the DCC-mGARCH model suitable for the study.

Graph 22: Log Daily Returns of Stock Exchange Markets





Data: Bloomberg, 2020

5.3 Results

DCC-GARCH models can be used to identify the volatility spillover and contagion effects across capital equity markets there have been high interdependence especially during the international financial crises. This chapter of the thesis uses disaggregated DCC- mGARCH method due to its flexibility, which is higher than the conditional correlation MGARCH model. Specifically, the DCC-mGARCH is superior to other models when there are structural breaks among variables (Acatrinei et al., 2013; Engle, 2002; Peters, 2008).

In this chapter of the thesis, daily stock returns of nine markets—XU100, ASE, BETI, CRBEX, BUX, WIG, DAX, DJI, and FTSE, from August 21, 2000, to July 2, 2019, are used for the analysis. In the model, the conditional means of the returns as a first-order vector autoregressive process and the conditional covariances as a DCC-mGARCH process in which the variance of each disturbance term follows a GARCH(1,1) process. In general, the results of all testing methods show that daily and weekly return values can be explained sufficiently by GARCH(1,1). As a result, it is observed that the standard GARCH(1,1) method is successful in modeling daily and weekly return volatility in stock markets.

The results of the DCC-mGARCH model are shown in Table in Appendix for Chapter 5. In this model, volatility transmission and spillover effects of DAX, DJI, and FTSE on ASE, BUX, CRBEX, BETI, WIG, and XU100 are examined. According to the results, the spillover effect of FTSE on CESEE is insignificant, whereas Dow Jones Industrial Average Index has an impact with a lag on all markets analyzed in this study. On the other hand, DAX has only significant spillover on BETI and BUX. The coefficients are significant in the model, and it proves that the GARCH (1,1) effect is observable.

5.4 Conclusion

This chapter questions the spillover effects for the CESEE region from developed markets. To compare the benefits and harms of financial integration, the spillovers from German, the US, and the UK markets on developing markets in the CESEE region investigated. These three major markets have been used to represent the importance of the shocks coming from developed stock markets. The similarities of the developing markets against the shocks have also been explained. The chapter also allows us to compare the financial integration between CESEE-Germany, CESEE-UK, and CESEE-US.

Due to the lack of savings in developing countries, capital inflows are needed to achieve desired growth rates. For this reason, shocks from other markets can be more fragile for emerging economies than developed countries. Under this condition, volatility transmission and spillover effects between German, the US, the UK, and stock markets of Croatia, Greece, Hungary, Poland, Romania, and Turkey in the last two decades are investigated in the analysis. This part of the thesis aimed to compare spillovers from three different developed markets on developing markets in the CESEE region. This study employed a DCC-mGARCH (1,1) to examine volatility spillovers from developed economies to Central and Southeastern European economies. VAR process proved that GARCH (1) is the most suitable method to study the volatility spillovers.

This chapter of the thesis aimed to illustrate the impact of financial integration on capital market volatility. These economies showed resemblance, especially in the case of the high volatility terms. According to the results of this study, Croatia, Greece, Poland, Romania, Hungary, and Turkey are affected by volatility in DJI (Dow Jones Industry Index). On the other hand, FTSE has no significant GARCH effect, and therefore, FTSE has been found not to have an impact on CESEE economies' stock markets. DAX has the only spillover on BETI and BUX. Although the analyzed countries and the UK are in the EU and all of these countries physically closer

than the US, the volatility that occurred in the US has a spillover effect on Croatia, Romania, Hungary, and Turkey stock markets.

Analysis of this study implies that investors on Croatian, Romanian, Hungarian, and Turkish stock markets should be aware of the risks arising from the US markets and hence follow volatilities in Dow Jones. On the other side, Hungarian and Romanian stock market investors should follow the developments of DAX. This study also illustrates that the Central and Southeastern Europe markets can be a good alternative for the UK Stock-market investors, and they can use studied markets for hedging opportunities.

As it is a well-known fact that during the crisis, investors search for the trusted investment options or they avoid investing. Therefore, a shock from developed markets can hit developing markets by the contagion and spillover effect. Because of the trust problem, the FDI may disappear significantly in a short time and the whole economy in developing markets will be harmed. The disruptive effect of the integration may be higher than the benefits of it.

Based on the results obtained in the analysis above, it can be concluded that the hypothesis, there is a spillover effect which is observable for developing CESEE region and for partner countries like Turkey coming from developed markets, could only partly be accepted. Because the GARCH effect from the US markets on developing markets has been observed, whereas from the FTSE there is no GARCH effect on the stock markets of the CESEE region. Also, the hypothesis, the spillovers from developed markets impact developing markets in the CESEE region similarly could be accepted, since the US stock market has an impact on all CESEE countries in the analysis. However, DAX has an impact only on two markets, FTSE has no spillover effect on mentioned CESEE countries.

CHAPTER 6

DISCUSSION AND CONCLUSIONS

Financial integration has been occurring since ancient times, and it is accelerating from time to time. Financial integration, which has been experienced in the past between 1690-1789 and 1875-1914, has been continuing to grow rapidly since the 1975's. Currently, the integration of financial institutions plays an important role in the establishment of the EU. As a cornerstone of the European integration process, free movement of capital has been encouraged by removing capital controls, harmonizing the financial sector and banking regulations, and Audit Mechanisms and Single Resolution Mechanism, especially since the Common Market was launched in 1957. The European Union, after its establishment, has contributed to the economic and social welfare of member countries significantly. Since its establishment, increased trade and financial transactions have given an unprecedented boost for economies in the region by allowing new inflows of the capital where it is needed. The benefits of macroeconomic discipline and stability of the union have provided growth while the allocation of funds is better. As an indicator of welfare, the GDP of the EU member countries has been growing significantly with some pauses.

The results of this thesis help to explain the changes in financial integration in Europe and its impact on banking and stock markets. The third chapter of the thesis aimed to explain the existence of the financial integration of the banking sector in Europe. Although the union is an important move and a great success in many aspects, the results of the analysis in the chapter show that there are still clusters according to their geographical positions and development level of member countries, specifically on the banking market which is the main part of the financial sector. As the analysis also supports that, the level of development and cooperation between countries in the same geographic area is one of the main characteristics for the clusters of the banking sector in the EU. This is indicating that economic union has not caused perfect unity in the banking sector. Even though integration is very high in Europe, the financial markets of countries in Europe are still grouped according to the geographical location and level of development instead of a homogeneous mixture.

According to the results of the analysis, the hypothesis, “the banking sector ratios of the EU countries show similarities among neighbor countries in cooperation” could be accepted. And

the hypothesis, “there is a change in the clusters of banking sector ratios of countries after the crisis”, is partly accepted according to the analysis of the banking sector ratios due to the fact that changes in the cluster for the observed period is very limited for most of the economies.

In the last few decades, fluctuations and downfalls have been observed especially in developing markets. Forth chapter questions the financial integration and economic volatility relationship. The impacts of financial integration on Eastern European countries are especially analyzed in this chapter. Moreover, differences between the impact on high volatility periods and low volatility periods have been analyzed. As shown in the results of the chapter, the countries that are fully integrated with the world economy can be affected by internal and external shocks and, they may experience a sudden loss of confidence in the market and significant deterioration in capital flows. To analyze the impact of the crisis on other economies and to compare the effects during non-crisis periods to high volatility, the Greek Debt Crisis period has been examined in the fourth chapter. The negative effects of integration for selected countries in the form of contagion in the integrated region have been observed. The results supported that impact of integration is stronger, especially during crises and high volatility periods.

Based on the results presented in the fourth chapter, we can conclude that the hypotheses, “the impact of integration is stronger especially during crises and high volatility periods” and “there are observable negative effects of integration for selected countries in the form of contagion in the integrated region” could not be rejected. Because the coherence among markets is higher when the volatility is high, whereas the stock markets are not highly correlated during good times.

The fifth chapter of the thesis analyzes to observe the spillovers spread from developed economies. To understand the benefits of financial integration for the economies in CESEE, the impact of two major stock markets’ spillovers has been compared. Spillovers from developed markets during high volatility periods are observed for the developing CESEE region and partner countries like Turkey. The CESEE stock markets followed the same way, especially during the high volatility terms according to the analyzes in chapter five. The analysis showed that spillovers from developed markets US stock markets have spillovers on developing markets in the CESEE region. Although they are in the same union, the UK stock markets have no spillover effects on CESEE countries. On the other hand, the spillover effects from DAX can only be observed in some of the CESEE countries.

Based on the results obtained in the analysis fifth chapter, it can be concluded that the hypothesis, “there is a spillover effect which is observable for developing CESEE region from developed markets”, could only partly be accepted. Because the GARCH effect from the US markets on developing markets has been observed, whereas from the FTSE there is no GARCH effect on the stock markets of the CESEE region. However, the hypothesis, the spillovers from developed markets impact developing markets in the CESEE region similarly, could be rejected, since the US stock market has an impact on all CESEE countries in the analysis, FTSE has no spillover effect on mentioned CESEE countries while DAX has spillovers on some of the economies in the region.

As a combination of the results of the chapters, it can be concluded that financial integration in banking and stock markets of CESEE countries is limited. However, it would be expected for a union to be more integrated. The results of studies show that integration can be volatile from one country to another and from one period to another period. The results illustrate that observed countries can show similarities during the crisis, whereas the integration is difficult to diagnose during normal period especially. The analyses in the thesis are supporting each other by asserting that integration of banking and stock markets of CESEE and the western part of Europe is limited or it is not always in favor of CESEE economies.

Table 6: Summary of the hypotheses and results

H1: The banking sector ratios of the EU countries show similarities among neighbor countries in cooperation.	Hypothesis 1 is accepted as clusters consist mainly of neighbor countries in cooperation.
H2: There is a change in the clusters of banking sector ratios of countries after the crisis.	Hypothesis 2 is partly accepted as the changes in the clusters are very limited.
H3: The impact of integration is stronger in stock markets especially during crises and high volatility periods.	Hypothesis 3 is accepted as the analysis supported that during a crisis coherence among markets is higher than other times.

H4: There are observable negative effects of integration for selective countries in the form of contagion in the integrated region	Hypothesis 4 is accepted due to the shocks from developed markets can spread easier developing markets.
H5: There is a spillover effect that is observable for developing CESEE regions coming from developed markets.	Hypothesis 5 is partly accepted since the spillovers from FTSE and DAX are very limited, while the spillovers from Dow Jones exist.
H6: The spillovers from developed markets impact developing markets in the CESEE region similarly.	Hypothesis 6 is rejected, hence the GARCH effect on CESEE countries varies for many countries.

Further conclusions and research areas are macro/microeconomic studies such as the impact of financial integration on economic growth, welfare, and trade. Besides, organizational and legal issues can be further analyzed to understand the structure of the markets and investor behavior. International organizations and their impact on developing markets can be further analyzed.

However, this thesis does not suggest that countries must close their economies to protect themselves from these shocks. On the contrary, countries with emerging markets must also establish and maintain a comprehensive communication strategy that aims to fully inform the markets, the fundamentals of the economy, policies, and the latest developments to increase the competition and transparency of their markets. Mechanisms should be established to diagnose and solve the emerging crises immediately.

The results of these analyses show that current market conditions shall need improvements by allowing better diversification and portfolio optimization, especially for the developing markets to resist shocks caused by high integration of markets. This thesis shows that financial markets are highly coherent during high volatility terms, whereas the coherence is low during normal times. Therefore, financial liberalization should be carried out carefully but should include updating and improving all banking regulation and oversight rules and reviewing company law. This is eminent for the economies due to the fact that financial liberalization makes ethical hazards (moral hazard) and preference mistakes. These problems worsen in the financial sector and the companies and harm all the sectors in an economy.

Since financial liberalization is a difficult and long process to implement successfully, developing countries should consider tools to reduce excessive dependence on short-term domestic and foreign debt - as a temporary and second-best tool. However, these policies should be flexible and properly designed, and implemented up to date.

Developing countries should focus on developing their banking systems. This includes measures such as increasing the banks' capital liabilities by increasing their flexibility, classifying their credit portfolios by quality, making provisions to prevent credit losses, and assessing maturity and exchange rate mismatches. Recent ECB research has proved empirically that improved insolvency frameworks are eligible for private financial risk-sharing in the euro area, both through banking and capital markets.

All in all, the studies presented in this thesis illustrate that coherence among markets is not always in favor of growing economies. The integration is inevitable among markets of economies that are open to world trade. Integration brought many advantages to the economies, households, and companies. The welfare of the people has been increasing as products have been varied and easy to reach. In international economics, openness to world trade is a debated topic as it may cause some vulnerabilities for the emerging economies. However, financial markets are very dynamic, and the world is growing faster than we observe. Therefore, even in a place where trade and financial integration is limited, transactions find ways to be implemented. Since financial integration of the markets is becoming more and more difficult to be ignored, countries should find ways to capture more advantages of being a part of it. For this reason, new tools for portfolio optimization shall be implemented and used to avoid the negative consequences that may be caused by crises. Increased transparency about data and regulation, enhanced communication and financial literacy, better identification of frictions, and policy evaluation are needed to foster the positive impacts of financial integration for all union members.

REFERENCES

- Acatrinei, M. Gorun, A. Marcu, and N. (2013). A DCC-GARCH model to estimate Rom. J. Econ. Forecast., 136–148.
- Agenor, P. R. (2001). Benefits and Costs of International Financial Integration: Theory and Facts. Policy Research Working Paper. No. 2699. World Bank, Washington, DC.
- Aghion, P. Philippe, B. and Abhijit, B. (1998). Financial Liberalization and Volatility in Emerging Market Economies. Cahiers de Recherches Economiques du Département d'économie, Université de Lausanne, Faculté des HEC, Département d'économie.
- Aizenman, J. Jinjara, Y. and Park, D. (2013). Capital Flows and Economic Growth in the Era of Financial Integration and Crisis, 1990–2010. Open Econ Rev 24, 371–396.
- Akgüc, Ö. (2012). Banka Finansal Tabloların Analizi. 2. Baskı
- Akyuz, Y. (1995), "Küresellesme ve Kriz", İktisat İşletme Finans Dergisi.
- Alam, P., Booth, D., Lee, K. and Thordarson, T., (2000). The use of fuzzy clustering algorithm and self-organizing neural networks for identifying potentially failing banks: an experimental study. Expert Systems with Applications 18, 185–199.
- Allen, F. and Gale, D. (2000). Financial Contagion. Journal of Political Economy 108 (1), 1–33.
- Aloui, C. and Hkiri, B. (2014). Co-movements of GCC emerging stock markets: New evidence from wavelet coherence analysis. Economic Modelling, 36, 421–431.
- Baba, Y., Engle, R. F., Kraft, D. F. and Kroner, K. F. (1990). "Multivariate Simultaneous Generalized ARCH". Mimeo, Department of Economics, University of California, San Diego.
- Bae, K.H., Karolyi, A.G. and Stulz, R.M., (2003). A new approach to measuring financial contagion. The Review of Financial Studies. Vol. 16, Iss. 13, 717–763.
- Bala, D. and Takimoto, T., (2017). Stock markets volatility spillovers during financial crises: A DCC-MGARCH with skewed- t density approach. Borsa Istanbul Review, 17(1), 25–48.
- Balassa, B. (1989). Comparative Advantage, Trade Policy and Economic Development, Harvester Wheatsheaf, New York.
- Balassa, B., (1973). Just How Misleading are Official Exchange Rate Conversions? A Comment. The Economic Journal, 1258–1267.
- Banz, R. W. (1981). The relationship between return and market value of common stocks. Journal of Financial Economics, 9(1), 3–18

- Baruník, J. and Vácha, L. (2013). Contagion among Central and Eastern European Stock Markets during the Financial Crisis. *Czech Journal of Economics and Finance*, 63(5), 443–453.
- Beck, T. and Levine R. (2004). Stock markets, banks, and growth: Panel evidence. *Journal of Banking and Finance*, 28(3), pp. 423–442. [https://doi.org/10.1016/s0378-4266\(02\)00408-9](https://doi.org/10.1016/s0378-4266(02)00408-9)
- Beirne, J. and Fratzscher, M. (2013). The pricing of sovereign risk and contagion during the European sovereign debt crisis. *Journal of International Money and Finance*, 34, 60–82. <https://doi.org/10.1016/j.jimonfin.2012.11.004>
- Bekaert G., C.R. Harvey and Ng, A. (2005). Market integration and contagion. *Journal of Business*, 78 (2005). 39–70
- Bekiros, S. and Marcellino, M. (2013). The multiscale causal dynamics of foreign exchange markets. *Journal of International Money and Finance*. 33, 282–305.
- Belkin, P., Mix, D. E. and Nelson, R. M. (2011). "Greece's Debt Crisis: Overview, Policy Responses, and Implications", Library of Congress, Congressional Research Service, Washington, USA, CRS Report for Congress, R41167.
- Bénétrix, A. (2008). Indicators of regional financial integration. IIS, The Institute for International Integration Studies Discussion Paper Series.
- Berthelemy, J. C. and Demurger, S. (2000). Foreign Direct Investment and Economic Growth: Theory and Application to China. *Review of Development Economics*. 140–55
- Blasius J. and Greenacre, M. (2014) *Visualization and Verbalization of Data*. Boca Raton: Chapman and Hall/CRC.
- Bloomberg (n.d.) "Stock price graph for Apple Inc. January 1, 2008 - March 1st, 2017, via Bloomberg LP" Available at: <https://www.bloomberg.com/markets/rates-bonds> [Accessed: 15 December 2020]
- Bollerslev, T. (1986). Generalized autoregressive conditional heteroskedasticity. *Journal of Econometrics*, 31(3), 307-327.
- Bollerslev, T. (1990). Modelling the Coherence in Short-Run Nominal Exchange Rates: A Multivariate Generalized ARCH Model. *Review of Economics and Statistics*, 72, 498–505.
- Bollerslev, T., Chou, R. Y. and Kroner, K. F. (1992). ARCH modelling in finance: A review of the theory and empirical evidence, in: *Journal of Econometrics*, Vol. 52, 1-2. 5–59.
- Borensztein, E., J. D. Gregorio and Lee, J. W. (1998). How Does Foreign Direct Investment Affect Economic Growth? *Journal of International Economics*, 45. 115–35.

- Brasili, A. and Vulpes, G. (2006). Banking integration and co-movements in EU banks' fragility. MIPRA paper, 1964. University Library of Munich, Germany.
- Bridges, C. C. (1966). Hierarchical cluster analysis. *Psych. Rep.* 18. 851–854.
- Brunnermeier, M. K., Crocket, A., Goodhart C., Persaud Avi and Shin Hyun, (2009), *Fundamental Principles of Financial Regulation*, 11th Geneva Report on the World Economy.
- Bubbico, A., Elkink, J. and Okolikj, M. (2017). Quality of government and regional competition: A spatial analysis of subnational regions in the European Union. *European Journal of Political Research.* 56. 10.1111/1475-6765.12211.
- Buriev, A., Dewandaru, G., Zainal, M. and Masih, M. (2017). Portfolio Diversification Benefits at Different Investment Horizons During the Arab Uprisings: Turkish Perspectives Based on MGARCH–DCC and Wavelet Approaches. *Emerging Markets Finance and Trade.*
- Campbell, K.A., R. Huisman, and K.G. Koedijk. (2001). Optimal Portfolio Selection in a Value-at-Risk Framework. *Journal of Banking and Finance*, vol. 25, no. 9 (September). 1789–1804
- Candelon, B., Piplack, J. and Straetmans, S. (2008). On Measuring Synchronization of Bulls and Bears: The case of East Asia, *Journal of Banking and Finance* 32. 1022–1035.
- Caprio, G. and Honohan, P. (1999). Restoring Banking Stability: Beyond Supervised Capital Requirements, *Journal of Economic Perspectives*, 13, issue 4, 43–64.
- Carnero, M. and Eratalay, M. (2014). Estimating VAR-MGARCH models in multiple steps. *Studies in Nonlinear Dynamics & Econometrics*, 18(3).
- Cho, J.H. and Parhizgari, A.M. (2008). East Asian financial contagion under DCC-GARCH. *International Journal of Banking and Finance*. Vol. 6, Iss. 1, pp. 16–30.
- Chordia, T., Sarkar, A. and Subrahmanyam, A. (2005). An Empirical Analysis of Stock and Bond Market Liquidity, *The Review of Financial Studies*, 18(1), 85–129.
- Connolly, R., Stivers, C. and Sun, L. (2007). Commonality in the time-variation of stock–stock and stock–bond return comovements. *Journal of Financial Markets.* 10.
- Crowley, M.P. (2005). An intuitive guide to wavelets for economists. Bank of Finland Research Discussion Paper No. 1/2005
- Dardac, N. and Boitan, A. I. (2009). A Cluster Analysis Approach for Bank's Risk Profile: The Romanian Evidence. *European Research Studies Journal*, *European Research Studies Journal*, vol. 0(1), pages 109-118.

De Nicolò, G., Corker, R. Tieman A. and Van-derVossen, J. W. (2005). European Financial Integration, Stability and Supervision, IMF Country Report 05/266, August, 113–146 (Washington: International Monetary Fund).

De Santis, R. A. (2012). The Euro area sovereign debt crisis: safe haven, credit rating agencies and the spread of the fever from Greece, Ireland and Portugal. No 1419, Working Paper Series, European Central Bank.

Decressin J., Faruqee, H., Fonteyne, W. (2007). Integrating Europe's Financial Markets, International Monetary Fund.

Demirgüç-Kunt, A. and Detragiache, E., (1997). The Determinants of Banking Crises: Evidence from Industrial and Developing Countries. World Bank Policy Research Working Paper No. 1828.

ECB (2007). “Financial Integration in Europe – March 2007”

ECB (2015). “Financial Integration in Europe, 2015”

ECB (2020). “Financial integration and structure report”
<https://www.ecb.europa.eu/pub/fie/html/ecb.fie202003~197074785e.en.html#toc1>

Égert, B., and Kočenda, E. (2007). Interdependence between Eastern and Western European stock markets: Evidence from intraday data. *Economic Systems*, 31(2), 184–203.

Embrechts, P., Mcneil, A. J. and Straumann, D. (1999). Correlation and Dependence in Risk Management: Properties and Pitfalls. In M.A.H. DEMPSTER (ed.). *Risk Management: Value at Risk and Beyond*. Cambridge: Cambridge University Press, 176–223

Engle, R. (2002). Dynamic conditional correlation: A simple class of multivariate generalized autoregressive conditional heteroskedasticity models. *J. Bus. Econ. Stat.*, 20, 339–350.

Ercan, H. and Karahanoğlu, I. (2019). A Wavelet Coherence Analysis: Contagion in Emerging Countries Stock Markets. *Periodica Polytechnica Social and Management Sciences*, 27(2), 99–107.

Ercan, H. and Sayaseng, S. (2016): The cluster analysis of the banking sector in Europe. *Economics and Management of Global Value Chains*. University of Szeged, Doctoral School in Economics, Szeged, 111–127.

Eren, A. and Süslü, B. (2001). Finansal Kriz Teorileri Isiginda Türkiye'de Yasanan Krizlerin Genel Bir Degerlendirmesi. *Yeni Türkiye*, Sayi: 41, Yil: 7, Eylül-Ekim, 662-674.

European Commission (2018). “European Financial Stability and Integration Review, 2018”

Eurostat (2020). <https://ec.europa.eu/eurostat/data/database> 20.04.2020

- Evans P., Hasan, I. and Vivas, A.L. (2008). Deregulation and Convergence of Banking: The EU Experience. *Finnish Economic Papers*, Finnish Economic Association, vol. 21(2), 104-117.
- Featherstone, K. (2011). The JCMS Annual Lecture: The Greek Sovereign Debt Crisis and EMU: A Failing State in a Skewed Regime. *JCMS: Journal of Common Market Studies*, 49(2), 193–217. <https://doi.org/10.1111/j.1468-5965.2010.02139.x>
- Forbes, K.J. and Rigobon, R. (2002). No Contagion, Only Interdependence: Measuring Stock Market Comovements. *The Journal of Finance*, 57
- Forte R. and Santos N. (2015). A cluster analysis of FDI in Latin America. *Latin American Journal of Economics-formerly Cuadernos de Economía*, Instituto de Economía. Pontificia Universidad Católica de Chile., vol. 52(1), 25–56.
- Friedman, M. (1953) The case for flexible exchange rates. *Essays in Positive Economics*, 157-203.
- Garcia, R. and Tsafack, G. (2009). Dependence structure and extreme co-movements in international equity and bond markets. *CIRANO Scientific Series*.
- George, D. and Mallery, M. (2010). *SPSS for Windows Step by Step: A Simple Guide and Reference*, 17.0 update (10a ed.) Boston: Pearson
- Gerrits, R.J. and Yuce, A. (1999). Short- and long-term links among European and US stock markets. *Applied Financial Economics*. Vol. 9, Iss. 1, 1–9.
- Gilmore, C.G., Lucey, B.M., McManus, G.M. (2008). The dynamics of Central European equity market comovements. *The Quarterly Review of Economics and Finance*, 48, 605–622.
- Gilmore, G.C. and Mcmanus, G.M. (2002). International portfolio diversification: US and Central European equity markets. *Emerging Markets Review*. Vol. 3, Iss. 1, 69-83
- Gjika, D., and Horváth, R. (2013). Stock market comovements in Central Europe: Evidence from the asymmetric DCC model. *Economic Modelling*, 33, 55–64.
- Gnath K., Grosse-Rueschkamp, B. Kastrop, C. and Ponattu, D. (2019). Financial market integration in the EU: A practical inventory of benefits and hurdles in the Single Market
- Goldsmith, R.W. (1969). *Financial Structure and Development*. Yale University, New Haven,
- González C. C., Gil Fariña, M. C. and Pestano G. C. (2012). Using Wavelets to Understand the Relationship between Mortgages and Gross Domestic Product in Spain. *Journal of Applied Mathematics* 2012. 1–17. <https://doi.org/10.1155/2012/917247>
- González-Hermosillo, B. (2008), Investors' Risk Appetite and Global Financial Market Conditions. IMF Working Paper, WP/08/85, (Washington: International Monetary Fund).

- Grieco, J. M. (1997). Systemic sources of variation in regional institutionalization in Western Europe, East Asia, and the Americas. In: *The Political Economy of Regionalism*, Columbia University Press, New York, USA, 164–187.
- Grinsted A, Moore, JC. and Jevrejeva, S. (2004). Application of the cross wavelet transform and wavelet coherence to geophysical time series. *Non-linear Processes in Geophysics*, 11. 561–566.
- Gropp, R. and Moerman, G. (2003). Measurement of contagion in banks' equity prices. Working Paper Series 0297, European Central Bank.
- Gropp, R., Vesala, J. and Vulpes, G. (2002). Equity and Bond Market Signals as Leading Indicators of Bank Fragility.
- Grossman, G. and Helpman, E. (1991). *Innovation and Growth in the Global Economy*, MIT Press (Cambridge, Mass)
- Guidi, F. and Ugur, M. (2014). An analysis of South-Eastern European stock markets: Evidence on cointegration and portfolio diversification benefits. *Journal of International Financial Markets, Institutions and Money*, 30, 119–136.
- Hamrita, M. and Trifi, A. (2011). The Relationship between Interest Rate, Exchange Rate and Stock Price: A Wavelet Analysis. *International Journal of Economics and Financial Issues* 1. 220–228.
- Hanousek, J. and Kocenda, E. (2009). Intraday Price Discovery in Emerging European Stock Markets. CERGE-EI Working Paper No. 382. <https://doi.org/10.2139/ssrn.1448618>
- Hansen, P. and Lunde, A. (2005). A Forecast Comparison of Volatility Models: Does Anything Beat a GARCH(1,1) Model?, in: *Journal of Applied Econometrics*, Vol. 20, No. 7, pp. 873–889.
- Hawkesby C., Marsh, I. Stevens, I. (2003). Large Complex Financial Institutions: Common Influences on Asset Price Behaviour?. *Bank of England Financial Stability Review*, (Issue 15, December), 91–101
- Heathcote, J. and Perri, F. (2004): Financial Globalization and Real Regionalization. *Journal of Economic Theory*, 119(1), 207–243
- Huang, B.-N., Hwang, M. J. and Yang, C. W. (2008). "Causal relationship between energy consumption and GDP growth revisited: a dynamic panel data approach", *Ecological Economics*, 67(1), 41–54.
- Hull, J., Predescu, M. and White, A. (2004). "The relationship between credit default swap spreads, bond yields, and credit rating announcements", *Journal of Banking & Finance*, 28(11), 2789–2811. <https://doi.org/10.1016/j.jbankfin.2004.06.010>

- Humpe, A. and Mcmillian, P. (2009) "Can macroeconomic variables explain long-term stock market movements? A comparison of the US and Japan", *Applied Financial Economics*, 19(2), 111–119. <https://doi.org/10.1080/09603100701748956>
- IMF (2018). *Financial Access Survey*, IMF
- IMF (2020). *Financial Development Index Database*. <https://data.imf.org/> 20.04.2020
- Ingram, J. C. (1973). *The case for European monetary integration*. Princeton University Essays in International Finance.
- Jeanne, O. (2003). *Why Do Emerging Economies Borrow in Foreign Currency?* CEPR Discussion Paper No. 4030
- Jiang, Z. and Yoon, S. M. (2020). Dynamic co-movement between oil and stock markets in oil-importing and oil-exporting countries: Two types of wavelet analysis. *Energy Economics* 90. <https://doi.org/10.1016/j.eneco.2020.104835>
- Joyo, A. and Lefen, L. (2019). Stock Market Integration of Pakistan with Its Trading Partners: A Multivariate DCC-GARCH Model Approach. *Sustainability*, 11(2), 303.
- Karahan, Ö., Yılıgör, M. and Öndes, H. (2020). Assessing the Financial Integration of Eastern European Countries. https://doi.org/10.1007/978-3-030-32426-1_6.
- Karolyi, G. A. (1995). A Multivariate GARCH Model of International Transmissions of Stock Returns and Volatility: The Case of the United States and Canada. *Journal of Business and Economic Statistics*, 13, 11–25.
- Karunanayake, I., Valadkhani, A. and O'Brien, M. J. (2009). Financial crises and stock market volatility transmission: evidence from Australia, Singapore, the UK, and the US. *Financial Crises: Causes, Characteristics, and Effects*, 3rd International Conference. 1-18. Perth, Australia: Edith Cowan University.
- Katzenstein, P. J. (2005). *World of Regions: Asia and Europe in the American imperium*. Cornell University Press, Ithaca, NY, USA. <https://doi.org/10.7591/9781501700385>
- Kazgan, G. (2001). Küreselleşmiş Dünyada Küreselleşen Türkiye'nin Krizleri. *İktisat Dergisi*. Şubat-Mart. 11 (572). 27– 31.
- Kentikelenis, A., Karanikolos, M., Papanicolas, I., Basu, S., McKee, M., and Stuckler, D. (2011). Health effects of financial crisis: omens of a Greek tragedy. *The Lancet*, 378(9801), 1457–1458
- Khashanah, K. and Miao, L. (2011). Dynamic structure of the US financial systems. *Studies in Economics and Finance*, Vol. 28, Iss 4. 321

- Koedijk, K., Campbell, A.J.R. and Kofman, P. (2002). Increased correlation in bear markets. *Financial Analysts Journal*, Vol. 58, Iss. 1. 87–94.
- Kouretas, G. P., and Prodromos, V. (2010). The Greek crisis: Causes and implications", *Panoeconomicus*, 57(4), 391–404. <https://doi.org/10.2298/pan1004391k>
- Kroner, K. F. and Claessens, S. (1991). Optimal Dynamic Hedging Portfolios and the Currency Composition of External Debt. *Journal of International Money and Finance*, 10, 131-148.
- Kumar, H, and Kattookaran T. (2016). Secular Stagnation: An Introduction. *Indian Journal of Commerce and Management Studies*, vol. 7, no. 3, Educational Research Multimedia & Publications, Sept. 42.
- Kumar, M. and Persaud, A. (2002). Pure Contagion and Investors Shifting Risk Appetite: Analytical Issues and Empirical Evidence. *International Finance*. 5. 401-36. 10.1111/1468-2362.00102.
- Kurnoga, N., Dumičić, K. and Čeh Č., A. (2009). Cluster and Factor Analysis of Structural Economic Indicators for Selected European Countries. *WSEAS Transactions on Business and Economics*. 7. 331–341.
- Lane, P. R. and G. M. Milesi-Ferretti (2003). International financial integration. *IMF Staff Papers*, Vol. 50, Special Issue, 82–113.
- Levine, R. (1997). Financial Development and Economic Growth: Views and Agenda. *Journal of Economic Literature*, 35(2), 688–726.
- Lien, D. and Luo, X. (1994). Multiperiod hedging in the presence of conditional heteroskedasticity. *Journal of Futures Markets*, 14(8), 927–955.
- Ling, X. and Dhesi, G. (2010). Volatility spillover and time-varying conditional correlation between the European and US stock markets. *Global Economy and Finance Journal*. Vol. 3, Iss. 2, 148–164.
- Longin, F. and Solnik, B. (1995). Is the correlation in international equity returns constant: 1960–1990? *Journal of International Money and Finance*. Vol. 14, Iss. 1, 3–26.
- Longin, F. M. and Solnik, B. (2001). Extreme Correlation of International Equity Markets. *Journal of Finance*, Vol. LVI, No. 2.
- MacDougall, G. D., (1960). The Benefits and Costs of Private Investment from abroad: A Theoretical Analysis. *Economic Record*, 13–35
- Madaleno, M. and Pinho, C. (2012). International Stock Market Indices Co-Movements: A New Look. *International Journal of Finance and Economics*, 17, 89–102.

- Malliaris, A.G. and Urrutia, J.L. (1992). The international crash of October 1987: Causality tests. *Journal of Financial and Quantitative Analysis*. Vol. 27, Iss. 3, 353–364.
- Markusen, J. and Venables, A. (1999). Foreign direct investment as a catalyst for industrial development, *European Economic Review*, 43, issue 2, 335–356
- Martin, P. (1998). Can Regional Policies Affect Growth and Geography in Europe? *The World Economy*, 21(6), 757–774
- Matworks (2020). <https://www.mathworks.com/help/wavelet/examples/compare-time-frequency-content-in-signals-with-wavelet-coherence.html>
- Mc Kinnon, R. (1973). *Money and Capital in Economic Development*, Brooking Inst Washington.
- McLean, B. and Shrestha, S. (2002). *International Financial Liberalisation and Economic Growth*. Reserve Bank of Australia, RBA Research Discussion Papers.
- Mendoza, E., Ríos-Rull, J.-V. and Quadrini, V. (2009). Financial Integration, Financial Development, and Global Imbalances. *Journal of Political Economy*. 117. 371–416. 10.1086/599706.
- Mensi, W., Hammoudeh, S., Reboredo, J. and Nguyen, D. K. (2014). Do global factors impact BRICS stock markets? A quantile regression approach. *Emerging Markets Review*, 19, issue C, 1-17.
- Mighri, Z. and Mansouri, F. (2014). Modeling international stock market contagion using multivariate fractionally integrated APARCH approach. *Cogent Economics and Finance*, 2(1).
- Mishkin, F. and Eakins, S. (2012). *Financial Markets and Institutions*. 7th Edition. Columbia University.
- Mishkin, F. S. (1999). Global Financial Instability: Framework, Events, Issues. *Journal of Economic Perspective*, Vol 13(4), 3–20.
- Morana, C. and Beltratti, A. (2008). Comovements in International Stock Markets. *Journal of International Financial Markets Institutions and Money*, Vol. 18, 31–45.
- Moya-Martínez, P., Ferrer-Lapena, R., Escribano-Sotos, F. (2015). Interest Rate Changes and Stock Returns in Spain: A Wavelet Analysis. *BRQ Business Research Quarterly* 18(2). 95–110. DOI.org/10.1016/j.brq.2014.07.004
- Murtagh, F. and Contreras, P. (2012). Algorithms for hierarchical clustering: an overview. *WIREs Data Mining Knowl Discov* 2. 86–97.
- Necula, C. (2010). Modeling the dependency structure of stock index returns using a copula function. *Romanian Journal of Economic Forecasting*. Vol. 13, Iss. 3, 93–106.

Obstfeld, M. (1998). The Global Capital Market: Benefactor or Menace? NBER Working Paper No. w6559

OECD (2020). <https://data.oecd.org/>

Pal, D. and Mitra, S. (2017). Time-frequency contained co-movement of crude oil and world food prices: A wavelet-based analysis. *Energy Economics* 62: 230–239. DOI: 10.1016/j.eneco.2016.12.020

Park, Y.S. (2003). Characters and Measurement Indicators of International Financial Integration in Developing Countries.

Patev, P., Kanaryan, N. and Lyroudi, K. (2006). Stock market crises and portfolio diversification in Central and Eastern Europe. *Managerial Finance*. Vol. 32, Iss. 5, 415–432.

Peters T. (2008) Forecasting the Covariance Matrix with the DCC GARCH Model

Prasad, E., Rogoff, K., Wei, S.-J., and Kose, M. A. (2003). Effects of Financial Globalization on Developing Countries: Some Empirical Evidence. IMF, Occasional Paper No. 220

Rajan, R., Dell’Ariccia, G. and Detragiache, E. (2008). The Real Effect of Banking Crises. *J. Financial Intermediation* S.17, 89–112

Razin, A. and Rose, A. (1994). Business Cycle Volatility and Openness: An Exploratory Cross-Section Analysis.

Reboredo, J. C., Rivera-Castro, M. A. and Ugolini, A. (2017). Wavelet-based test of co-movement and causality between oil and renewable energy stock prices. *Energy Economics* 61(C): 241–252. DOI: 10.1016/j.eneco.2016.10.015

Rejeb, A. and Boughrara, A. (2015). Financial integration in emerging market economies: Effects on volatility transmission and contagion. *Borsa Istanbul Review*. 15. 161–179.

Rioja, F. and Valev, N. (2004). Finance and the Sources of Growth at Various Stages of Economic Development. *Economic Inquiry*. 42. 127-140. 10.2139/ssrn.438261.

Royen, A. S. (2002). Financial Contagion and International Portfolio Flows. 58. 35–49.

Schmukler, S.L. Zoido, P. and Halac, M. (2004). Financial Globalization, Crises, and Contagion, World Bank Globalization Policy Research Report,

Schularick, M., and Steger, T. M. (2007). Financial Integration, Investment, and Economic Growth. Evidence from Two Eras of Financial Globalization. Center for Economic Studies and Ifo Institute for Economic Research (CESifo). Working Paper No. 1691.

Schwender, A. (2010). The estimation of financial markets by means of regime-switching model. St. Gallen, 147 p. Dissertation. University of St. Gallen, Graduate School of Business Administration, Economics, Law and Social Sciences, No. 3794

Shahzad, S. J. H., Kumar, R., Ali, S. and Ameer, S. (2016). Interdependence between Greece and other European stock markets: A comparison of wavelet and VMD copula, and the portfolio implications. *Physica A: Statistical Mechanics and its Applications*, 457, 8–33.

Shaw, E. S. (1973). *Financial Deepening in Economic Development* New York, Oxford University Press.

Shen, C.-H. and Lee, C.C. (2006). Same Financial Development yet Different Economic Growth—Why? *Journal of Money, Credit and Banking*, 38, 1907-1944.

Sørensen, C.K. and P. Gutiérrez, J.M. (2006). Euro Area Banking Sector Integration using Hierarchical Cluster Analysis Techniques, ECB Working paper series, No. 627,

Stiglitz, J. (2000), The Contributions of the Economics of Information to Twentieth Century Economics, *The Quarterly Journal of Economics*, 115, issue 4, 1441–1478.

Stock, J. H. and Watson, M. W. (1989). "New Indexes of Coincident and Leading Economic Indicators", *NBER Macroeconomics Annual*, 4, 351–394.

Syriopoulos, T., Makram, B. and Adel, B. (2015). Stock Market Volatility Spillovers and Portfolio Hedging: BRICS and the Financial Crisis. *International Review of Financial Analysis*. 39. 10.1016/j.irfa.2015.01.015.

The World Bank (n.d.) "World Bank Open Data: Free and open access to global development data" [online] Available at: <http://data.world-bank.org/> (Accessed: 15 March 2017)

Torre, A., Levy Y., E. and Schmukler, S. L. (2002). *Financial Globalization: Unequal Blessings*. Policy Research Working Paper. No. 2903. World Bank, Washington, DC.

Torrence C. and Webster P.J. (1999). Interdecadal changes in the ENSO monsoon system. *Journal of Climate*, 12(8). 2679–2690.

Tse, Y.K. and Tsui, A.K. (2002). A Multivariate Generalized Autoregressive Conditional Heteroscedasticity Model with Time-Varying Correlations. *Journal of Business and Economic Statistics*. Vol. 20, Iss. 3, 351–362.

UNCTAD (2018). *World Investment Report*

UNCTAD (2020). "<https://unctadstat.unctad.org/>". 23.03.2020

- Ural, M. (2003). Finansal Krizler ve Türkiye. Dokuz Eylül Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi, 18(1), 11–28.
- Vassalou, M. (2003). News related to future GDP growth as a risk factor in equity returns. *Journal of Financial Economics*, 68(1). 47–73
- Vermeulen, R. (2010). *Essays on International Financial Integration*. Datawyse Maastricht. Maastricht, Netherlands.
- Vo, X. and Ellis, C. (2017). An empirical investigation of capital structure and firm value in Vietnam. *Finance Research Letters*, 22, 90–94.
- Volz, U. (2004). European financial integration and the financing of local businesses in the new EU member states. *European Bank Working paper* 89.
- Ward, J. H. Jr. (1963). Hierarchical Grouping to Optimize an Objective Function. *Journal of the American Statistical Association*, 58, 236–244.
- Yang, J., Kolari, J.W. and Sutanto, P.W. (2004). On the stability of long-run relationships between emerging and US stock markets. *Journal of Multinational Financial Management*, Vol. 14 No. 3, 233–48.
- Yeldan, E. (2001). Türkiye Ekonomisinde 2000-2001 Krizinin Yapısal Kaynakları Üzerine. *Doğu-Batı Dergisi*. 4 (17). 187–195.
- Zhao, Y., Laguna, R. C., Zhao Liu, J. J., He, X., Yianni, J. and Sarrigiannis, P. G. (2018). A Wavelet-Based Correlation Analysis Framework to Study Cerebromuscular Activity in Essential Tremor. *Advanced Methods to Analyse the Complexity of the Brain, Special Issue* 1–15. DOI: doi.org/10.1155/2018/7269494
- Žuk P. and Savelin L. (2018). Real convergence in central, eastern and south-eastern Europe, *ECB Economic Bulletin Issue* 3. Articles

APPENDIX FOR CHAPTER 3

Appendix 1.

Data for Cluster Analysis (2008)

Country	Leverage	ROA	Tier1	CapRequirement	Equity
Austria	18.484	0.0936	7.7289	54,253,295	5.4101
Belgium	30.4574	-1.4715	11.4728	38,441,343	3.2833
Bulgaria	8.7705	1.9753	11.2016	3,259,255	11.4018
Cyprus	16.889	0.87	8.3191	4,820,223	5.921
Czech Republic	13.5887	1.0734	10.5506	5,805,929	7.3591
Germany	34.1591	-0.2858	9.2628	262,647,707	2.9275
Denmark	23.907	-0.141	10.2268	28,846,961	4.1829
Estonia	12.2374	1.3058	10.2594	2,356,595	8.1716
Spain	18.0317	0.676	8.1348	165,530,840	5.5458
Finland	18.2485	0.4555	12.5493	12,303,375	5.4799
France	26.7094	0.109	8.4197	201,091,377	3.744
United Kingdom (GB)	26.2029	-0.3704	8.1637	261,892,359	3.8164
Greece (GR)	18.5491	0.5771	7.9329	21,994,733	5.3911
Hungary	15.4759	0.9732	10.8554	6,761,447	6.4616
Ireland	29.9447		9.236	51,297,594	
Italy	14.3106	0.3425	6.9022	130,709,091	6.9878
Lithuania	14.4255	0.7899	9.2	1,657,433	6.9322
Luxembourg	25.8462		12.7425	21,227,165	
Latvia	12.1633	0.2045	9.619	1,869,969	8.2215
Malta	12.3952	0.2083	15.5771	1,484,210	8.0676
Netherlands	31.9463	-0.3734	9.672	87,268,157	3.1303
Poland	10.8333	1.324	10.1659	13,942,851	9.2308
Portugal	18.1171	0.2025	6.6088	25,474,399	5.5196
Romania	10.9235	1.7173	11.5891	4,275,634	9.1546
Sweden	26.1328	0.4623	7.9157	41,904,866	3.8266
Slovenia	12.7079		8.8329	3,463,667	
Slovakia	12.2707	0.8362	10.0573	2,722,886	8.1495

Data for Cluster Analysis (2009)

Country	Leverage	ROA	Tier1	CapRequirement	Equity
Austria	15.3615	0.1814	9.2653	50,664,897	6.5098
Belgium	22.1828	-0.1063	13.2336	32,572,320	4.508
Bulgaria	7.5121	1.0617	14.0277	3,358,614	13.3119
Cyprus	17.2477	0.5779	9.5242	5,322,630	5.7979
Czech Republic	12.0953	1.4118	12.2923	5,822,104	8.2677
Germany	26.584	-0.0814	10.6271	238,740,463	3.7617
Denmark	22.2348	-0.1724	13.4764	26,426,489	4.4975
Estonia	14.2187	-3.414	11.7766	1,895,313	7.033
Spain	16.4252	0.5705	9.3301	165,974,100	6.0882
Finland	16.7894	0.4246	13.7935	11,717,905	5.9561
France	20.7173	0.2259	10.1198	182,007,398	4.8269
United Kingdom (GB)	22.0024	0.0171	9.9342	277,918,553	4.545
Greece (GR)	14.6004	0.1417	10.7635	22,533,656	6.8491
Hungary	13.4433	1.6748	11.9099	6,312,373	7.4386
Ireland	20.8829		9.794	48,654,312	
Italy	12.7805	0.3104	8.2637	126,629,623	7.8244
Lithuania	17.7896	-3.9417	9.3	1,544,561	5.6213
Luxembourg	18.52		15.5865	19,566,279	
Latvia	13.1993	-3.969	10.7948	1,689,273	7.5762
Malta	9.4955	1.8496	21.3406	1,191,789	10.5313
Netherlands	23.1534	-0.0079	12.477	73,783,847	4.319
Poland	9.2855	0.75	12.1019	13,790,434	10.7695
Portugal	16.0828	0.3409	7.8843	26,114,316	6.2178
Romania	10.9766	0.5583	12.9124	3,942,945	9.1103
Sweden	22.8382	0.2354	10.5819	37,965,941	4.3786
Slovenia	12.8849		9.0261	3,554,973	
Slovakia	10.4738	0.5377	11.615	2,627,358	9.5476

Data for Cluster Analysis (2010)

Country	Leverage	ROA	Tier1	CapRequirement	Equity
Austria	13.8427	0.4629	9.9846	52,264,989	7.224
Belgium	20.1439	0.5203	15.5209	29,791,581	4.9643
Bulgaria	7.36	0.8134	15.1552	3,123,506	13.5869
Cyprus	15.1724	0.6112	10.8734	6,501,400	6.5909
Czech Republic	11.9219	1.2751	13.6129	6,071,727	8.3879
Germany	25.8002	0.0728	11.4068	206,805,282	3.8759
Denmark	21.7731	0.1096	14.0713	25,922,141	4.5928
Estonia	12.4335	0.3963	12.6885	1,772,383	8.0428
Spain	17.1792	0.4679	9.645	164,360,762	5.821
Finland	19.6205	0.3547	13.7287	12,162,046	5.0967
France	20.0658	0.4161	10.7579	184,330,358	4.9836
United Kingdom (GB)	20.7826	0.2103	10.8592	274,936,542	4.8117
Greece (GR)	15.4277	-0.3064	10.8968	22,085,395	6.4818
Hungary	12.3455	0.0108	11.5457	6,258,429	8.1001
Ireland	21.13		11.5579	36,745,967	
Italy	12.7009	0.2898	8.6641	127,083,411	7.8734
Lithuania	14.1775	-0.2769	10.77	1,469,154	7.0534
Luxembourg	16.8331		15.0906	14,102,022	
Latvia	12.6955	-1.6604	10.888	1,547,071	7.8768
Malta	5.0129	0.9722	49.5895	1,354,462	19.9484
Netherlands	23.191	0.3253	11.8438	79,190,851	4.312
Poland	9.9845	0.9955	12.5916	15,215,855	10.0155
Portugal	16.2055	0.4137	8.3075	26,096,489	6.1707
Romania	10.095	0.2954	14.0672	4,037,813	9.9059
Sweden	22.4228	0.454	10.6524	43,710,697	4.4597
Slovenia	13.1997		8.6168	3,576,843	
Slovakia	10.3912	0.9449	11.3775	2,718,788	9.6235

Data for Cluster Analysis (2011)

Country	Leverage	ROA	Tier1	CapRequirement	Equity
Austria	14.7088	0.0997	10.3362	51,999,521	6.7987
Belgium	21.7333	0.0624	15.1171	29,890,473	4.6012
Bulgaria	7.4215	0.6177	15.7269	3,221,143	13.4744
Cyprus	19.8765	-3.6021	7.3632	6,374,158	5.0311
Czech Republic	11.8051	1.1576	13.6476	6,285,205	8.4709
Germany	25.6969	0.0842	11.7204	206,239,892	3.8915
Denmark	21.1156	0.0284	14.8696	25,325,210	4.7358
Estonia	8.1191	3.1434	18.4969	909,014	12.3167
Spain	17.3905	-0.0273	10.2619	156,483,994	5.7503
Finland	26.0877	0.3111	13.7169	11,980,470	3.8332
France	21.084	0.2652	10.9386	189,799,375	4.7429
United Kingdom (GB)	20.5369	0.2063	10.7202	288,964,098	4.8693
Greece (GR)		-0.0949		19,698,781	
Hungary	13.5349	-0.8951	11.2816	5,771,852	7.3883
Ireland	17.6693	-0.6294	16.6557	31,116,525	
Italy	14.905	-0.8718	9.5307	127,785,604	6.7092
Lithuania	11.3141	1.5054	12.03	1,121,924	8.8385
Luxembourg	17.7315	0.2009	15.3167	14,308,763	
Latvia	10.6825	0.4733	13.5012	1,315,170	9.3611
Malta	5.1414	0.7665	52.1754	1,296,174	19.45
Netherlands	24.2033	0.2543	11.8275	81,110,097	4.1317
Poland	9.9034	1.244	11.8829	15,766,958	10.0975
Portugal	19.6136	-0.2085	8.5551	24,239,384	5.0985
Romania	9.9772	0.1075	14.218	4,085,412	10.0228
Sweden	24.1422	0.4411	10.9112	45,404,048	4.1421
Slovenia	13.2804	-0.8355	9.3185	3,330,766	
Slovakia	9.3784	1.1814	12.5071	2,652,139	10.6628

Data for Cluster Analysis (2012)

Country	Leverage	ROA	Tier1	CapRequirement	Equity
Austria	13.5207	0.3062	10.9854	49,754,082	7.3961
Belgium	17.3671	0.1889	15.8583	28,226,572	5.758
Bulgaria	7.621	0.6374	15.1336	3,371,846	13.1216
Cyprus	25.9792	-3.5796	6.2633	5,700,242	3.8492
Czech Republic	10.3912	1.3555	14.9338	6,454,205	9.6235
Germany	23.5117	0.0469	13.7989	195,088,473	4.2532
Denmark	20.2651	0.1008	16.6608	23,132,427	4.9346
Estonia	7.064	2.0073	22.7723	966,849	14.1563
Spain	17.9187	-1.3788	9.8022	137,974,018	5.5807
Finland	26.307	0.3467	16.309	9,418,246	3.8013
France	20.1376	0.17	13.3286	164,164,739	4.9658
United Kingdom (GB)	19.0944	0.1012	12.324	274,510,602	5.2371
Greece (GR)	26.618	-2.82	7.9557	17,922,374	3.7569
Hungary	11.517	-0.4416	13.3064	5,475,297	8.6829
Ireland	15.8325	-0.9205	16.6923	27,737,230	
Italy	14.3504	-0.0697	10.5522	116,845,177	6.9685
Lithuania	10.1774	0.9495	14.57	1,006,297	9.8257
Luxembourg	15.1105	0.494	18.601	13,367,031	
Latvia	10.2472	0.5863	14.5244	1,289,105	9.7588
Malta	4.979	1.1466	49.5596	1,386,382	20.0845
Netherlands	22.2859	0.1764	12.3005	77,342,810	4.4871
Poland	9.0904	1.2037	13.1377	17,737,291	11.0006
Portugal	15.4954	-0.2556	11.3057	23,240,349	6.4535
Romania	9.6992	-0.645	14.8007	3,769,413	10.3101
Sweden	22.0775	0.5141	11.2932	46,984,943	4.5295
Slovenia	12.9332	-1.4891	9.7697	2,947,298	
Slovakia	8.5302	0.9505	14.877	2,417,137	11.723

Data for Cluster Analysis (2013)

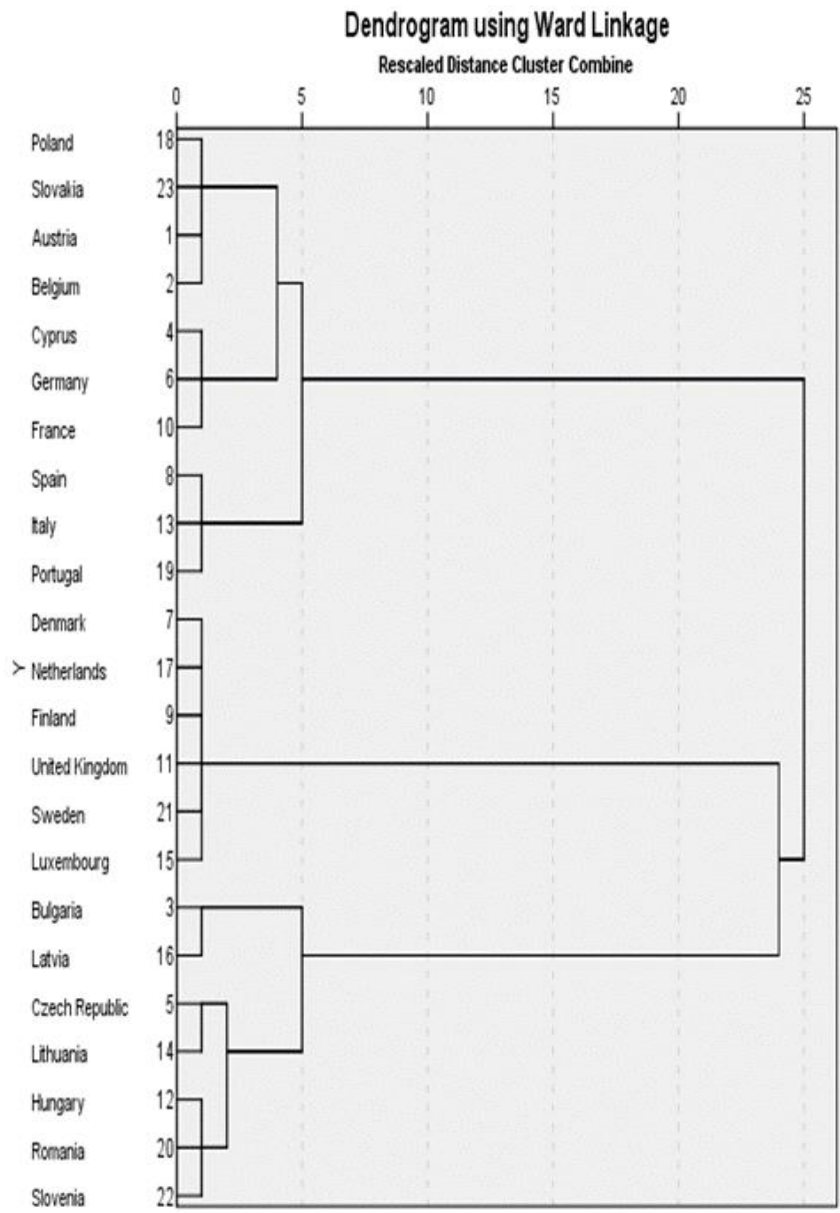
Country	Leverage	ROA	Tier1	CapRequirement	Equity
Austria	13.4435	-0.0439	11.892	51,339,531	7.4385
Belgium	15.6546	0.394	16.3718	29,302,875	6.3879
Bulgaria	7.786	0.589	16.0098	3,238,832	12.8436
Cyprus	12.2869	-2.8939	12.3376	6,191,933	8.1388
Czech Republic	10.7822	1.0847	15.9901	6,270,379	9.2745
Germany	20.2666	0.0618	15.1935	202,711,216	4.9342
Denmark	18.3646	0.2415	17.2719	24,793,259	5.4453
Estonia	6.8031	1.7727	22.7433	1,216,082	14.6992
Spain	14.8566	0.3587	11.8454	152,939,591	6.731
Finland	21.694	0.3919	15.4561	11,186,921	4.6096
France	18.0676	0.3319	13.1586	179,431,491	5.5348
United Kingdom (GB)	17.8832	0.1224	14.3809	279,470,414	5.5918
Greece (GR)	14.0211	0.0121	13.1786	19,902,183	7.1321
Croatia	7.466	0.0749	18.5906	5,835,193	13.394
Hungary	10.6735	-0.0035	14.6667	31,866,574	9.369
Ireland	15.015	-0.8763	17.3135	123,904,731	
Italy	14.9563	-0.7694	10.5504	1,199,125	6.6861
Lithuania	9.6382	1.016	17.0399	13,925,939	10.3754
Luxembourg	13.9009	0.4954	21.3035	1,383,782	
Latvia	9.9115	0.9114	16.4961	1,345,673	10.0893
Malta	6.6128	0.7233	43.8705	79,214,586	15.1222
Netherlands	20.7787	0.2421	12.856	16,240,035	4.8126
Poland	9.0393	1.1202	13.9635	24,525,407	11.0628
Portugal	14.8435	-0.7051	12.2322	3,964,213	6.7369
Romania	9.6599	0.0803	15.7667	45,366,563	10.3521
Sweden	21.3431	0.5391	11.4627	3,284,969	4.6854
Slovenia	11.2884	-7.9899	12.9071	2,596,021	
Slovakia	8.2076	0.9624	16.2224	88.2005	12.1838

Data for Cluster Analysis (2015)

Country	Solvency Ratio	Tier1 ratio	Leverage Ratio	ROA
Austria	16.1711	12.7110	13.5270	0.5633
Belgium	18.6884	15.9676	14.7427	0.6968
Bulgaria	21.6123	19.9327	7.6811	1.0262
Cyprus	16.5667	15.9969	10.7340	-0.6345
Czech Republic	17.5731	17.0630	10.1007	1.1720
Germany	17.9119	15.4358	18.5557	0.0918
Denmark	19.8170	17.6336	16.6700	0.4085
Spain	14.4769	12.6634	13.7165	0.4663
Finland	23.7774	22.3936	19.0619	0.4663
France	16.4076	13.8058	17.2598	0.3955
United Kingdom	19.4591	15.5893	15.6323	0.2028
Hungary	16.9457	13.8852	11.2245	-0.0938
Ireland	25.2644	23.1843	7.8237	0.8701
Italy	14.8271	12.3228	13.1300	0.2394
Lithuania	24.8462	24.2938	9.0433	0.9186
Luxembourg	20.9232	20.1808	13.4468	0.5523
Latvia	21.8429	18.9821	9.5206	1.1951
Netherlands	20.6233	16.5665	17.9580	0.3974
Poland	15.8145	14.5110	9.1847	0.8626
Portugal	13.3227	12.5939	12.3784	0.0901
Romania	18.9177	16.3772	9.7944	1.1694
Sweden	24.1120	21.0329	18.8243	0.6154
Slovenia	18.6446	17.9843	8.5691	0.4057
Slovakia	17.7472	16.4936	8.9909	0.9295

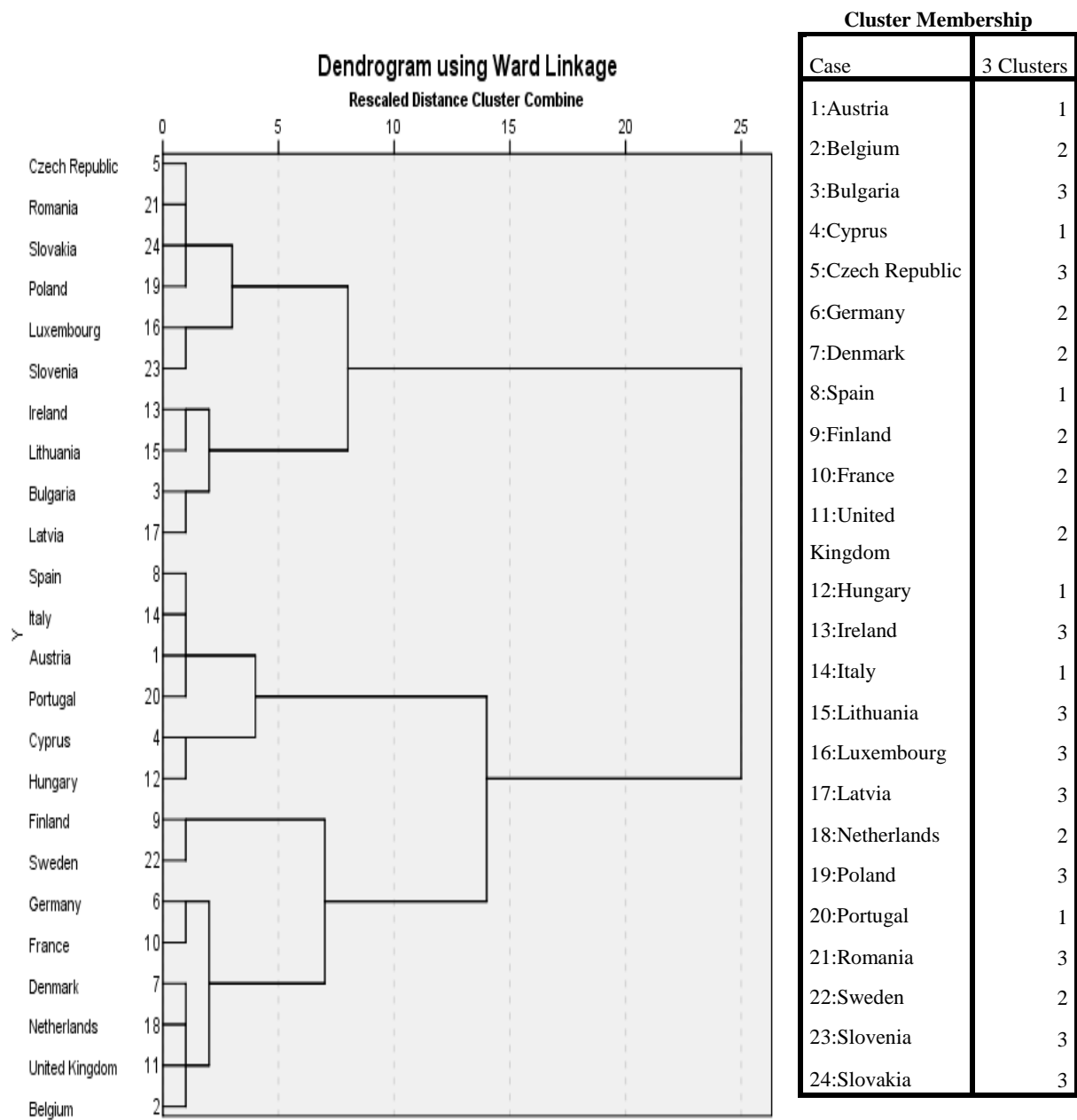
Data for Cluster Analysis (2018)

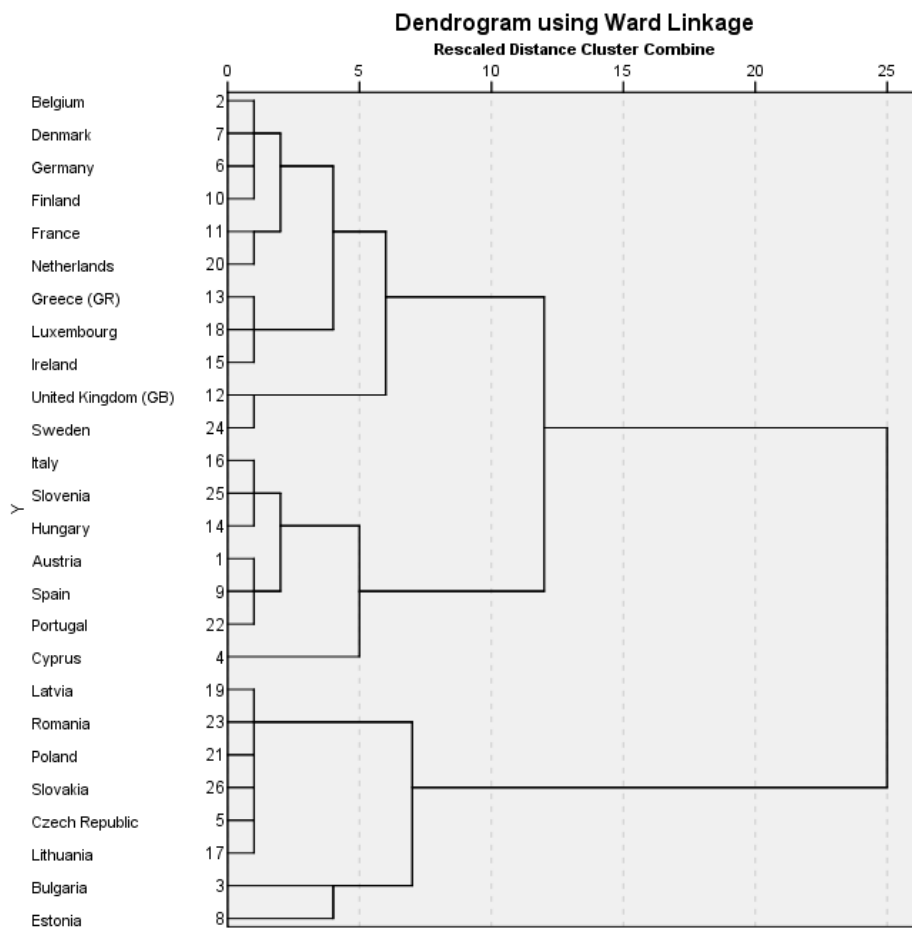
Country	Solvency ratio	Tier1 ratio	LeverageRatio	ROA
Austria	18.5835	16.0298	11.4088	0.7628
Belgium	18.7665	16.4819	13.1326	0.6245
Bulgaria	20.5918	19.6610	7.4742	1.6138
Cyprus	17.1210	16.1301	14.0871	0.2641
Czech Republic	18.2887	17.7780	12.4662	1.1022
Germany	18.4361	16.2910	13.8551	0.1746
Denmark	21.5924	19.7083	16.4032	0.4875
Spain	15.3690	13.5138	13.5859	0.6120
Finland	20.9469	18.6479	16.0591	0.5383
France	18.0372	15.5637	15.3245	0.4222
United Kingdom	21.3930	17.8878	15.2981	0.3617
Hungary	18.4571	16.6927	9.3736	1.5968
Italy	16.0853	13.8996	13.0607	0.4411
Lithuania	18.5788	18.4494	10.4187	1.2432
Luxembourg	21.3977	20.7695	14.6113	0.4323
Latvia	22.2634	20.2604	7.8065	1.2210
Netherlands	22.3818	18.9588	16.1408	0.5034
Poland	17.9274	16.1250	9.3141	0.7608
Portugal	15.1583	13.9477	11.0049	0.2816
Romania	19.6669	17.7367	9.2838	1.5322
Sweden	20.7121	18.4594	18.0750	0.7518
Slovenia	17.9486	17.6282	8.1546	1.2803
Slovakia	17.7648	16.1542	9.4812	0.8375



Cluster Membership

Case	3 Clusters
1:Austria	1
2:Belgium	1
3:Bulgaria	2
4:Cyprus	1
5:Czech Republic	2
6:Germany	1
7:Denmark	3
8:Spain	1
9:Finland	3
10:France	1
11:United Kingdom	3
12:Hungary	2
13:Italy	1
14:Lithuania	2
15:Luxembourg	3
16:Latvia	2
17:Netherlands	3
18:Poland	1
19:Portugal	1
20:Romania	2
21:Sweden	3
22:Slovenia	2
23:Slovakia	1

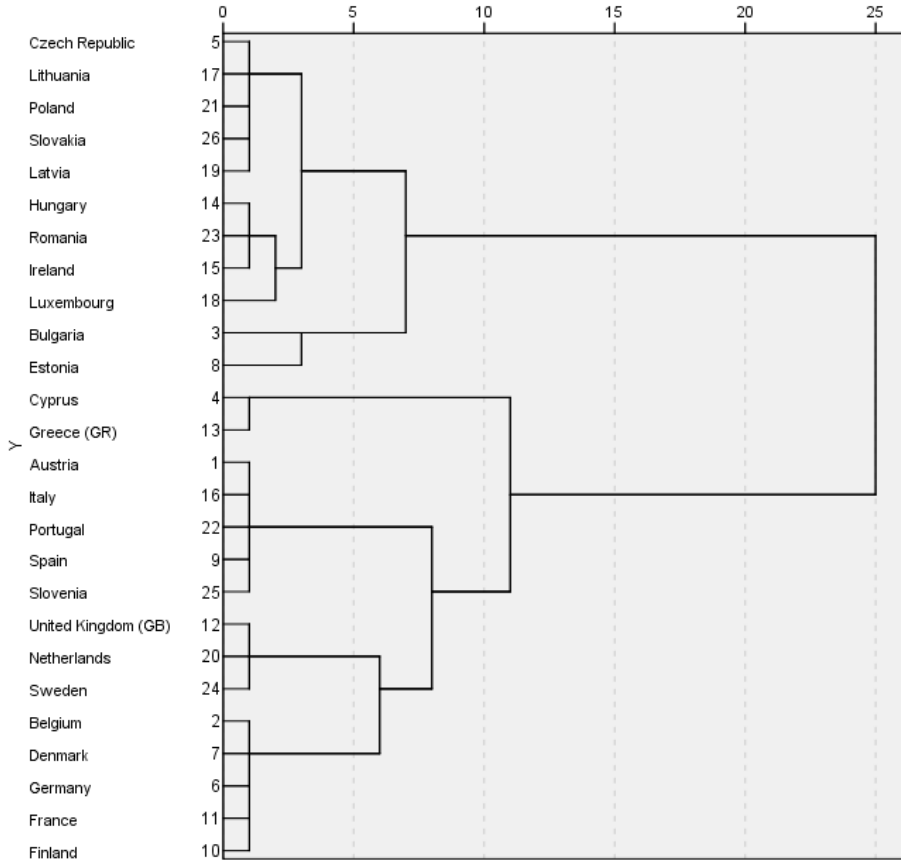




Cluster Membership

Case	3 Clusters
1:Austria	1
2:Belgium	2
3:Bulgaria	3
4:Cyprus	1
5:Czech Republic	3
6:Germany	2
7:Denmark	2
8:Estonia	3
9:Spain	1
10:Finland	2
11:France	2
12:United Kingdom (GB)	2
13:Greece (GR)	2
14:Hungary	1
15:Ireland	2
16:Italy	1
17:Lithuania	3
18:Luxembourg	2
19:Latvia	3
20:Netherlands	2
21:Poland	3
22:Portugal	1
23:Romania	3
24:Sweden	2
25:Slovenia	1
26:Slovakia	3

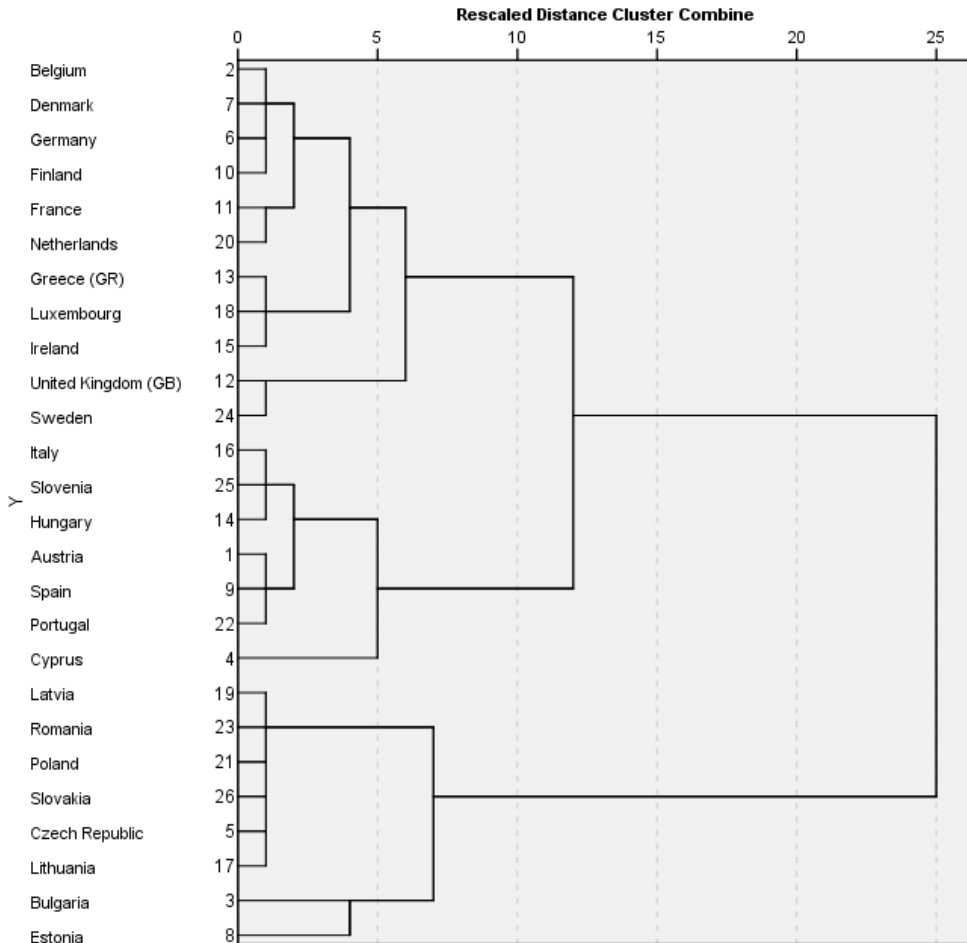
Dendrogram using Ward Linkage
Rescaled Distance Cluster Combine



Cluster Membership

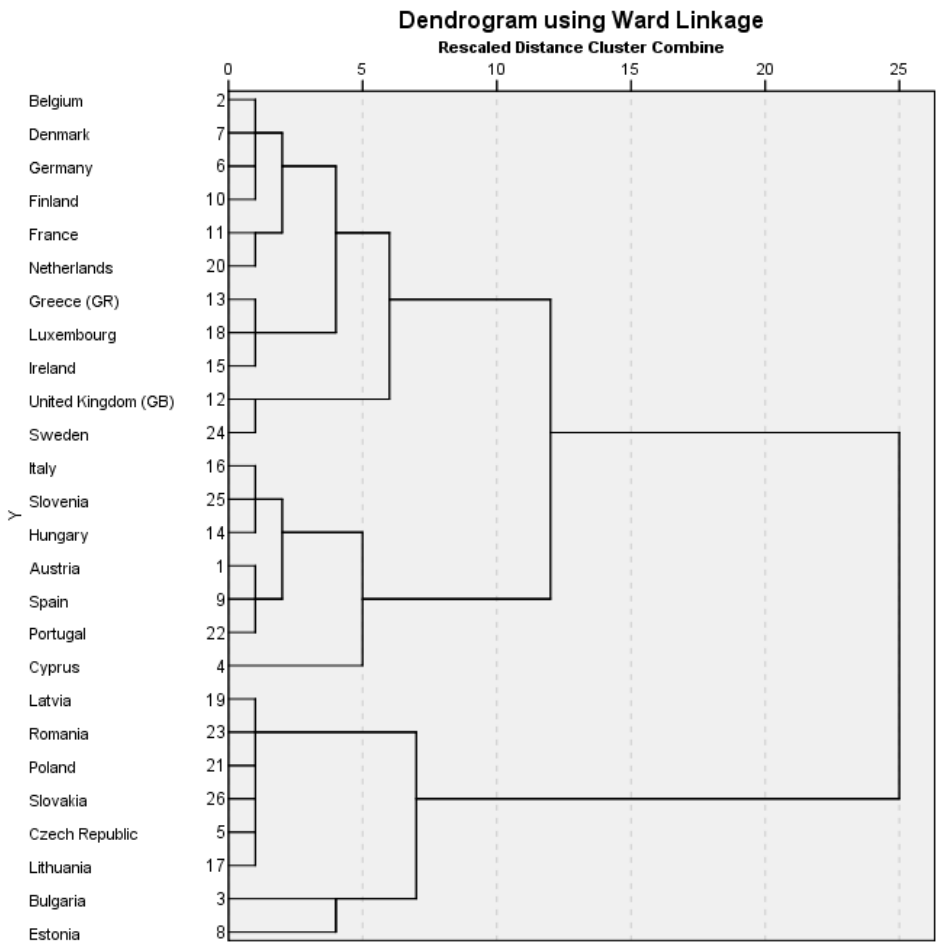
Case	3 Clusters
1:Austria	1
2:Belgium	1
3:Bulgaria	2
4:Cyprus	3
5:Czech Republic	2
6:Germany	1
7:Denmark	1
8:Estonia	2
9:Spain	1
10:Finland	1
11:France	1
12:United Kingdom (GB)	1
13:Greece (GR)	3
14:Hungary	2
15:Ireland	2
16:Italy	1
17:Lithuania	2
18:Luxembourg	2
19:Latvia	2
20:Netherlands	1
21:Poland	2
22:Portugal	1
23:Romania	2
24:Sweden	1
25:Slovenia	1
26:Slovakia	2

Dendrogram using Ward Linkage



Cluster Membership

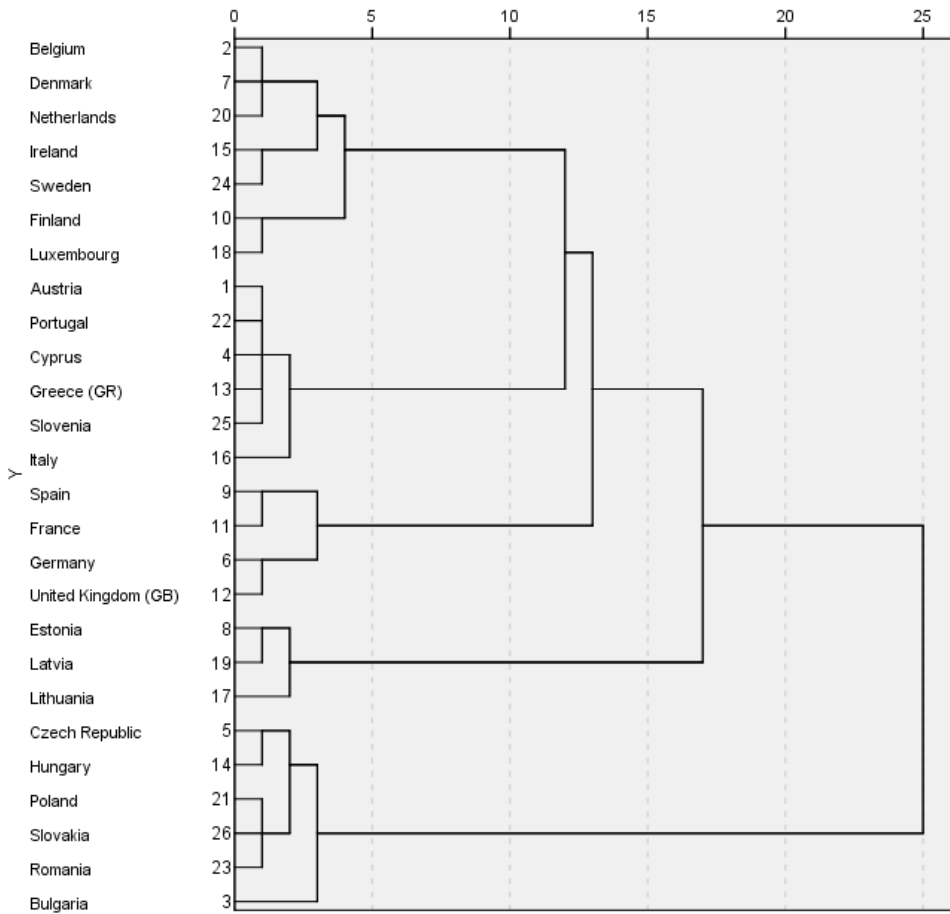
Case	3 Clusters
1:Austria	1
2:Belgium	2
3:Bulgaria	3
4:Cyprus	1
5:Czech Republic	3
6:Germany	2
7:Denmark	2
8:Estonia	3
9:Spain	1
10:Finland	2
11:France	2
12:United Kingdom (GB)	2
13:Greece (GR)	2
14:Hungary	1
15:Ireland	2
16:Italy	1
17:Lithuania	3
18:Luxembourg	2
19:Latvia	3
20:Netherlands	2
21:Poland	3
22:Portugal	1
23:Romania	3
24:Sweden	2
25:Slovenia	1
26:Slovakia	3



Cluster Membership

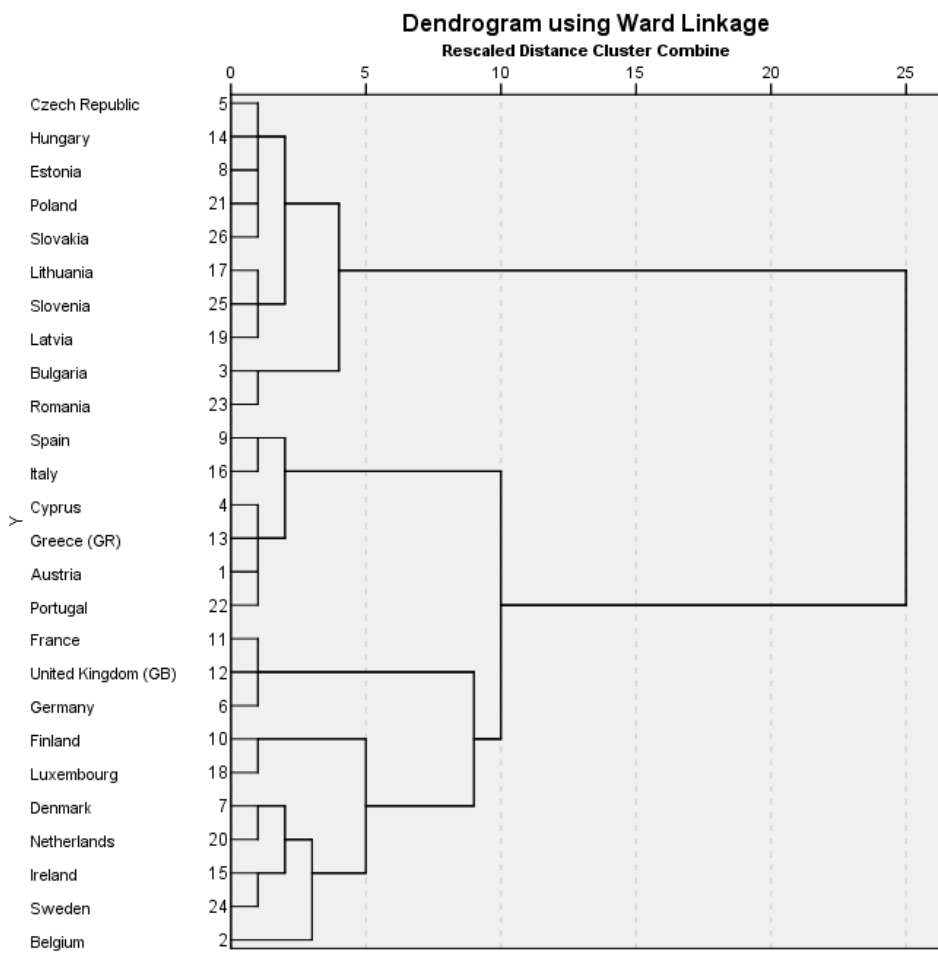
Case	3 Clusters
1:Austria	1
2:Belgium	2
3:Bulgaria	3
4:Cyprus	1
5:Czech Republic	3
6:Germany	2
7:Denmark	2
8:Estonia	1
9:Spain	2
10:Finland	2
11:France	2
12:United Kingdom (GB)	2
13:Greece (GR)	1
14:Hungary	1
15:Ireland	2
16:Italy	1
17:Lithuania	1
18:Luxembourg	2
19:Latvia	1
20:Netherlands	2
21:Poland	3
22:Portugal	1
23:Romania	1
24:Sweden	2
25:Slovenia	1
26:Slovakia	3

Dendrogram using Ward Linkage
Rescaled Distance Cluster Combine



Cluster Membership

Case	3 Clusters
1:Austria	1
2:Belgium	1
3:Bulgaria	2
4:Cyprus	1
5:Czech Republic	2
6:Germany	1
7:Denmark	1
8:Estonia	3
9:Spain	1
10:Finland	1
11:France	1
12:United Kingdom (GB)	1
13:Greece (GR)	1
14:Hungary	2
15:Ireland	1
16:Italy	1
17:Lithuania	3
18:Luxembourg	1
19:Latvia	3
20:Netherlands	1
21:Poland	2
22:Portugal	1
23:Romania	2
24:Sweden	1
25:Slovenia	1
26:Slovakia	2



Cluster Membership

Case	3 Clusters
1:Austria	1
2:Belgium	2
3:Bulgaria	3
4:Cyprus	1
5:Czech Republic	3
6:Germany	2
7:Denmark	2
8:Estonia	3
9:Spain	1
10:Finland	2
11:France	2
12:United Kingdom (GB)	2
13:Greece (GR)	1
14:Hungary	3
15:Ireland	2
16:Italy	1
17:Lithuania	3
18:Luxembourg	2
19:Latvia	3
20:Netherlands	2
21:Poland	3
22:Portugal	1
23:Romania	3
24:Sweden	2
25:Slovenia	3
26:Slovakia	3

Descriptive Statistic for 2008 data

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation	Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error
leverage	27	8.7705	34.1591	19.026952	7.4186622	-.903	.872
ROA	27	-1.4715	1.9753	.481429	.7056013	1.444	.872
Tier 1	27	6.6088	15.5771	9.748011	1.9725025	1.570	.872
cap requirement	27	1484210	262647707	53974198.56	79224186.76	2.162	.872
Equity % of assets	27	2.9275	11.4018	6.179858	2.1087315	-.059	.872
Valid N (listwise)	27						

Descriptive Statistic for 2009 data

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation	Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error
leverage	27	7.5121	26.5840	16.288070	4.9973233	-.826	.872
ROA	27	-3.9690	1.8496	-.034292	1.4502855	3.534	.872
Tier 1	27	7.8843	21.3406	11.546385	2.7334247	5.310	.872
cap requirement	27	1191789	277918553	51567498.74	77157181.96	2.653	.872
Equity % of assets	27	3.7617	13.3119	6.886975	2.2691782	1.159	.872
Valid N (listwise)	27						

Descriptive Statistic for 2010 data

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation	Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error
leverage	27	5.0129	25.8002	15.626244	5.1735673	-.613	.872
ROA	27	-1.6604	1.2751	.362745	.5500084	6.372	.872
Tier 1	27	8.3075	49.5895	13.139400	7.5490138	22.990	.872
cap requirement	27	1354462	274936542	50119850.52	74271139.25	2.588	.872
Equity % of assets	27	3.8759	19.9484	7.570611	3.3294726	6.699	.872
Valid N (listwise)	27						

Descriptive Statistic for 2011 data

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation	Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error
leverage	27	5.1414	26.0877	16.040504	5.9668284	-1.053	.872
ROA	27	-3.6021	3.1434	.184659	1.1253929	5.465	.872
Tier 1	27	7.3632	52.1754	13.947196	8.0678228	21.104	.872
capital requirment for credit, counter party (% of total capital req)	27	58.2101	91.4904	82.835196	8.4840285	2.568	.872
Equity % of assets	27	3.8332	19.4500	7.568466	3.5456818	3.623	.872
Valid N (listwise)	27						

Descriptive Statistic for 2012 data

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation	Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error
leverage	27	4.9790	26.6180	15.485981	6.3470186	-1.012	.872
ROA	27	-3.5796	2.0073	-.011774	1.2158424	2.378	.872
Tier 1	27	6.2633	49.5596	14.867270	7.7072916	16.709	.872
cap requirement	27	57.17	91.01	81.9777	9.20381	2.106	.872
Equity % of assets	27	3.7569	20.0845	7.927437	3.8229630	2.526	.872
Valid N (listwise)	27						

Descriptive Statistic for 2013 data

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation	Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error
leverage	27	5.1414	26.0877	16.040504	5.9668284	-1.053	.872
ROA	27	-3.6021	3.1434	.184659	1.1253929	5.465	.872
Tier 1	27	7.3632	52.1754	13.947196	8.0678228	21.104	.872
capital requirment for credit, counter party (% of total capital req)	27	58.2101	91.4904	82.835196	8.4840285	2.568	.872
Equity % of assets	27	3.8332	19.4500	7.568466	3.5456818	3.623	.872
Valid N (listwise)	27						

Descriptive Statistic for 2015 data

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation	Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error
Solvency	24	13.3227	25.2644	19.012208	3.3272669	-.641	.918
Tier 1 ratio	24	12.3228	24.2938	16.983379	3.4436300	-.454	.918
Leverage	24	7.6811	19.0619	12.815433	3.7783804	-1.271	.918
ROA	24	-.6345	1.1951	.541950	.4411443	.739	.918
Valid N (listwise)	24						

Descriptive Statistic for 2018 data

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation	Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error
Solvency ratio	23	15.1583	22.3818	19.020361	2.0908316	-.743	.935
Tier 1 ratio	23	13.5138	20.7695	17.251083	2.0012406	-.556	.935
Leverage Ratio	23	7.4742	18.0750	12.426957	3.1038079	-1.157	.935
ROA	23	.1746	1.6138	.775900	.4466243	-.778	.935
Valid N (listwise)	23						

APPENDIX FOR CHAPTER 5

Unit root test results.

Null Hypothesis: _BETI has a unit root

Exogenous: Constant

Lag Length: 0 (Automatic - based on SIC, maxlag=32)

	t-Statistic	Prob.*
	-	
	64.75382366930	
Augmented Dickey-Fuller test statistic	906	0.0001

Null Hypothesis: _BUX has a unit root

Exogenous: Constant

Lag Length: 1 (Automatic - based on SIC, maxlag=32)

	t-Statistic	Prob.*
	-	
	51.51886315566	
Augmented Dickey-Fuller test statistic	101	0.0001

Null Hypothesis: _CRBEX has a unit root

Exogenous: Constant

Lag Length: 0 (Automatic - based on SIC, maxlag=32)

	t-Statistic	Prob.*
	-	
	68.14402119286	
Augmented Dickey-Fuller test statistic	93	0.0001

Null Hypothesis: _DJI has a unit root

Exogenous: Constant

Lag Length: 1 (Automatic - based on SIC, maxlag=32)

	t-Statistic	Prob.*
	-	
	55.00792563213	
Augmented Dickey-Fuller test statistic	238	0.0001

Null Hypothesis: _FTSE has a unit root

Exogenous: Constant

Lag Length: 5 (Automatic - based on SIC, maxlag=32)

	t-Statistic	Prob.*
	-	
	33.01375232574	3.0546867724
Augmented Dickey-Fuller test statistic	13	79505e-39

Null Hypothesis: _XU100 has a unit root

Exogenous: Constant

Lag Length: 0 (Automatic - based on SIC, maxlag=32)

	t-Statistic	Prob.*
	-	
	71.70320523079	
Augmented Dickey-Fuller test statistic	471	0.0001

Null Hypothesis: DAX has a unit root

Exogenous: Constant

Lag Length: 0 (Automatic - based on SIC, maxlag=29)

		t-Statistic	Prob.*
<hr/>			
Augmented Dickey-Fuller test statistic		-63.78079	0.0001
<hr/>			
Test critical values:	1% level	-3.431934	
	5% level	-2.862125	
	10% level	-2.567125	

Null Hypothesis: ASE has a unit root

Exogenous: Constant

Lag Length: 0 (Automatic - based on SIC, maxlag=29)

		t-Statistic	Prob.*
<hr/>			
Augmented Dickey-Fuller test statistic		-56.57874	0.0001
<hr/>			
Test critical values:	1% level	-3.431934	
	5% level	-2.862125	
	10% level	-2.567125	

Null Hypothesis: WIG has a unit root

Exogenous: Constant

Lag Length: 0 (Automatic - based on SIC, maxlag=29)

		t-Statistic	Prob.*
<hr/>			
Augmented Dickey-Fuller test statistic		-57.68561	0.0001
<hr/>			
Test critical values:	1% level	-3.431934	
	5% level	-2.862125	
	10% level	-2.567125	

Table 7: DCC-mGARCH Model Results

Dynamic conditional correlation MGARCH model	
Sample: 21aug2000 - 02jul2019, but with gaps	Number of obs = 2462
Distribution: Gaussian	Wald chi2(18) = 267.31
Log likelihood = -5034.319	Prob > chi2 = 0.0000

```

-----
      |   Coef.   Std. Err.   z   P>|z|   [95% Conf. Interval]
-----+-----
wig   |
      |   ftse   |
      | L1. | -0.000611   .0002932   -0.21   0.835   -0.0006357   .0005135
      |   |
      |   dji   |
      | L1. | -0.0031744   .00029   -10.94   0.000   -0.0037428   -0.0026059
      |   |
      |   dax   |
      | L1. | -0.044256   .0277233   -1.60   0.110   -0.0985928   .0100807
      |   |
      | _cons | .0004996   .0002333   2.14   0.032   .0000423   .0009569
-----+-----
ARCH_wig |
      |   arch   |
      | L1. | .1503948   .033036   4.55   0.000   .0856455   .2151442
      |   |
      |   garch  |
      | L1. | .7385644   .2120268   3.48   0.000   .3229994   1.154129
      |   |
      | _cons | .000029   .0000331   0.88   0.381   -0.0000359   .0000938
-----+-----
ase   |
      |   ftse   |
      | L1. | .0009661   .0006759   1.43   0.153   -0.0003586   .0022908
      |   |
      |   dji   |
      | L1. | -0.0059296   .0006702   -8.85   0.000   -0.0072432   -0.0046159
      |   |
      |   dax   |
      | L1. | .0161422   .0657576   0.25   0.806   -0.1127404   .1450248

```

```

      |
    _cons | .0006159 .000566 1.09 0.277 -.0004935 .0017253
-----+-----
ARCH_ase  |
  arch |
  L1. | .2783134 .0434876 6.40 0.000 .1930793 .3635475
      |
  garch |
  L1. | .5225518 .1427821 3.66 0.000 .2427041 .8023996
      |
    _cons | .0002328 .0001114 2.09 0.037 .0000144 .0004511
-----+-----
bux       |
  ftse |
  L1. | -.0418434 .0439863 -0.95 0.341 -.128055 .0443682
      |
  dji |
  L1. | .4423081 .0462522 9.56 0.000 .3516554 .5329608
      |
  dax |
  L1. | 11.30387 4.12265 2.74 0.006 3.223623 19.38411
      |
    _cons | -.0821045 .0349741 -2.35 0.019 -.1506526 -.0135564
-----+-----
ARCH_bux  |
  arch |
  L1. | .310059 .0457616 6.78 0.000 .2203679 .3997501
      |
  garch |
  L1. | .2697368 .1458958 1.85 0.064 -.0162137 .5556873
      |
    _cons | 2.204231 .6082703 3.62 0.000 1.012043 3.396419
-----+-----
crbex     |
  ftse |
  L1. | -.0167251 .0308706 -0.54 0.588 -.0772303 .0437802
      |
  dji |

```

```

L1. | .2724656 .0298775 9.12 0.000 .2139067 .3310245
|
dax |
L1. | 3.966149 2.736578 1.45 0.147 -1.397446 9.329743
|
_cons | -.0470319 .0229015 -2.05 0.040 -.091918 -.0021457

```

```

-----+-----
ARCH_crbex |
arch |
L1. | .3588827 .0453744 7.91 0.000 .2699505 .4478149
|
garch |
L1. | .3357309 .1526691 2.20 0.028 .036505 .6349569
|
_cons | .7222859 .2727664 2.65 0.008 .1876735 1.256898

```

```

-----+-----
beti |
ftse |
L1. | -.010369 .0353576 -0.29 0.769 -.0796686 .0589305
|
dji |
L1. | .4028308 .0371725 10.84 0.000 .329974 .4756876
|
dax |
L1. | 7.515214 3.323879 2.26 0.024 1.000531 14.0299
|
_cons | -.0703428 .0284832 -2.47 0.014 -.1261689 -.0145168

```

```

-----+-----
ARCH_beti |
arch |
L1. | .4124488 .0448678 9.19 0.000 .3245095 .500388
|
garch |
L1. | .5799158 .1339524 4.33 0.000 .317374 .8424577
|
_cons | .4429265 .3614695 1.23 0.220 -.2655407 1.151394

```

```

-----+-----
xu100 |

```

```

ftse |
L1. | -.0298775 .0597779 -0.50 0.617 -.14704 .087285
|
dji |
L1. | .498809 .0590773 8.44 0.000 .3830197 .6145984
|
dax |
L1. | 8.124732 5.558057 1.46 0.144 -2.768859 19.01832
|
_cons | -.0608386 .0463239 -1.31 0.189 -.1516317 .0299545
-----+-----
ARCH_xu100 |
arch |
L1. | .3311668 .0378447 8.75 0.000 .2569926 .4053411
|
garch |
L1. | .6677498 .101606 6.57 0.000 .4686057 .8668939
|
_cons | .3760948 .6795099 0.55 0.580 -.9557201 1.70791
-----+-----
corr(wig,ase) | .4268095 .0563466 7.57 0.000 .3163722 .5372467
corr(wig,bux) | -.8113719 .0356631 -22.75 0.000 -.8812703 -.7414736
corr(wig,crbex) | -.7261873 .0479063 -15.16 0.000 -.820082 -.6322926
corr(wig,beti) | -.7804657 .040714 -19.17 0.000 -.8602636 -.7006677
corr(wig,xu100) | -.7429045 .0377225 -19.69 0.000 -.8168393 -.6689698
corr(ase,bux) | -.4100544 .0623954 -6.57 0.000 -.5323471 -.2877617
corr(ase,crbex) | -.351947 .0670249 -5.25 0.000 -.4833134 -.2205806
corr(ase,beti) | -.4130791 .0616689 -6.70 0.000 -.533948 -.2922103
corr(ase,xu100) | -.3498465 .0594567 -5.88 0.000 -.4663796 -.2333135
corr(bux,crbex) | .8565489 .0365261 23.45 0.000 .784959 .9281388
corr(bux,beti) | .8782703 .0316748 27.73 0.000 .8161889 .9403518
corr(bux,xu100) | .7708876 .0369291 20.87 0.000 .698508 .8432672
corr(crbex,beti) | .8872047 .0269759 32.89 0.000 .834333 .9400764
corr(crbex,xu100) | .7320671 .0431352 16.97 0.000 .6475236 .8166106
corr(beti,xu100) | .7567602 .0398946 18.97 0.000 .6785683 .8349522
-----+-----
Adjustment |
lambda1 | .0018333 .0004775 3.84 0.000 .0008975 .0027691

```

lambda2 | .9950441 .0002112 4711.11 0.000 .9946301 .995458

Source: Author's own