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INCREASED CO-MOVEMENT OR CONTAGION BETWEEN ECONOMIES? EVIDENCE FROM 45 STOCK MARKETS

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ABSTRACT

The Global Financial Crisis of 2007 - 2009 and the European Sovereign Debt Crisis represent two of the most dangerous treats at the stability of the modern financial system. The consequences of these two crises translated their impulse all around the globe, contaminating everything in their way like falling domino pieces. This has revealed that the modern financial system has flows and that certain actions need to be implemented in order to avoid in the future these catastrophic events, and to preserve the stability of economy.

This thesis investigates how the above mentioned crises have changed the co-movement and correlations between different countries and translated their consequences to other economies, by testing for contagion. Using an asymmetric GARCH model, the paper examines the evolution of the correlations between 45 major stock markets, in different economic states, for the period 2000 - 2014. The results reveal that during the Global Financial Crisis the correlations between individual stock markets and the global stock index increased significantly, resulting in contagion at the level of the majority of countries included in the analysis. After the crisis, the correlation levels tend to decrease. However, when compared to the pre-crisis level, values are considerably higher, suggesting that the global stock market is becoming more and more integrated, and that there may still be some contagion left in the markets. The results for the European Sovereign Debt crisis suggest that every member of the group felt the consequences but in different measure. The crisis originated at the periphery, and then gradually shifted to the core.

KEYWORDS: Contagion, correlation, co-movement, crisis

1. INTRODUCTION

Economy has always been an uncertain phenomenon, incorporating periods of stability, ascending evolution, and positive market sentiment on one hand, and upward volatility, distress and dramatic losses on the other hand. The objective of each investor is to create such a portfolio that will maximize his wealth, while keeping the level of exposure to uncertainty and risk at minimal values. Recently, thanks to the so called globalization phenomenon, the set of tools and methods for immunizing investor's portfolio has been broadened with one more: international portfolio diversification. Now, companies as well as individual investors have the possibility to hold stocks, bonds or financial derivatives of companies from foreign countries, or to take a direct piece of an international company by merging or acquiring it. Moreover, the diversification options go further, allowing investing also in foreign government bonds, limiting in this way the exposure of the portfolio to that country's specific level of risk.

However, thanks to the above mentioned phenomenon, the level of integration between economies and countries in general has started to increase. Now, the national economies are becoming more and more regional, while at their turn regional economies are evolving into global economies. According to the publication "Mergers & Acquisitions Review Financial Advisors First Half 2014" by Thomson Reuters, the total volume of global Mergers & Acquisitions for the first half of 2014 increased by more than 73%, registering the strongest first half for worldwide deal making since 2007 when compared to the same period of the last year, which means that the correlation coefficient of financial integration between countries is increasing year by year. This phenomenon is beneficial for investors and countries in general as individual entities in good times, but extremely dangerous in crisis periods because a higher degree of correlation between countries, markets and investments represents a higher degree of contagion and risk transferring from one country to another when there is a crisis happening. And this proved to be true in 2007, when what seemed to be a small local problem degenerated extremely quickly in a global crisis, transferring its consequences from one economy to another, from one local market to an international one.

The failure of Lehman Brothers, one of the biggest financial firms in the USA with an international exposure, represented the first fallen domino piece which translated its impulse to other countries, and other economies thanks to the existing linkages between them. The severity of the contagion was different from country to country, those who

had stronger interdependencies with an economy affected by the crisis had suffered at their turn. Baur (2012), Kenourgios & Dimitriou (2015), Dimitriou et all. (2013), Fry-McKibbin, Martin & Tang (2014) show that the consequences of the Global Financial Crisis were felt not just at the level of US but also at the level of smaller and less developed countries. Contagion was registered in a large number of global and local economies.

This showed that each country's economy cannot be anymore treated and analyzed just as an individual and separate player; it has to be treated as a whole entity. In order to get a complete picture it is necessary to extend the natural and financial borders; it is necessary to take into consideration the linkages between countries and their economies, no matter if these are financial linkages or trade linkages. It is necessary to analyze this "network" and see where the weak points are; how the contagion does spread around, and how it can be avoided in the future.

Recently this subject has started to gain a significant attention from academic researchers. Attention has been concentrated on the linkages between countries, on the evolution of the degree of correlation between local and global economies, as well as how the financial contagion resulted from the explosion of the financial bubble in the USA translated its impulse all around the world, contaminating everything in its way like a reckless virus. Moshirian (2011) analyzes the relationship between the financial crisis and regulations, Guo, Chen & Huang (2011) study the correlation between different markets and how vulnerable are they to different shocks, Aloui, Aissa & Nguyen (2011) evaluate the effects that the global financial crisis had on emerging markets, while Kenourgios, Samitas & Paltdalidis (2011) focus their attention on BRIC markets. However, previous literature focuses its attention mainly on the immediate impact of the crisis on the global and local economies, while its long term impact and recovery period is left on the dark. Therefore, this paper comes as a completion of previous studies regarding the co-movement between countries and the post-crisis economic situation.

The Global Financial Crisis has revealed that the global financial system is still vulnerable and its foundations weak and that linkages and correlations between economies need to be studied and quantified in order to better protect the investment, or taking a macroeconomic perspective, which measures and actions need to be implemented in order to limit the impact of negative shocks coming from outside.

1.1. Purpose of the study

The aim of this thesis is to analyze the linkages between global economies before the Global Financial Crisis of 2007-2009, during the crisis, and after the crisis. It tends to evaluate the level of interdependencies between countries; how interconnected and integrated are they at the level of their economies; what happened during the financial crisis; which countries where affected the most, and from which direction the contagion started to spread. Moreover, it aims to check if after the crisis finished, the linkages between countries expressed in absolute value have reached the pre-crisis level, decreased more or there still exists some unidentified contagion.

From the perspective of European Union countries linkages, the paper aims to investigate the level of economic dependencies between the members, and to quantify the impact of financial crisis on each individual country, as well as the impact of the European sovereign debt crisis. All in all, the paper aims to make a clear presentation of the impact of crises on the economic stability of countries and how the contagion transfers from one economy to another.

1.2. Hypotheses

The primary interest of this thesis is to investigate the linkages between countries and the impact of the financial crisis on these relationships, which yields the following hypothesis:

H_{01}: The relationship between a country's stock market and world portfolio of stocks in the crisis period is higher than in normal periods: contagion.

Previous research papers (Baur 2012; Chevallier 2012; Grammatikos & Vermeulen 2012; Dovern & Roye 2014) reveal that during a crisis the relationship between countries tends to increase in value and economies to co-move in the same direction. As a result, the diversification benefits that investors constructed their portfolios based on, are eliminated exactly when they are needed the most. Therefore, similar results are expected to be found.

Moving forward, another point of interest of this paper is to analyze the level of dependency between countries before the crisis and after the crisis, to see if after the

crisis the co-movement between countries had come to its pre-crisis levels or, it is higher. Therefore, the second hypothesis that is going to be tested takes the following form:

H_{02}: The level of co-movement between economies after crisis is higher than the level of co-movement before the crisis.

Because generally the speed of economy's recovery after a crisis is low, it is expected that the level of co-movement between countries after the crisis is higher, and therefore, evidence in favor of the second hypothesis to be found.

Previous literature documents that a negative shock in a developed economy translates quickly its impulse to other countries. Dungey and Gajurel (2014) study the equity market contagion during the global financial crisis (2007 - 2009) using a latent factor model. The paper finds strong evidence in favor of contagion presence. The contagion from US explains a large amount of the variance registered at the level of stock returns in both advanced and emerging markets. Another paper of interest is Samarakoon (2011) who study the transmission of shocks and contagion between US, emerging markets and frontier markets. The paper reveals that at the level of emerging markets-US there exists an important asymmetric bi-directional interdependence and contagion. Strong co-movements are driven in most part by US shocks whereas contagion is driven more by emerging market shocks.

Taking the analysis at the level of European Union, this thesis aims to test the following hypotheses:

H_{03}: The level of co-movement between country members during the crisis is the same as the level of co-movement before the crisis.

H_{04}: The degree of contagion is the same for all European Union country members.

Ludwig (2014), Grammatikos & Vermeulen (2012) and Claeys & Vasicek (2014) reveal that during the financial crisis European countries registered an increased co-movement with US and had suffered from contagion. Each member was affected in different measure and the negative impulse translated from one economy to another.

1.3. Intended contribution

The innovative aspect that this thesis intends to bring is the triple comparison between countries co-movement: before the crisis, during the crisis and after the crisis. All research papers until now studied the period before the crisis and during the crisis, and none of them focused on the period after the crisis. It will be useful to see how long is the impact of a shock in the economy, and what is the speed of recovery for individual countries. Moreover, the thesis will make a synthesis of the degree of co-movement between all European Union countries individually. The existing research papers have focused only on some categories of countries while none of them divided and examined the European Union individually.

The limitations of this thesis consist in the potential bias caused by the delimitation of the crisis period. Many research papers use different methods in order to delimit the beginning and the ending of a crisis, and from this point of view the results can be slightly different. In the same order of thoughts, the time period chosen for the analysis can limit the consistency of the results. The outcomes of the investigation can be different if one will use the period 1999-2012 for his analysis, and another the period between 2002 and 2012 because of the Dot.com crisis which happened in 2000. The results may lose a degree of confidence when that period is taken into consideration. Anyway the impact of this issue is too small to bias the result of the analysis and to put a shadow of doubt on it.

1.4. Structure of the thesis

The present thesis is organized in six chapters. First chapter presents a general introduction about the topic, research questions and hypotheses. Chapter two presents the theory behind the crises: factors, channels of transmission, integration of economies. Chapter three and four develop a broad image about the previous literature related to the topic, and the methodologies used in this thesis. Chapter five reveals the results of the investigation and their implication. The last chapter summarizes the conclusions of the thesis.

2. CRISES - THEORETICAL BACKGROUND

2.1. Transmission channels

History has proved that bad news always spread around at a very fast speed, even when there seems no way for it to go around. And no exception from this proved fact is crises. Russian crisis, Asian crisis, Financial crisis of 2007-2009, they all started locally in a certain country or region but thanks to their connections with other sectors, regions, countries, economies, very soon exploded in size and effects, translating their negative impulse all around the world. This contagion and risk transferring at such a big scale is possible only because there are certain channels that assure, and in some cases ease the flow of negative news, effects and losses from one economy to another, no matter if the shock is coming from a developed country or a developing one.

The first channel that contributes to the expansion of crises is the trade channel. When two economies have strong trade relationships fortified by high levels of import and export of goods, at the moment when one of these two members will have difficulties or will record an internal crisis the other one at its turn will also be affected. Worsening the economic situation in a developed country will cause a reduction in quantities of goods imported, contributing in this way to the development of a demand-supply problem in other countries, that at its turn can cause serious economic problems, and in the end start a crisis. The same situation can be expressed from the perspective of a developing country. If a developing country starts to register some financial or economic problems, than its exports of goods or raw materials to other countries will decrease, causing the prices in the respective countries to rise and companies to be limited in the resources that are so vital for their activities and survival.

An argument that sustains the importance of trade channel as a primary source of crises spreading can serve the Claessens, Tong and Wei's (2012) paper which reveal that the degree of economic openness and exposure to international trade was a statistically and economically vital channel in the global transmission of the financial crisis. Didier, Hevia and Schmukler (2012) find out that those countries with a higher degree of economic and financial openness, with higher current account deficits and with higher values of domestic credit over GDP, registered higher growth collapses during the financial crisis. Moreover, the results suggest that on average an increase in trade openness of 10 percentage points of GDP is associated with a plus 0.6 percentage point

decrease in GDP growth during uncertain times. Gorea and Radev (2014) reveal that countries that have stronger trade linkages with economies that register troubles tend to have higher joint default probabilities.

Another important channel in the shock transmissions during turbulent times is the financial channel, which operates through financial links that exists between accounts, countries and economies. A crisis in one country can reduce considerably the availability of financial resources for other countries by reducing the level of foreign investments in those countries or by directly limiting the access of foreign companies by including additional requirements related to liquidity, capital and quality of assets, which in turn affects the revenue and profitability of those companies. This represents the starting point of market uncertainty, asset sales and panic. Moreover, as a consequence of a crisis in a certain country and increased risk, investors will look to reallocate their resources and protect their investments. As a result, there is being registered an internal outflow of capital at the level of affected country and a loss at the level of investors manifested in unrealized profits, transfer costs, additional fees and psychological pain.

Moving further, recently, thanks to the active globalization phenomenon and integration of economies, financial channel has gained additional points for its role in spreading the effects of a local crisis globally. International mergers and acquisitions, capital markets liberalization, securitization and the possibility to invest beyond national borders, have made the global and each country's economy in part to be interconnected in one system, to breathe in the same time, and whenever there is an injury to feel the pain at the level of all economies. And this proved to be true on 15 of September, 2008 when Lehman Brothers, one of the biggest players in the subprime market with an international exposure, filed for bankruptcy. In consequence, a wave of financial pain has been transmitted globally, with losses at the order of billions, bankruptcies that seemed impossible, and bailout programs that shook the entire financial systems and believes.

Didier et al. (2012) after analyzing the transmission channels of financial crisis to other economies, reveal that along with trade channels financial channels played an important role in spreading the effects of crisis around the world. The same fact is documented by Yamamoto (2014) which using sign restriction vector autoregressions to study the transmission of US shock to Asian economies, reveals that financial shocks have a greater influence than trade shocks, and that these shocks become greater with respect to the level of economic development of the respective country. The results show that the

financial shock is about 2.43 times larger than the trade shock in Korea and 2.95 times larger in Taiwan. In the case of European countries, Gorea et al. (2014) reveal that during the recent sovereign debt crisis financial linkages are an important transmission channel only in the case of troubled Euro periphery.

Another transmission channel that played an important role during the financial crisis of 2007-2009 is the business cycle channel. A negative business cycle shock in one country affects or can have a negative influence on another's country economy that is sensitive to the respective country. Moreover, companies that are more business-cycle-sensitive perform worse when there is a negative shock coming from outside. A proof in this sense serves the Claessens et al. (2012) paper which using data for 7722 non-financial firms in 42 countries in order to study how the financial crisis of 2007-2009 affected firms' performance and how the shocks were propagated beyond national borders. They reveal that changes in profits are more pronounced for those sectors that are more sensitive to business cycle shocks. For example a one standard deviation increase in the business cycle sensitivity will reduce profits by 0.44% or 14% of the average decline in profit.

Michaelides, Papageorgiou & Vouldis (2013) using Vector Error Correction models to establish the long-run equilibrium of Greek economy with the US and the rest of the European Union countries show that the Greek business cycles tend to be caused at least partly by the US business cycles, and Irish and Spanish fluctuations. In the same order of thoughts, Erden and Ozkan (2014) using bilateral data from 22 countries reveal that both trade and financial linkages have an important influence in the transmission of business cycles to Turkish economy. Moreover, the results show that Turkish business cycles are related with the business cycles of other members of European Custom Union.

A less mentioned channel in literature but which still has a big influence in crises transfer between countries and economies is geographical proximity and neighbors. When one neighbor country starts to register problems, the other countries will also be affected through trade constraints, capital reduction or currency implications. As a result the negative wave will transfer from one country to another infecting everything in its way. De Gregorio and Valdes (2001) document the importance of geographical proximity channel, by studying the reaction of four crisis indicators in 20 countries during three crises: the 1982 debt crisis, the 1994 Mexican crisis, and the 1997 Asian

crisis. They reveal that the neighborhood effect appears to be the most important channel in transferring and propagation of crises along with trade channel.

All in all, the crises propagation channels require additional attention from markets and governments in order to limit at the right time the expansion of a negative wave coming from a certain economy and to assure the stability of the global financial system.

2.2. Factors causing financial crises

Financial crises represent a complex phenomenon that incorporates in itself a various list of consequences, negative effects and financial pain. In order to understand financial crises, their development and ways to fight them, it is necessary to analyze the factors that trigger crises and how do they act. According to Mishkin, Matthews and Giuliodori (2013, 176-179), the factors that contribute to apparition and development of financial crises can be arranged in six categories:

2.2.1. Asset market effects on balance sheets:

The situation and quality of borrowers' balance sheets play a vital role in the economy and in its health. Because companies are the primary pillar of the economy and the main contributor to wealth accumulation, deterioration in companies' balance sheets would represent the first symptom and factor that trigger the development of a financial crisis.

Stock market decline: A sudden and significant decline in stock prices represents one of the factors that contribute to the worsening of companies' balance sheets, intensification of moral hazard problems and adverse selection. The decline in stock prices results in firm's value decline, and as a direct consequence, to a sharp decline in company's ability to borrow in order to maintain its activity. Moreover, the decline in firm's value reduces the firm's collateral and credibility that it will be able to repay its debt, and honor its contractual obligations. In the same order of thoughts, the stock market decline increases exponentially the moral hazard, as firms are now willing to borrow more and to be implied in risky investment opportunities because they have much less to lose in case of default. The stagnation in companies' activity results in economic stagnation and financial crises development.

Unanticipated decline in price levels: Price levels represent one of the ground factors that affect the economy. Because most of the loan contracts are standardized, with fixed conditions and expressed in nominal terms a drop in price levels will have severe implications for companies' balance sheets. One direct consequence is that it increases the burden of debt. Now, serving the debt is more expensive than it was before because companies have to pay more in loan installments. Moreover, the debt value rises while the value of assets remains at the same level, causing gaps between assets and debt, and require additional funds in order to cover these differences. At their turn, banks can require more capital and collateral from companies to cover their obligations. A decline in price levels causes financial difficulties and increases the uncertainty.

Unanticipated decline in the value of the domestic currency: Thanks to the active globalization and securitization phenomenon, now companies can establish business relations with foreign companies, can invest overseas, and can diversify risk all around the globe. Moreover, companies as well as governments can borrow internationally and in a currency different than their national one. As a result, the exposure of firms and governments to fluctuations in domestic currency has increased significantly. When there is a decline in the domestic currency of a country, the companies from that country that issued debt in a foreign currency will find that their debt level has increased, and that it is more difficult to honor the obligations. Because the assets' value are expressed in domestic currency and debt in a foreign currency a decline in domestic currency will result in a decline in asset value and increase in debt, causing a gap in the balance sheet. This will raise the necessity of additional funds to cover the differences.

On the other side the decline in domestic currency has a slightly positive impact on company's earnings and profits. When a company has branches in a foreign country or it has business relationships with a foreign country, a decline in domestic currency will have a positive effect on the profits registered by the company because the value of the translated earnings will increase proportionally with the decrease in the value of the domestic currency, pushing the value of company's capital up. However, this impact is insignificant when compared to overall effect induced by depreciation in domestic currency. Another proof serves the fact that governments are required to maintain guarantee deposits in an international currency. When there is a drop in the domestic currency the cost of maintaining these deposits raises, causing financial problems and uncertainty.

Asset write-downs: Stock prices declines cause deterioration in assets value and finally write-downs. As a result, the value of the company reduces significantly. Moreover, because companies are selling assets, their borrowing possibilities are decreasing as a consequence of limited or poor quality collateral. Moral hazard and adverse selection is increasing because firms that are more delinquent are more willing to borrow and to invest in risky projects, increasing in this way the probability of a default on their obligations.

2.2.2. Deterioration in financial institutions' balance sheets:

Financial institutions have always played an important role in the development and good functioning of economy, acting as major players in the financial markets. They are the link between individual and corporate consumers and financial markets, providing financial products, information and investment opportunities. Deterioration in financial institutions' balance sheets has major impacts on these institutions activities, and economy in general. Because they are the main source of capital supply, even a small negative change in the quality of their balance sheets cause a severe contraction in their capital, and as a consequence, the lending declines significantly, resulting in fewer and more expensive resources for companies at the level of economy. At its turn, this contraction in lending will result in a new contraction in companies' activity and in an increase in adverse selection and moral hazard. Companies with worse financial indicators are willing to borrow more and look for investment projects that have a higher rate of return but in the same time are riskier. Asymmetric information can result in acceptance of these projects at the expense of banks and investors.

2.2.3. Banking crises:

A severe enough deterioration in financial institutions balance sheets' can cause defaults. When big companies start to fail, fear of default can spread from one institution to other very quickly, even in the case of healthy ones. And this is significantly important for banks because the main source of financing their activities is represented by deposits attracted from population and companies, deposits which can be pulled out very quickly, triggering in this way a wave of contagion.

"A bank panic is registered when multiple banks fail simultaneous" (Mishkin et al. 2013:178). Thanks to asymmetric information in a bank panic, depositors fearing for the safety of their deposits and doubting the capacity of bank to honor its obligations, start

pulling out their deposits, causing a big outflow of capital and severe financial contractions. Because most of the investment activities and loans that banks get implied in are long term, in case of a big withdrawal of deposits banks register liquidity problems, and fail in case they do not inject capital quick. Bank failures and contraction in lending activities decrease significantly the supply of capital to borrowers, which results in higher interest rates, economic stagnation, moral hazard and adverse selection problems. These problems, at their turn, have more severe implications with a final result: financial contagion and psychological pain. This turned to be true in 2008, when the failure of Lehman Brothers translated a wave of contagion, defaults and uncertainty all around the world at a very fast pace.

2.2.4. Increase in uncertainty:

One of the most fearful events in financial markets is a dramatic increase in uncertainty, maybe due to the failure of a big company, inaction of the government or a stock market crash. The resulting uncertainty blocks the ability of market participants to solve the adverse selection problems. It is more difficult to differentiate bad investment projects from good ones, and it is hard to clearly establish the level of risk that the respective project implies. As a result, lenders are less willing to lend, or the lending conditions are extremely severe which in the end leads to a contraction in lending, investment and economic activity.

2.2.5. Increase in interest rates:

Increase in interest rates affects the economy in two ways. First, it increases the moral hazard and adverse selection problems. When interest rates are high enough only individuals and companies that are involved in risky projects and are delinquent on their payments are willing to borrow more and to pay these excessive amounts of money expressed in interest. As a result, banks and other financial companies will tend to decrease their lending volumes and limit their credit risk, which in the end leads to liquidity constraints for companies and decline in investment activities. Second, increases in interest rates play an important role in the level of cash flows that the companies have at their disposal. Companies with sufficient cash flows can finance their investment project with internal sources, without being obliged to justify their decision. Therefore, when there is an increase in interest rates, the level of cash flows that the company has at its disposal is being diminished proportionally because the company has to pay more in interest now. With less cash, the company needs to attract

external fund from banks or other financial companies. Because of asymmetric information and adverse selection the companies can choose not to lend to the respective firm, even though it has a good risk and profitable activities. In the end healthy firms are capital constrained and economic activity is being pulled down, triggering in this way the beginning of a new crisis.

2.2.6. Government fiscal imbalances:

Government fiscal imbalances are an important factor that can mark the beginning of a financial crisis. Excess debt and a wrong fiscal policy, marked by fiscal gaps, can trigger the fear of impossibility to honor its obligations, and in the end default on government debt. This is the case of Euro Zone sovereign debt crisis that affected the periphery of Europe, and initiated a crisis that Europe has never seen. As a result of unprecedented bailouts, the level of government debt increased very vast, while the possibility of repaying this debt lost ground thanks to fiscal imbalances and budget deficits discovered at the level of national economies. In the same order of thoughts, fears of default can cause a currency crisis which results in a fast depreciation in domestic currency. The decline in the value of the national currency will result in balance sheet imbalances for companies that are exposed to foreign currencies, by having debt denominated in other currency or by investing overseas. These balance sheets problems lead to an increase in adverse selection problems and decline in economic activity.

These factors can have severe implications not just for local economies but also for the entire financial system and concrete measures and actions need to be taken in order to assure the health of world economy and society development.

2.3. Integration of economies

Thanks to active globalization that is taking place and recent financial crisis, the international stock market integration and international stock co-movements have started to gain significant attention.

Loh (2013), after analyzing the co-movement of 13 Asia-Pacific stock returns with that of European and US stock market returns, using the wavelet coherence method, reveals that there is consistent co-movement between the returns of the biggest Asia-Pacific

stock markets and that of Europe and US. Moreover this relationship tends to differ across time, registering high values during periods of distress and relatively lower values in periods with low volatility. The study also shows different results for the European sovereign debt crisis and US financial crisis.

Graham, Kiviaho and Nikkinen (2012), using the three dimensional analysis of wavelet coherency to study the relationship between 22 emerging economies and US, reveal that there is a high degree of co-movement at relatively lower frequencies between the US and these emerging economies. They also find these results to differ from country to country. Moreover, the level of integration of these economies seems to increase after 2006 and forward. In the same order of thoughts Baur (2012) shows that the degree of co-movement between economies during the global financial crisis of 2007-2009 increased statistically significantly. For some countries the value more than doubled (India). This increased market integration resulted in a global contagion of economies, the epicenter being in the USA.

Dovern and Van Roye (2014), using country-specific monthly financial stress indices for 20 major economies, show that co-movement between the financial stress indicators increases during major financial crises. Moreover, the risk of large financial stress spillovers to an economy depends directly on its economic openness. A shock in the USA quickly transmits internationally, which means that smaller economies and markets partially depend on the information that comes from USA. Morana and Beltrati (2008), after analyzing the correlations between US, UK, Germany and Japan during the period 1973-2004, discover that the integration between these four markets tend to increase over time, resulting in higher co-movements in prices, returns, volatilities and correlations.

From a European perspective, Albuquerque and Vega (2008), after analyzing the effects that real-time domestic and foreign news about fundamentals have on the co-movement between stock return of Portugal and USA, show that cross-country stock market co-movement is unchanged when Portuguese news are released. The US public information affects Portuguese stock market returns, but this effect is smaller when US stock market returns are taken into regression. The effect that news has on the Portuguese market depends on the nature of the news.

More proof is presented by Graham and Nikkinen (2011). The wavelet analysis used by authors reveals that there is a high degree of co-movement, at relatively lower

frequencies, between MSCI Finland and MSCI Emerging Europe, MSCI Emerging Latin America and MSCI Emerging Asia. From a developed stock market relationship perspective, the study documents a relatively high degree of co-movement between MSCI Finland and MSCI Europe (ex-Finland), and a relatively low frequency co-movement between MSCI Finland and MSCI North America. Furthermore, Finnish stock market returns reveal low levels of co-movements with the Pacific region, and low co-movements of volatilities between the Finnish stock market and emerging and developed countries stock indices.

In the same order of thoughts, Ostermark (2001) reveals that Japanese and Finnish markets are cointegrated, and that Japanese stock market influences Finnish economy. The multivariate cointegration analysis shows that Nikkei stock market has an impact on the error correction mechanism of the Finnish stock market.

Gjika and Horvath (2013) after studying the stock market co-movements between Central Europe countries, using asymmetric dynamic conditional correlation multivariate GARCH models, reveal that correlations between stock markets in Central Europe are strong with respect to the euro area and that it increased after joining the European Union and further. As a result, the diversification benefits decreased proportionally leading to a necessity to move to other markets in order to decrease the portfolio risk.

Kollias and Mylonidis (2010), after studying the level of cointegration between four major European markets (Germany, France, Spain and Italy), reveal that the level of cointegration between these markets is increasing as time passes by. Moreover, the role of Germany as a dominant position is documented. These findings suggest that the diversification benefits at the level of these markets are limited, and that policy makers need to coordinate actions at the level of national and community level in order to assure a good functioning of financial system and prevention of crises spreading.

From the perspective of stock market co-movements on frontier markets, Graham et al. (2012) reveal that the co-movement of stock returns for these countries varies considerably at different time horizons. Co-movement is relatively weaker for the frontier markets of Central and Southeastern Europe than for the Baltic region. Overall, a stronger co-movement is observed for the European frontier markets with the USA and the three most developed markets in Europe at low frequencies (long horizons) compared to high frequencies (short horizons). This intensity increases during the

period of distress registered in 2008-2009. In the same order of thoughts, Nikkinen, Piljak and Aijo (2012), after studying the integration level between Baltic countries and the developed European stock markets during the financial crisis of 2007-2009, conclude that the Baltic countries were highly integrated during the crisis and that portfolio diversification was considerably reduced exactly when it was needed the most. According to their results, in the crisis period all the coefficients are statistically significant when using quantiles regressions and that in lower quantiles coefficients are higher than in highest quantiles.

Guidi and Ugur (2014) study the level of cointegration between the South-Eastern stock markets (Bulgaria, Croatia, Romania, Slovenia and Turkey) and those of Germany, UK and USA. They find out that the integration test is positive and statistically significant for Germany and UK but not for USA and that this cointegration relationship is time variant. Until mid-2008 the cointegration between South-Eastern countries and Germany and UK was represented by short periods of no cointegration followed by episodes of integration. On the other hand during the financial crisis of 2007-2009 the cointegration between these markets was continuous.

Taking the analysis to a more advanced level Chen, Chen and Lee (2014) after studying the level of integration between 29 frontier markets and 14 leading markets, before and during the financial crisis of 2007-2009, reveal that the global financial crisis has a big impact on the level of cointegration between these markets, and that it influences the causality between frontier and developed markets. Moreover, the crisis not just changed the degree of co-movement between frontier and developed markets but also changed the factors that lead to financial integration.

Yang, Chen, Niu and Li (2014) study the global linkages between countries using a sample of 26 global stock market indices during the Global Financial Crisis and European sovereign crisis. Their results show that the level of cointegration between these countries increased significantly after Lehman Brothers collapse, and further decreased gradually from subprime crisis to European sovereign debt crisis. During these two crises, the role of USA as a leading factor has diminished considerably, while Chinese stock markets started to co-move with other stock markets, fact which could not be seen before. Moreover, a new order is taking place: emerging stock markets are leading now the global stock markets.

In the same order of thoughts, Yunus (2013) uses the recursive cointegration technique in order to study the dynamic relationships between ten major equity markets from North America, Europe, Latin America and Asia. The results show that these major markets are cointegrated, the cointegration level has increased over time and that the recent financial crisis had a major impact on the level of cointegration. Moreover, the study finds out that US, Japan, India, China, UK, Germany and US influence other markets contributing to the establishment of their evolution trend. Therefore, portfolio diversification is limited across the markets, and profitable benefits are reduced considerably during periods marked by global financial uncertainty and crises. Zhang and Li (2014), after studying the relationship between US and China, reveal that there is no long-run cointegration at the level of these two countries. However, they document a strong impact at the level of Chinese markets which is coming from US markets, and that the correlation between these two markets is time variant.

Partial contrary results are found by Gupta and Guidi (2012), who study the cointegration relationship between India and Asian developed stock markets. The results reveal that there is no evidence of cointegration between these markets and no evidence in favor of long-run relationship between India and Asian developed market has been found. The paper finds out that a time varying correlation between markets is present, and that this correlation increased significantly during the last financial crisis. However, after the crisis finished the correlation levels returned to their normal values. In the same order of thoughts, Lucey and Voronkova (2008), after studying the relationships between Russian and other equity markets during the period 1995-2004, reveal that Russian equity markets remain isolated in the long run with respect to other international markets and that the degree of cointegration between these markets is relatively low.

All in all, the international stock market integration and the level of co-movement between stock returns represent the base for modern portfolio diversification and necessitate a deeper analysis and further study.

2.4. The US subprime crisis

"The astonishing thing about the subprime crisis is that something so small wreaked so much havoc. Subprime loans started out as just a pocket of the US home loan market, then mutated like a virus into a crisis of global proportions" (Engel and McCoy 2011:13)

The financial crisis of 2007-2009, which originated in the USA, is considered one of the most destructive and dangerous crises that the world has ever seen after the Great Depression. Its consequences and effects have put the entire financial system with its way of functioning and structure under the question mark.

It started just as a small local problem. Everybody thought that this is just a small turbulence that appeared in the flight to development and that very soon it will end without any important consequences. But it was not to be. Soon, what seemed to be a nobody's problem, translated into one of the biggest financial crises that the society has ever seen, with losses in billions of dollars, bankruptcy of many financial institutions which were considered the pillars of modern economy and "to big to fail" and enormous job losses and destroyed lives. But what are the causes? What are the factors that triggered this chain of events that distorted the entire world and how did it happen?

In order to answer these questions it is necessary to go back in time when it all started: home mortgage market in the 1970's. Back then, mortgage lending activities were practiced mainly by banks. Banks took deposits in their portfolio and used them to convert into mortgage loans. The capacity of applicants to repay the loan was assessed by loan officers and the bank took the full hit in case the borrowers defaulted on their loans. The lending activity was merely conservative because of the strict regulation from the federal and government institutions. During this period there were imposed interest rates on home mortgages and some states even banned adjustable-rate mortgages (ARMs). These measures kept bank's lending at modest levels. But as nothing is forever, these restrictions soon were eliminated and banks could lend more and construct a new portfolio of credit products that were meant to increase the value of banks, and to enhance the sales of homes. This deregulation, unfortunately, is the starting point and the first cause of the financial crisis of 2007-2009 because banks started to be so innovative and inventive in their loan products that created exotic products which borrowers could not understand, or had small chances in understanding (Engel & McCoy, 2011:15).

Another important factor that has accelerated exponentially the development of mortgage market and subprime lending is technological advances. In the past, banks were extremely careful in lending because they did not know exactly how to evaluate the risk related to that loan, and how to quantify the default risk. But with the

appearance of computers, they could analyze vast quantities of data in really short periods of time. Credit histories, loan payments and collateral were accessible to the loan officer just at a click distance. Moreover, the development of computing allowed developing models that could measure and determine the risk that borrowers would default. Now, it was possible to take the information regarding a specific client from loan application, run it trough a computer and asses the applicant's default risk and its eligibility for a loan. Moreover, these computer innovations made the cost of underwriting to be relatively small and very quick in terms of time and efforts. New Century Financial, one of the biggest companies in the subprime lending in that time, advertised on their website: *"We'll give you loan answers in just 12 seconds"* (Browning, 2007).

However, these technological innovations had their dark side. One of the biggest problems of these models was that in order to give accurate results it had to use a very large set of historical data, data which for the subprime market was not available because of its recent development. Moreover, the bank analysts were using in their modeling scenarios the assumption that housing prices in the US will keep growing in the future which evidently was a wrong assumption. The third pitfall of computer modeling was that it suffered from the so called phenomenon "garbage in garbage out". It means that if the data or the assumptions that the analysts were using were inappropriate or wrong, then the results accumulated were biased and did not represent the reality. However, technological advances played their role in the development of the subprime market and in the end at the explosion of the biggest financial crisis in the history because it created the false image of a reliable and effective underwriting.

Taking the analysis to a broader view, it can be found that macroeconomic and public policy factors also played an important role in the rise and development of subprime market. The Asian crisis in 1997, the Russian crisis in 1998 and the Dot-com bubble in 2000 had an enormous effect on American economy, destroying people's confidence in the stock market. After a short period of time the terrorist attack on September 11, 2001 and the Enron's bankruptcy dropped the country into a deeper recession. Throughout this, the housing and subprime markets were seen as the light at the end of the tunnel and the authorities started to axe their influence in that direction. In 2000, the FED started to implement its "Greenspan put" and decreases the interest rates causing a steady increase in housing prices of 10 percent per year. Moreover, further the Fed decreased more the interest rates, fact which resulted in cheap credit and affordable housing investment plans (Engel & McCoy, 2011:19). In the next years the politicians

axed on the American spending culture and instigated population to spend more money and to use actively their credit cards and other financing possibilities that they have, one of this being mortgage debt and refinancing. Different campaigns and advertisements started to appear such as: *"There's got to be at least $25000 hidden in your house. We can help find it"* (CitiCorp) or *"Need cash? Use your home"* (Banco Popular) (Story, 2008).

In the same order of thoughts, another factor that contributed to the development of subprime market was the development of China and its economic boom. Thanks to the accelerated evolution of Chinese economy, people started to accumulate more and more capital, and to search investment opportunities that offer a relatively high rate of return, while the risk is kept under control. And here, the subprime market lending appeared as a gold mine for external investors. America started to register high volumes of capital inflows in its economy, while the levels of capital outflows were kept at the same level or even decreasing. These capital inflows represented an adrenaline injection into the subprime market, just what was needed to stimulate the housing prices, fact sustained and by Jagannathan, Kapoor and Schaumburg (2013).

Probably, one of the factors that contributed most to the Global Financial Crisis is the securitization phenomenon. The idea behind the securitization process consists in taking a mortgage loan, transfer it to a legally remote trust, transform the monthly loan payments into bonds rated by rating agencies and then sell these bonds to investors. The bonds have as collateral the mortgage. The beginning of the securitization date back to the 1930s, when at the initiative of the Government to assure the availability of money for home mortgages was created the Federal National Mortgage Association (Fannie Mae). Thirty years later the Congress divided this association and created a new government-sponsored entity (Freddie Mac). Later on both entities became private sector companies but which had to serve the shareholders and the government, being exempted from taxes for this. Freddie Mac and Fannie Mae were responsible for mortgage securitization process (Engel & McCoy, 2011:18).

Observing the success of these two organizations investment banks and other financial companies also started to enter the game. Thanks to the active deregulation of this market niche in USA, soon financial companies started to offer a large range of financial products to their clients. The problem was that these products were extremely complicated for customer understanding. Moreover, there were so many intermediaries and companies that offered these products that in the process their quality diminished

exponentially, being also hard to value them and to asses a risk category. One of these products was the collateralized debt obligations or CDOs. The idea behind CDOs is that the company takes a bond, divides the bond into tranches and repackages them into new securities. Moreover, the tranches from CDOs were further divided and sold as CDOs2 and CDOs3. The entire process can be represented by an upside down pyramid, the base line being represented by the initial mortgage loan and the pyramid levels by CDOs, CDOs2 and CDOs3. Further, banks did find out a solution to the limits of exposure of their balance sheets to debt. They created Special Investment Vehicles (SIVs) which were entities that bought the securities from the bank so that these could not appear on the balance sheet. In this way, banks could invest as much as they wanted in subprime market instruments without being required to increase their capital. The problem with this structure is that it is extremely unstable and can fall down in every moment, at the smallest shock coming from outside or inside or, when the base is losing ground. And this is what happened in 2007 when the value of homes started to decline; people were not able to repay their loans and defaulted. As a consequence the support of the pyramid just diminished considerably and the pyramid started to shake until it felt in pieces.

One factor that should had maintained equilibrium between risk and return for these investment products is the rating agencies. However, this did not happen because first of all rating agencies did not have enough resources to handle the increased volume of work which in turn affected the quality of ratings. One employee from a rating agency stated: *"Tensions are high. Just too much work, not enough people, pressure from company, quite a bit of turnover and no coordination of the non-deal 'stuff' they want us and our staff to do"* (Securities and Exchange Commission, 2008:12). The same fact is reflected by another employee from the same firm: *"We ran our staffing model assuming the analysts are working 60 hours a week and we are short on resources... The analysts on average are working longer than this and we are burning them out. We have had a couple of resignations and expect more"* (Securities and Exchange Commission, 2008:12). The second reason why rating agencies were wrong in their ratings is that they became interested parts in valuing subprime market products. Rating agency's analysts seemed to be aware of the agency interest when rating a deal. One proof in this sense can serve the following affirmation of an analyst from a rating agency: *"...if you have not done so please send me any updates to fees on your transactions for this month. It is your responsibility to look at the deal list and see what your deals are currently listed at"* (Securities and Exchange Commission, 2008:25).

Finally, one factor that maybe not contributed directly to the financial crisis development but which certainly had a major role in its formation is the companies' greed and desire for more and more market share and bigger profits. At the end of twentieth century, US investment banks became so big and multinational that soon their investment opportunities wiped out or did not meet their expectations. Moreover, the strong competition between biggest bank players accentuated the necessity for finding new investment opportunities and market niches that can offer important gains in terms of clients and revenues in order to beat the competition. As a result, the banks started to compete into a blind race for revenues, a race in which rules could be adopted to their needs and where supervision was limited. And the solution was seen to be in the subprime mortgage market, which was at its boom in that time, and which offered unprecedented gains and ways to register revenues.

This was the beginning of a period of financial innovations, easing credit conditions and active search of new potential clients, search which soon became so fierce that evolved into a predatory lending activity. The predatory lending activity consisted in trying to get as much clients as possible by sending different offers, meeting with potential clients and convincing them to take a loan or refinance. Banks and other investment companies were hiring the so called "cold callers" who were responsible for just calling random people and offering their services and trying to convince them to refinance, often using different "dirty" methods. An inside information about these practices was revealed by a former finance company employee who stated: *"Finance companies try to do business with blue-collar workers, people who have not gone to college, older people who are on fixed incomes, non English-speaking people, and people who have significant equity in their homes. In fact, my perfect customer would be an uneducated widow who is on a fixed income, hopefully from her deceased husband's pension and Social Security, who has her house paid off, is living off of credit cards, but having a difficult time keeping up with her payments and who must make a car payment in addition to her credit card payments..."* (Dough, 1998:31) and *"Our entire sale is built on confusion. Blue-collar workers tend to be less educated. I know I am being very stereotypical, but they are the more unsophisticated. They can be confused in the loan closings, and they look to us as professionals"*(Dough, 1998:35). Moreover, the bank employees targeted as a potential category of clients those who were delinquent in their loan payments, fact which reduced considerably the chances that the client will pay its loan installments or that it will not default on his loan.

The problem with these practices is that people who did not need to take a mortgage or to refinance did it. And this happened at a very high price because banks used to include high fees into the contract or sky rocket interest on loans, the main reasons being the fact that clients were missing the knowledge about the housing market or did not know that they could get a loan somewhere else at a lower price. An example in this sense can serve the case of Eller Guyton who got an interest rate for her house in Southern Baltimore in October 1997 that was approximately twice the market rate even though she had "A" credit rating, the highest possible (Rath, 2000).

Another proof of interest, which shows that financial companies were intentionally misleading people in their financial necessities or loan terms choices, is the following statement that comes from an insider source: *"To flip one of these small loans into a personal or home equity loan, we were trained to sell the monthly "savings"-that is, how much less per month the customer would be paying off if we flipped the loan. In reality, the "savings" that we were trained to sell to the customers were just an illusion. The uneducated customer would jump for the "savings," thinking that he would have more money to buy other things. What the customer would not figure out, and what we would not tell him, is that he would be paying for a longer period of time and, in the end, would pay a whole lot more"* (Dough, 1998:31-32). Thanks to these practices, people were taking loans in excess and over their possibilities to return them, fact which led to a formation of a financial bubble that finally exploded in one of the most dangerous and damaging crises that the world has seen since the Great Depression.

The first signs of financial troubles started to appear at the end of 2006, when two large mortgage lenders, Ownit Mortgage Solutions and Sebring Capital Partners LP, started to register problems with their mortgage loans. In a short period of time both of them were bankrupt (Engel & McCoy, 2011:69). Since then, many other companies started to feel the shocks coming from the subprime market and the situation started to get worse. Prices on houses started to decline sharply and many borrowers defaulted on their loans. The situation was far more than worse because with the housing prices down it was impossible to sell them and to cover the losses and even though some of them could be sold their value did not cover the gaps. As a result, in June 2007 two Bear Stern Subprime hedge funds sank, and it was clear that the company has bought a one way ticket. Meanwhile, the biggest insurance company AIG, that had a big portfolio of credit default swaps started to shake. The problems that the company was dealing with were that the value of swaps might go down forcing the company to register major write

downs and the other is that its counterparties might require additional guarantees to back of its obligations.

But the worst part was just coming up. Lehman Brothers, one of the biggest players in the mortgage market, started to register considerable losses and to shake. Its toxic assets started to eat the capital that the bank had at a very fast rate leaving the bank in a deplorable situation. Moreover, the fact that the company refused to sell its bad assets or to raise more capital, when the situation started to get worse at the end of 2007, because did not want to dilute shareholders' value, had disastrous effects on the company's balance sheet. Meanwhile investors were anxious and started to put bets against Lehman which aggravated the situation more. The bank was looking for a buyer. It went to Warren Buffet and Bank of America but the deals were not closed because government representatives said that they will not support closing of the deal. In this time the stock price was registering record low levels. Barclays was ready to step in being the saving anchor for Lehman but because Federal Reserve declined to back up the firm's assets, Barclays stepped out from the game. (Engel & McKoy, 2011:103) As a result on September 15, 2008 Lehman filed for bankruptcy this being the biggest bankruptcy in the US history. The effects started to translate very quickly to other market participants such as insurance companies that sold credit default swaps on Lehman's debt.

The markets were in a panic not seen in a very long time and the flu that couple of days ago seemed just a small cold, quickly degenerated into a virus that contaminated everything in its way, and did not seem to stop just in America. Soon the effects of Lehman Brother's collapse were visible in different areas and markets with billions in write-downs and multiple rescue packages from the government in order to protect the economy and to stop the crisis going deeper and deeper, until it cannot be saved anymore. This crisis has revealed again that the modern financial system has a lot of flaws and that a more severe regulation is needed not just at the structural level but also at the psychological level, in order to avoid in the future a disastrous déjà-vu. It is required a more severe discipline from the side or market participants and especially from market makers who have the responsibility and the obligation to construct and to maintain a healthy and ethical financial system.

2.5. The Euro Zone sovereign debt crisis

The Euro Zone sovereign debt crisis represents one of the most dangerous attacks on the Euro Zone stability and integrity as a whole unit. Its roots back down into the financial crisis of 2007, which started in the US and expanded very quickly globally translating a wave of negative losses and instability to other economies and countries. Euro Zone was no exception thanks to the fact that European countries have had a strong connection with US in terms of trade and financial linkages. Moreover, the increased level of exposure that Europe's banks had in subprime market increased exponentially the translation of risk and losses from USA to Euro Area, pushing the economy and its active members in trouble, and further into recession. But the real origin of the problem is related to the country members' fiscal indiscipline and lack of proper regulation at the level of entire European Union. Joining the euro for some countries was equivalent to an open door to a considerably cheaper source of financing and lower interest rates fact explained by Figure 1:

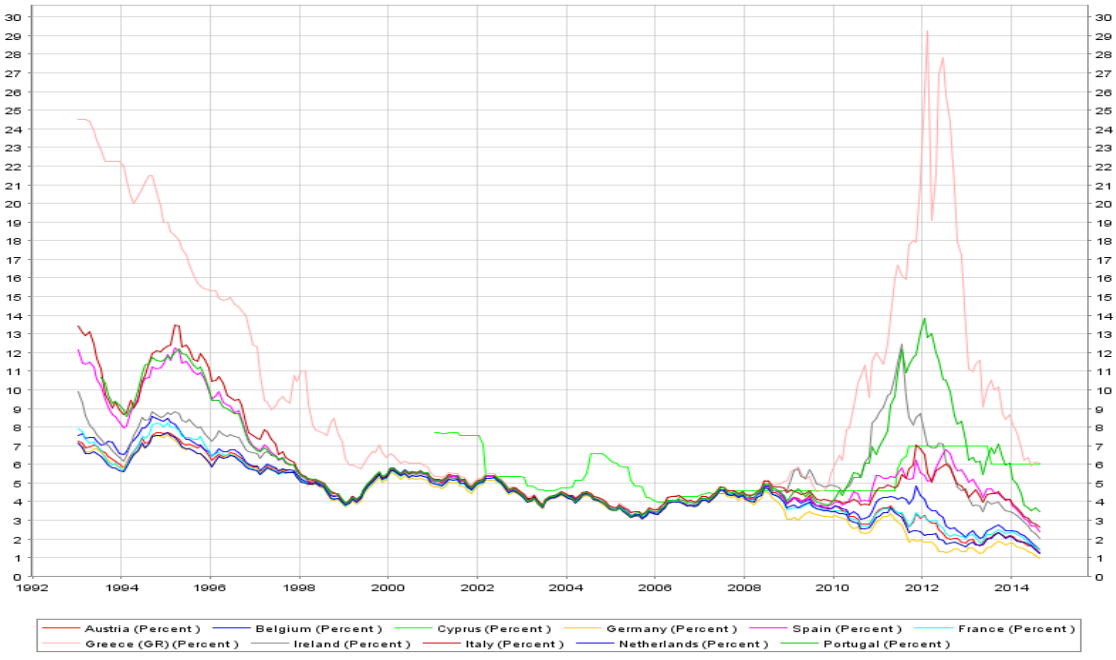

Figure 1: Evolution of interest rates for European Union countries. (European Central Bank).

As it can be seen, after joining the European Union these countries' interest rates fell close to the interest level of Germany, fact which made local governments to realize

soon that their debt burden has lost ground, and that they can afford to borrow more and more, without facing any constraints or visible problems, at least at that time. Soon, the debt level in the southern European countries and Ireland started to reach high levels. Companies started to invest more and more, to engage in diverse investment opportunities and to expand exponentially, being propelled by cheap bank loans and advantageous credit conditions. Moreover, after seeing the gains and rate of return that mortgage market was offering to companies in USA, investment banks from Europe started to get involved more and more in the subprime market and to increase their' balance sheet exposure to mortgage loans and their derivatives. The governments and companies were so attracted by revenues and cheap credit that went on a lending fever which increased artificially the home prices and in the end turned out into a credit boom.

The burning point erupted when the financial crisis in the USA started to expand at unprecedented levels with the bankruptcy of Lehman Brothers. From that moment, banks started to register losses on their subprime market instruments, as the value of houses started to decline sharply and borrowers to default on their loans. The assets that not a long time ago were bringing an astonishing revenue for banks and other financial companies now started to became toxic. The necessity of asset write downs was imminent. As a result the lending activity started to decrease and the interest rates to increase exponentially. Economic activity was stopped when was needed the most. However, the problems did not end there. Moral hazard and information asymmetry played their role again. Firms that were in a bad situation and knew that in case of default will walk away, started to search actively for credit supplies, while those with the lowest probability to default considered the interest rate to expensive. As a consequence, delinquent firms started to borrow even at high interest rates, contributing in this way to the worsening of the economic situation.

The worst was still to come. On October, 2009 the newly elected government of Greece made a statement that shocked the entire Euro area. It was stated that the previous Hellenic government has mislead its Euro zone neighbors by presenting false numbers in what concerns the macroeconomic situation in Greece. The public deficit was 12.7% or with 7.6% higher than the presented forecasted value (Katsimi & Moutos, 2010). As a consequence of this statement, the situation started to aggravate. Investors as well as rating agencies started to doubt the capacity of Greece to repay its obligations. The sovereign CDS spreads and bond yields started to sky rocket, and to register considerably higher values when compared with those for Germany. On January 8, 2010

when the European Commission condemned Greece for presenting false data, the spread rose by 170 basis points and reached approximately 400 basis points (Kosmidou, Kousenidis & Negakis, 2014). Moreover, rating agencies downgraded the Greek government bonds pushing Greece into a deeper recession. The crisis has just begun as the contagion started to spread and other countries registered the same problems. Spain, Portugal, Ireland and later Italy were in the same situation with a debt level that was more than anyone expected.

Some immediate actions were required. The broken leg of European Union had or to be treated or amputated. By entering the European Union Greece, as well as the other members, gave up the possibility to use two main tools in order to adjust its economy to shocks. It lost the right to establish its own monetary policy and to change the nominal exchange rate of its currency (Gibson, Hall & Tavlas, 2012). Therefore, these countries required assistance and liquidity injections from outside. According to European Central Bank (2013) between 2010 and 2012 Portugal, Greece and Ireland received financial assistance from European Union and International Monetary Fund. In order to ease to economic situation in Greece members or European Union agreed to assist Greece financially in form of a bailout program. Initially a 3 year 110 billion Euros plan formed with the participation of European Union, International Monetary Fund and European Central Bank was adopted on May 2nd, 2010. In turn, Greece agreed to an unprecedented austerity plan. However, this rescue package was not received with enthusiasm by markets and another bailout was required. Therefore on July 21, 2011 the Council of Europe agreed to another rescue package for Greece summing up a 109 billion Euros from EA countries and a write off of 50% of Greek government debt. The implementation of this plan was registering some impediments from Greece but soon the situation started to improve when the Greek government announced that it will buy back some issued bonds at a price higher than market expectations. Market tension started to ease and rating agencies upgraded Greece's rating (Kosmidou et al., 2014). A visual representation of Euro crisis can be seen in Figure 2.

Many economists say that European Union has made a big mistake by injecting so much money into Greece's recovery at the expense of taxpayers and that it should exclude it from its list, while others think that the last action will have more severe implications in the future than bailing out Greece now. It is hard to find a middle ground position regarding this issue so probably in this case time is a better judge and it will show at the right moment.

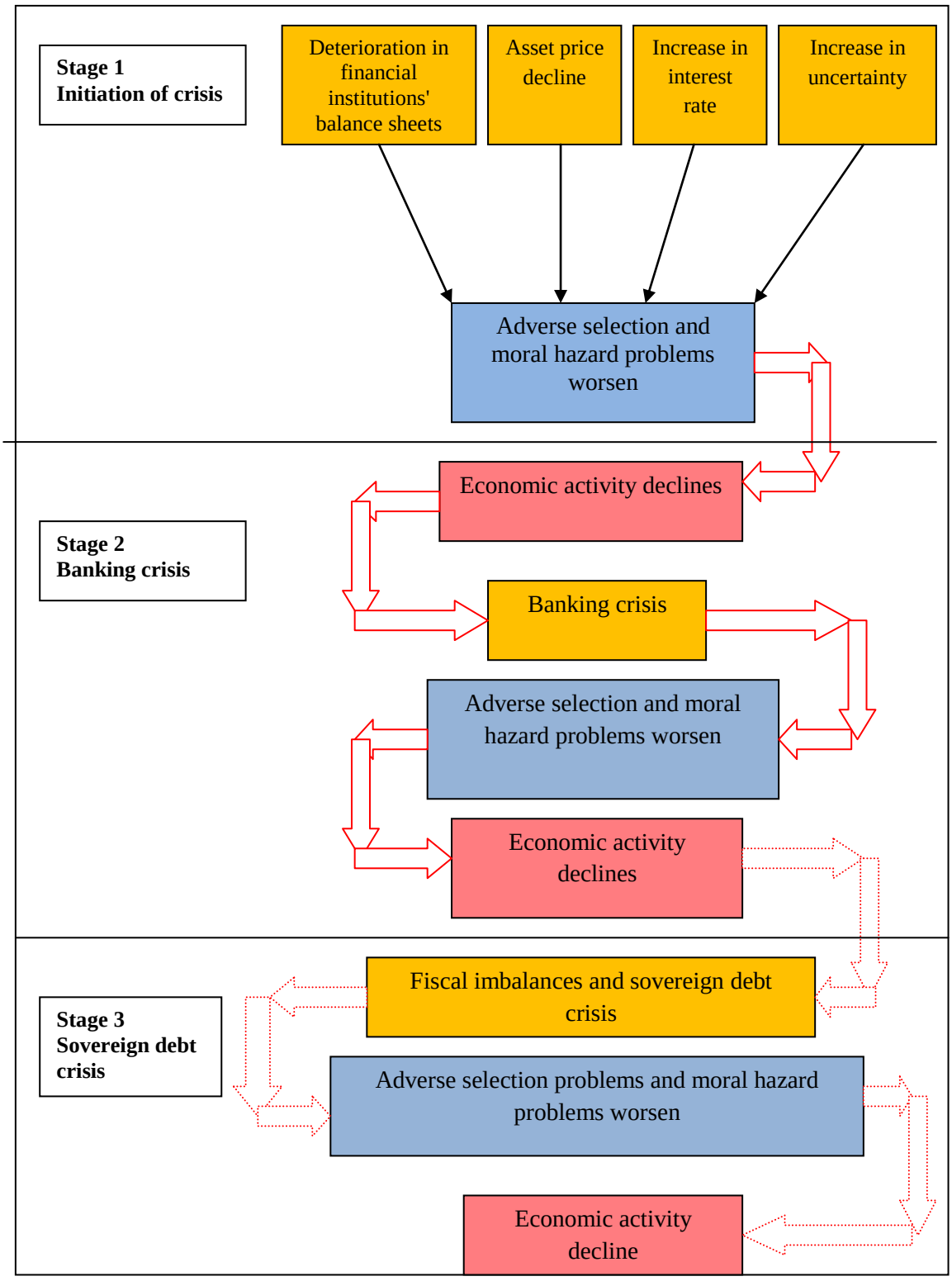

Figure 2: Evolution of the European Sovereign Debt Crisis. (Source: Mishkin, Matthews & Giuliodori, 2013:198).

3. PREVIOUS EMPIRICAL RESEARCH

The macroeconomic and financial linkages between countries, as well as risk transferring, have started to be analyzed in detail by a lot of studies, especially after the financial crisis of 2007 - 2009. Baur (2012), after analyzing 25 countries and ten sectors for the period October 1979 - October 2009, reveals that the degree of co-movement between countries during the financial crisis of 2007-2009 increased significantly, resulting in a rapid risk transferring between economies and a severe contagion. In some cases, the degree of co-movement can more than double in the crisis period, this being the case of India. In normal times, its financial market is moderately linked with the global financial sector (0.3650), while in the crisis period the linkage increases significantly (1.1593). On the other way, for some countries the relationship takes an opposite sign. If in normal times it is positively correlated with the global market then during the crisis the respective correlation is becoming negative. This is the case of New Zeeland which in normal times it has a degree of co-movement equal to 0.3384 while in the crisis period the value is changing to -0.1330, the result being statistically significant at 1% level. The same results are revealed when analyzing the relationships between countries through the prism of sectors. The lowest degree of contagion is registered in emerging markets which means that they are less exposed to the global financial system than developed markets.

Similar results are revealed by Dovern and Roye (2014). They take a slightly different approach when modeling and measuring the dependencies between economies. The model used to measure the degree of co-movement of financial stress is based on six indicators: stock market volatility, exchange rate volatility, stock market returns, government bond volatility, banking sector volatility, and money market volatility. This approach allows identifying the magnitude of the impact of the crisis and the channels through which the contagion is transferred from one country to another. The results show that the financial spillovers are going from developed countries to emerging ones, and depend on the degree of economic and financial openness of that country. Moreover, when using a GVAR model to simulate a potential shock in the economy the results show that the direction of contagion is from developed economies to emerging ones and depends on the degree of openness of the last ones.

Another proof of interest in this sense is presented by Chevallier (2012). After using multivariate Markov switching models the author reveals that global imbalances stand

at the core of the financial crisis and that they are impacted by the changing market conditions in the credit and commodity markets. Moreover, the results show that the epicenter of the financial crisis was the USA housing and mortgage markets.

Taking the analysis to a European angle, it is found that the results are approximately similar to those exposed above. Castren, Dees & Zaher (2010), after studying the relationship between euro area corporate default probabilities and macroeconomic fluctuations and macro-financial shocks through the prism of a GVAR model, show that the Expected Default Frequencies in the euro area react to shocks which come from GDP, euro/US dollar exchange rate, equity prices and oil prices. Moreover, the findings reveal that the euro area firms are more sensitive to shocks to global GDP compared to shocks to the euro area and US GDP.

Grammatikos & Vermeulen (2012), after dividing their sample of observations in three country group categories: North, South and Small in order to study the impact of financial and sovereign debt crises on the performance of European countries, reveal that there is a statistically significant evidence of crisis transmission to European non-financials from US non-financials, while the financials are inconsistent in this case. In what concerns the sovereign debt crisis, the results show that financials depend more on changes in the difference between the Greek and German CDS spreads after Lehman Brothers' collapse compared to the period before the collapse.

Ludwig (2014) studies the presence of wake-up and pure contagion in the Euro area. The results attest the presence of pure sovereign contagion in the Eurozone and an increasing risk aversion via Eurozone countries since May 2010. However, the pure sovereign contagion is time variant, its intensity decreasing since its peak in 2010. Evidence that the crisis started at the periphery of Eurozone is found. In the same order of thoughts Fong & Wong (2012), after using CoVar methodology to study the sovereign relationships between European Union countries, reveal that Greece is the most vulnerable country in terms of sovereign default followed by Portugal. The value registered by Greece's ΔCoVar is 46 basis points, Portugal's 44 basis points, Ireland's 27 basis points and Italy and Spain 18 and 14 basis points respectively. Finland and Germany have the lowest values of ΔCoVar: 2 and 3 basis points. From the point of view of spillover effects the paper finds out that Greece has a big impact on Portugal and Ireland but not on Spain and Italy and this relationship is not symmetrical. For example, when Greece is under stress, Italy's ΔCoVar at the 99th percentile is 4 basis points, while when Italy is under stress the Greece's ΔCoVar at the 99th percentile will

be 80 basis points. These results have important implications for policy makers, suggesting the direction and intensity of their measures in order to reduce the contagion and to start the recovery.

Gomez-Puig & Sosvilla-Rivero (2014) take a different approach in their analysis. In order to study the existence of contagion between countries during the sovereign debt crisis they use daily data of 10-year bond yields for 11 Eurozone countries, both central and peripheral. The results show that during the crisis there are new causality patterns that occur between countries which were absent before the crisis started. Moreover, the paper reveals an increase in causality in more than 70% of the cases, fact which suggests that there is a high degree of contagion between countries, most of it coming from peripheral countries. However, this paper shows that an intensification of relationships is registered not only within peripheral countries but also with other central countries such as Germany and France. This means that contagion can spread not only from peripheral countries to peripheral countries but also to central Eurozone countries that have a big exposure in those countries debt.

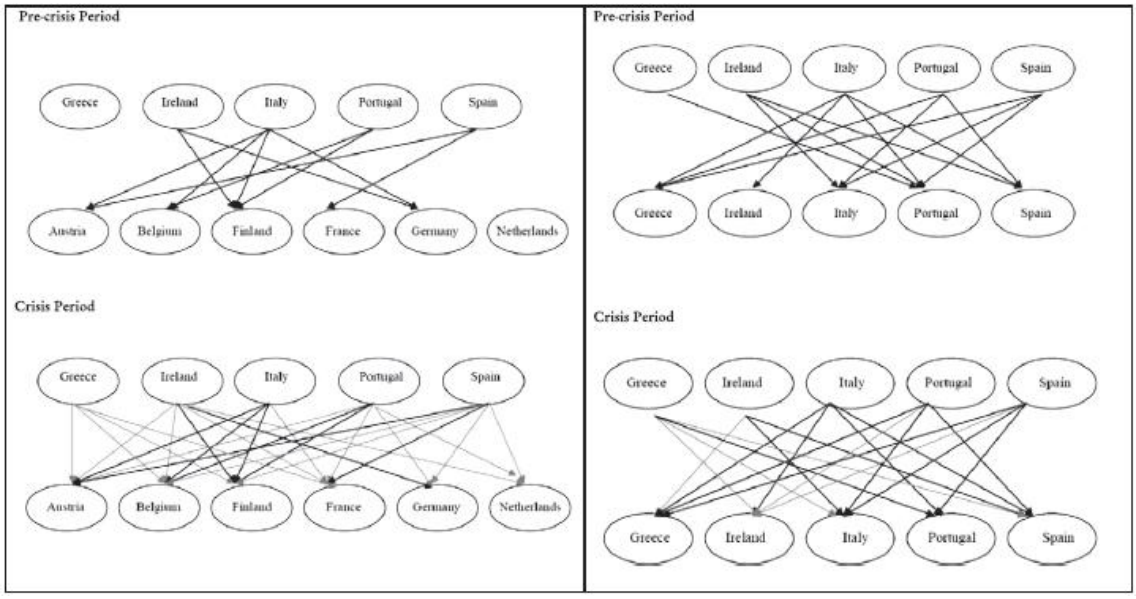

Figure 3: Causal relationships from EMU peripheral countries. a: Causal relationships from EMU peripheral to central countries. b: Causal relationships within EMU peripheral countries. **(**Gomez-Puig and Sosvilla-Rivero 2014:23)

From Figure 3 and 4 it can be seen that the number of relationships between peripheral and central Eurozone countries multiplies considerable, proving the fact that during the

crisis the linkages between countries are increasing exponentially, leading to an ease in contagion spreading within peripheral countries and from peripheral countries to central EMU countries.

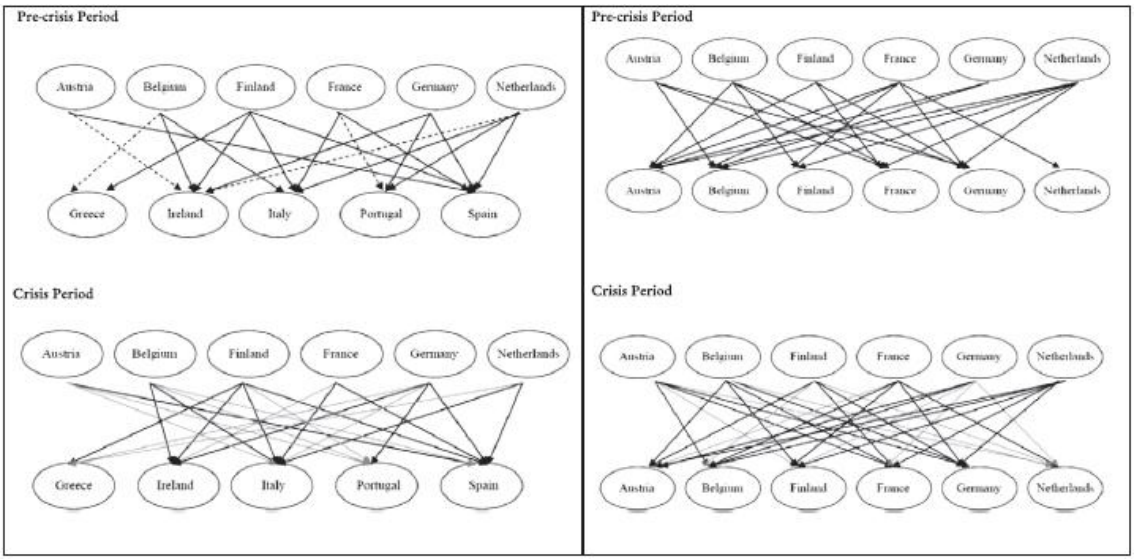

Figure 4: Causal relationships from EMU central countries. a: Causal relationships from EMU central to peripheral countries. b: Causal relationships within EMU central countries. (Gomez-Puig & Sosvilla-Rivero, 2014:24).

Li and Zhu (2014), after studying the evolution of the level of co-movement between five Asian countries (Hong Kong, Indonesia, Korea, Malaysia, Thailand), G7 countries (Canada, France, Germany, Italy, Japan, UK, US) and four Latin American countries (Mexico, Argentina, Brazil, Chile) during the 1997 Asian crisis and the 2007 financial crisis, find out that there exist a significant increase in market co-movements and the test for international financial contagion, coming from these two crises, is positive. The paper presents proofs that the East Asian Crisis increased the linkages between Hong Kong and a big number of Asian countries, Latin American countries and G7 countries, resulting in contagion at the level of these countries' markets. However, when comparing the 2007 financial crisis with East Asian crisis, the paper finds out less evidence of financial contagion in Asian countries and Latin American coming from the Global Financial Crisis. However, this is not true for G7 countries. The linkages between this group of countries and US increased dramatically during the 2007 financial crisis, resulting in a high level of contagion, with the epicenter being in US.

Another proof of interest is presented by Claeys & Vasicek (2014) who, after studying the linkages between 16 EU sovereign debt markets using a factor augmented version of

the VAR model and multivariate structural break test, reveal important spillovers, with Belgium, Italy and Spain being the central markets during the financial crisis. The results show that the total contagion on 16 EU bond markets is approximately equal to 59% meaning that shocks to bonds in other countries have a huge impact on sovereign bond spreads. The other 41% in variation are caused by domestic factors. The paper identifies three groups of countries with respect to strength in their bilateral contagion: (I) the core Eurozone (Austria, Finland, France, Netherlands) where domestic factors play an insignificant role; (II) Portugal, Ireland and Greece, where domestic variations are more important than bilateral ones and (III) Belgium, Italy and Spain who register important mutual effects, receiving and transferring shocks to all Eurozone markets.

Miyasuyoshi, Takahashi, Shimada & Tsukuda (2014) analyze the contagion from USA during the financial crisis of 2007 using a bivariate EGARCH model. The paper investigates the daily data on bond risk premiums for the financial and manufacturing industries. The results show that the risk premium for 5-year bonds issued by manufacturing industry companies is affected from a constant shock coming from foreign industries. The 5-year maturity bond risk for the manufacturing industry is sensitive to the foreign risk at the 5% level of significance, meaning that foreign shocks transmit directly into the Japanese manufacturing industry. Specific for the Japanese economy is that shocks translate from manufacturing industry into financial sector, even after the collapse of Lehman Brothers, and not the other way as in the case of USA.

Chen, Wei, Zhang & Yu (2014), after studying the relationship between USA and China during the Global Financial Crisis using various modern econometric techniques, reveal that there was an increased contagion during the crisis translating from USA into the Chinese economy. The time-varying lower Kendall's τ registered during the period of financial crisis is about 1.87 times the value of that registered in a non-crisis period in average. This means that the spillovers increased during the crisis with approximately 87%, resulting in a high degree of translation of negative effects from USA into the Chinese economy.

Moving forward, Hui & Chan (2014) study the presence of contagion between real estate and equity markets during the financial crisis for Hong Kong, US and UK. Using coskewness and cokurtosis tests, they register a statistically significant proof of contagion between equity and real estate markets in both directions, the contagion between US's equity and real estate markets being the most significant. Countries with weaker economy and financial conditions are more exposed and have bigger chances of

contagion meaning that investors should analyze carefully the decision to invest in a certain country and evaluate the potential implications in case of a crisis. The same is true for policy makers because of the rapidity and quality of their measures depend the level of contagion that the respective country will register.

Dungey and Gajurel (2014) study the equity market contagion during the global financial crisis (2007 - 2009) using a latent factor model. The paper finds strong evidence in favor of contagion presence. The contagion from US explains a large amount of the variance registered at the level of stock returns in both advanced and emerging markets. The results show that the contagion coming from US accounts and explains about 73 percent of the volatility registered at the level of French equity markets; 77 and 65 percent at the level of German and British equity markets. Japan registered the lowest level of contagion among developed countries - only 19 percent. From the point of view of emerging markets US crisis had a small impact in the stock return volatility of these countries except Brazil. US crisis accounts for 21 percent in the Brazil's stock market volatility. The authors affirm that contagion effects are not strongly correlated with the level of global integration.

Another paper that analyzes the volatility transmission between stock markets is Jung and Maderitsch (2014). Using intra-daily data and a Heterogeneous Autoregressive Distributed Lag Model, the authors find evidence of market synchronization in what concerns the volatility. The volatility from Hong Kong is sensible to volatility coming from trading in US, while Europe's volatility spillovers seem to be insignificant. However the volatility coming from Hong Kong directly affects European markets. Europe has a positive significant effect on US markets' volatility. During the crisis the volatility spillovers register record high levels in all markets. However, after taking account of conditional heteroskedasticity in their models the authors do not find evidence of market contagion, only interdependence.

Chang and Chen (2014) take a slightly different approach in measuring contagion. They analyze the presence of contagion in global REITs returns over 2006-2010 applying a correlation coefficient analysis for 16 countries' daily REITs indices. The results suggest the presence of clear evidence of contagion in global REITs markets. Moreover, the REITs markets from Europe suffer more from contagion than those from Asia. The 99.9% VAR estimates of European and Asian countries are 13.19% and respectively 19.81%. During the crisis the average values increase to 35.52% and 38.82%

respectively, proving the fact that European REITs are more affected by contagion during the period 2006-2010.

Choudhry and Jayasekera (2014) study the leverage and spillover effects between banking institutions' stock markets of the biggest economies (Germany, UK and US) and PIIGS countries (Portugal, Italy, Ireland, Greece and Spain) during the Global Financial Crisis. The results show that the crisis intensified the volatility spillovers between the major economies and PIIGS countries, big movements coming from Germany, UK and US. The relationship during pre-crisis was unidirectional and asymmetric: from major economies to the European distressed countries. However the crisis changed the situation, evidence of spillovers coming from smaller European economies to major economies being found, the countries most affected being Germany and UK. The results support the hypothesis that during the crisis contagion has expanded from one country to another like a virus.

Different results are found by Morales and Andreosso-O'Callaghan (2014) who, after studying the effects of the financial crisis at the global and regional level using different econometric methods, reveal that there is no contagion in the markets, not in a regional or global form. There are just spillover effects coming from USA.

Another paper of interest is Samarakoon (2011) who study the transmission of shocks and contagion between US, emerging markets and frontier markets. The paper reveals that at the level of emerging markets-US exists an important asymmetric bi-directional interdependence and contagion. Strong co-movements are driven in most part by US shocks whereas contagion is driven more by emerging market shocks. In what concerns the contagion effect coming from US except Latin America no proof is found that contagion spreads from US to emerging markets. From the perspective of frontier markets, the paper shows that there is a small, when expressed in magnitude, interdependence and contagion in frontier markets with respect to US shocks. Frontier markets are affected more during turbulent times, the level of contagion increasing exponentially with market turmoil. The financial crisis of 2007 affected more in terms of contagion than emerging markets.

Continuing the idea of the previous paragraph, Bekiros (2014) study the relationships existent between US, EU and BRICS countries. The results confirm that the integration level between almost all countries included in the analysis has increased after the Global

Financial Crisis and Euro Sovereign debt crisis. Countries tested positive for contagion while evidences in favor of the "decoupling" phenomenon have not been found.

All in all, crises represent an incontrollable phenomenon, and in order to minimize the potential impact that it can cause it needs to be studied and quantified from all aspects and from all points of view.

4. DATA AND METHODOLOGY

4.1. Data

In order to establish the macroeconomic relationships and interdependencies between economies it is necessary to make a clear distinction between a crisis period and a period of economic stability. Moreover, it is vital to identify as accurate as possible the beginning and the ending of the respective crisis. In order to identify the starting and ending point of the Global Financial Crisis this thesis uses the results presented in Baur (2012). According to this paper, the author first of all identifies a relatively long crisis period according to all major financial and economic news related to the Global Financial Crisis. The next step consists in modeling the excess volatility registered in the market as a benchmark to identify the start and the end date of the Global Financial Crisis. Because it is a unanimous opinion that the crisis originated in the financial sector, the conditional volatility is estimated using an asymmetric GARCH model based on the global financial sector returns. By combining these two methods, the author reveals that the beginning of the financial crisis is August 2007 and its ending is March 2009. Therefore this paper assumes the beginning of the crisis being August 2007 and its ending March 2009.

The data used in this analysis contains weekly prices of aggregate stock indices for 45 countries expressed in local currency in order to analyze the transmission of the crisis in the financial sector to the real sector at the global level. In order to analyze the interdependencies at the European Union level, data regarding CDS spreads for 28 member states is used. The data is obtained from Thomson Financial (Datastream). The analysis uses weekly data in order to avoid the potential bias caused by the differences in trading time across countries. The data covers a 14-year period from January 2000 until September 2014.

Table 1: Descriptive statistics - the period before the crisis

Country	Before the crisis							
	Mean return	Median	Maxim	Minim	Std. Dev.	Kurtosis	Skewness	No. Obs.
Australia	0.0018	0.0029	0.0461	-0.0562	0.0145	0.8321	-0.4181	395
New Zeeland	0.0016	0.0025	0.0537	-0.0892	0.0155	3.6013	-0.7652	342
Brazil	0.0031	0.0083	0.1618	-0.1248	0.0364	1.0076	-0.1277	395
Mexico	0.0037	0.0060	0.1169	-0.0960	0.0313	1.2120	-0.2490	395
Canada	0.0013	0.0018	0.0780	-0.1003	0.0214	1.8060	-0.4924	395
USA	0.0001	0.0004	0.1018	-0.0784	0.0225	2.4370	0.1784	395
Chile	0.0027	0.0036	0.0551	-0.0522	0.0158	0.9000	-0.1881	395
China	0.0029	0.0029	0.1280	-0.0754	0.0302	0.8060	0.2970	395
Hong Kong	0.0009	0.0028	0.0775	-0.1421	0.0282	1.6368	-0.5633	395
Indonesia	0.0032	0.0071	0.0894	-0.1010	0.0310	0.7362	-0.5666	395
Korea	0.0017	0.0045	0.1168	-0.1488	0.0376	0.8538	-0.3758	395
Taiwan	0.0004	0.0041	0.1176	-0.1161	0.0362	1.0890	-0.3048	395
Thailand	0.0015	0.0033	0.0860	-0.1403	0.0324	0.6934	-0.3122	395
India	0.0030	0.0080	0.1213	-0.1682	0.0389	2.7546	-1.0990	395
Japan	-0.0001	0.0026	0.1011	-0.0979	0.0285	0.7885	-0.2312	395
Russia	0.0067	0.0111	0.1951	-0.2279	0.0492	2.3224	-0.4908	395
South Africa	0.0032	0.0058	0.0976	-0.1030	0.0266	1.2907	-0.3268	395
Austria	0.0035	0.0050	0.0550	-0.0947	0.0218	2.3514	-0.8917	395
Belgium	0.0008	0.0039	0.1791	-0.1269	0.0281	8.5021	-0.1439	395
France	0.0000	0.0032	0.1663	-0.1292	0.0312	4.8368	-0.0054	395
Czech Rep	0.0034	0.0054	0.1021	-0.1030	0.0289	1.6819	-0.5389	395
Finland	-0.0006	0.0045	0.2297	-0.1863	0.0478	3.6787	-0.5578	395
Germany	0.0003	0.0059	0.1715	-0.1522	0.0346	3.8362	-0.4076	395
Luxembourg	0.0008	0.0036	0.1074	-0.1118	0.0276	2.6687	-0.5029	395
Netherlands	-0.0005	0.0035	0.2038	-0.1754	0.0338	7.7959	-0.3322	395
Sweden	0.0001	0.0041	0.1349	-0.1727	0.0348	3.0880	-0.5371	395
UK	0.0001	0.0022	0.1237	-0.0965	0.0221	5.4543	-0.0483	395
Norway	0.0030	0.0066	0.0916	-0.1315	0.0278	2.5915	-0.9647	395
Denmark	0.0018	0.0023	0.1068	-0.1483	0.0264	3.2978	-0.4106	395
Ireland	0.0014	0.0040	0.0754	-0.1015	0.0249	1.6817	-0.6201	395
Portugal	0.0003	0.0027	0.0725	-0.1132	0.0230	2.9877	-0.7696	395
Greece	-0.0002	0.0033	0.1448	-0.1374	0.0319	2.7634	-0.2241	395
Spain	0.0006	0.0041	0.1239	-0.1067	0.0288	2.1961	-0.5524	395
Italy	-0.0001	0.0031	0.1060	-0.1259	0.0275	2.9442	-0.6688	395
Latvia	0.0049	0.0054	0.2566	-0.4081	0.0422	42.8614	-2.9454	394
Lithuania	0.0044	0.0031	0.0934	-0.0835	0.0232	2.1343	0.0932	394
Malta	0.0010	-0.0007	0.1124	-0.0844	0.0221	3.9628	0.6773	395
Estonia	0.0052	0.0041	0.1251	-0.1326	0.0272	3.8850	-0.3218	395
Cyprus	0.0110	0.0085	0.1033	-0.1572	0.0354	4.9197	-1.1308	150
Hungary	0.0030	0.0054	0.0955	-0.1239	0.0309	2.0639	-0.6925	395
Poland	0.0032	0.0058	0.1192	-0.1104	0.0302	1.6720	-0.1551	395
Romania	0.0080	0.0065	0.1708	-0.2501	0.0386	6.6811	-0.2863	395
Bulgaria	0.0077	0.0055	0.1800	-0.1992	0.0378	6.0625	0.2137	352
Slovakia	0.0043	0.0029	0.1432	-0.1034	0.0264	3.5345	0.5751	395
Slovenia	0.0051	0.0000	0.1692	-0.0798	0.0246	13.6041	2.7484	395

Table 1 reveals that before the Global Financial Crisis almost all countries included in the analysis registered a positive mean stock market return. Developing countries tend to record higher returns when compared to developed market, which is line with the theory that markets which bear more risk should offer a higher return to compensate for the potential losses that the investor can suffer, and to make him willing to take the risk. Just couple of countries registered a negative mean stock return: Japan, Finland, Netherlands, Greece, and Italy.

Table 2: Descriptive statistics - the period during the crisis

Country	During the crisis							
	Mean return	Median	Maxim	Minim	Std. Dev.	Kurtosis	Skewness	N. Obs.
Australia	-0.0065	-0.0045	0.1202	-0.1153	0.0380	1.1858	-0.1869	87
New Zealand	-0.0069	-0.0061	0.0499	-0.0789	0.0235	0.4077	-0.0506	87
Brazil	-0.0034	0.0044	0.1058	-0.2549	0.0541	4.2876	-1.1333	87
Mexico	-0.0049	-0.0045	0.0979	-0.1944	0.0432	3.8498	-1.0482	87
Canada	-0.0054	0.0007	0.0783	-0.1526	0.0364	2.4582	-0.8783	87
USA	-0.0072	-0.0024	0.0964	-0.1645	0.0381	3.4439	-0.7907	87
Chile	-0.0024	0.0030	0.0793	-0.1744	0.0339	6.8837	-1.5481	87
China	-0.0073	-0.0097	0.1392	-0.1177	0.0543	-0.3038	0.1307	87
Hong Kong	-0.0062	-0.0030	0.1556	-0.1548	0.0559	0.6188	-0.0562	87
Indonesia	-0.0060	0.0030	0.2045	-0.2330	0.0594	4.3818	-0.8013	87
Korea	-0.0056	-0.0056	0.1983	-0.1666	0.0532	2.7655	0.1142	87
Taiwan	-0.0069	-0.0058	0.1220	-0.1073	0.0466	-0.1347	0.0009	87
Thailand	-0.0081	-0.0028	0.1744	-0.1915	0.0475	5.6012	-0.6448	87
India	-0.0061	-0.0059	0.1521	-0.1564	0.0551	0.2799	-0.2085	87
Japan	-0.0086	-0.0085	0.1479	-0.2113	0.0474	3.7568	-0.5214	87
Russia	-0.0117	0.0000	0.2535	-0.4455	0.0927	6.1987	-1.1900	87
South Africa	-0.0036	0.0012	0.1375	-0.1075	0.0425	0.6496	0.2984	87
Austria	-0.0119	0.0026	0.1409	-0.2052	0.0584	1.0782	-0.6390	87
Belgium	-0.0108	-0.0070	0.0850	-0.1561	0.0440	0.6113	-0.3850	87
France	-0.0081	-0.0070	0.0696	-0.1480	0.0394	1.6350	-0.8623	87
Czech Rep.	-0.0095	-0.0007	0.1333	-0.1696	0.0531	1.7855	-0.5363	87
Finland	-0.0097	-0.0041	0.0948	-0.1373	0.0434	0.6991	-0.5974	87
Germany	-0.0069	-0.0021	0.0718	-0.1487	0.0423	1.9936	-1.0438	87
Luxembourg	-0.0112	-0.0066	0.1095	-0.2590	0.0598	2.6154	-0.7701	87
Netherlands	-0.0102	-0.0024	0.0786	-0.1571	0.0434	0.9876	-0.5547	87
Sweden	-0.0073	-0.0040	0.1320	-0.1477	0.0435	1.4420	-0.1983	87
UK	-0.0060	0.0013	0.0717	-0.1230	0.0365	0.2348	-0.5031	87
Norway	-0.0086	-0.0022	0.1971	-0.2012	0.0572	2.9136	-0.4239	87
Denmark	-0.0091	-0.0063	0.1158	-0.1828	0.0449	2.2448	-0.6318	87
Ireland	-0.0160	-0.0187	0.1488	-0.1758	0.0602	0.7333	0.1310	87
Portugal	-0.0089	-0.0060	0.0916	-0.1892	0.0413	3.4191	-0.8471	87
Greece	-0.0126	-0.0060	0.1200	-0.1617	0.0512	0.6607	-0.1897	87
Spain	-0.0071	-0.0067	0.1192	-0.1200	0.0412	0.9122	-0.1616	87
Italy	-0.0105	-0.0088	0.1166	-0.1421	0.0435	1.3546	-0.1342	87
Latvia	-0.0143	-0.0060	0.1243	-0.2248	0.0410	9.0439	-1.6082	87
Lithuania	-0.0148	-0.0083	0.1483	-0.2950	0.0490	12.6114	-1.9952	87
Malta	-0.0068	-0.0040	0.0366	-0.0561	0.0156	1.5911	-0.5612	87
Estonia	-0.0146	-0.0100	0.1252	-0.2022	0.0440	4.2252	-0.6748	87
Cyprus	-0.0199	-0.0156	0.1485	-0.2336	0.0698	0.5160	-0.2446	87
Hungary	-0.0110	-0.0091	0.1338	-0.2005	0.0533	3.6937	-1.0532	87
Poland	-0.0107	-0.0104	0.1070	-0.1277	0.0456	0.4805	-0.3231	87
Romania	-0.0168	-0.0084	0.1366	-0.1838	0.0576	0.6214	-0.4533	87
Bulgaria	-0.0198	-0.0111	0.0650	-0.2821	0.0582	7.1559	-2.0450	87
Slovakia	-0.0042	0.0000	0.0853	-0.0775	0.0225	4.5587	-0.3652	87
Slovenia	-0.0145	0.0000	0.1091	-0.2079	0.0557	2.8351	-1.1752	87

During the financial crisis the situation changes dramatically. Table 2 shows that all the countries included in the analysis register a negative mean stock market return, which suggests that the impact and negative effects of the Global Financial Crisis translated at the level of each country and affected developed as well as emerging markets. There is however not a clear pattern on which group of countries was affected the most.

Table 3: Descriptive statistics - the period following financial crisis

Country	After the crisis							
	Mean return	Median	Maxim	Minim	Std. Dev.	Kurtosis	Skewness	No. Obs.
Australia	0.0015	0.0021	0.0684	-0.0473	0.0203	0.1257	0.0011	285
New Zealand	0.0015	0.0010	0.0479	-0.0568	0.0131	1.7918	-0.0375	285
Brazil	0.0012	0.0018	0.0866	-0.0887	0.0310	0.0486	-0.1178	285
Mexico	0.0029	0.0033	0.0795	-0.0745	0.0221	1.3585	0.0292	285
Canada	0.0020	0.0030	0.0744	-0.0721	0.0204	1.3764	-0.2426	285
USA	0.0031	0.0048	0.0707	-0.1174	0.0217	3.5506	-0.7217	285
Chile	0.0017	0.0029	0.0646	-0.0745	0.0193	1.6114	-0.4477	285
China	0.0000	0.0000	0.0818	-0.1110	0.0287	1.6219	-0.4147	285
Hong Kong	0.0021	0.0034	0.1204	-0.1059	0.0286	2.1980	0.1172	285
Indonesia	0.0045	0.0054	0.0990	-0.1080	0.0245	2.8815	-0.2711	285
Korea	0.0018	0.0026	0.0823	-0.1345	0.0248	3.3038	-0.6179	285
Taiwan	0.0020	0.0037	0.1567	-0.0891	0.0243	6.5685	0.3692	285
Thailand	0.0045	0.0089	0.0994	-0.1000	0.0268	1.7403	-0.4668	285
India	0.0037	0.0047	0.1772	-0.0765	0.0286	4.6091	0.5789	285
Japan	0.0022	0.0043	0.0909	-0.1523	0.0298	2.6849	-0.6862	285
Russia	0.0018	0.0026	0.1454	-0.2126	0.0438	1.8906	-0.2800	285
South Africa	0.0031	0.0034	0.0683	-0.0740	0.0218	0.9056	-0.1384	285
Austria	0.0011	0.0046	0.1110	-0.1460	0.0340	1.7265	-0.4637	285
Belgium	0.0021	0.0028	0.0754	-0.0910	0.0246	1.4588	-0.2988	285
France	0.0015	0.0036	0.1113	-0.1402	0.0286	2.9370	-0.3342	285
Czech Rep.	0.0007	0.0008	0.1195	-0.1567	0.0278	4.7789	-0.1923	285
Finland	0.0016	0.0034	0.0961	-0.1057	0.0304	1.3453	-0.0554	285
Germany	0.0029	0.0051	0.1094	-0.1680	0.0286	5.2348	-0.8010	285
Luxembourg	0.0007	-0.0006	0.0963	-0.1676	0.0349	1.8965	-0.2476	285
Netherlands	0.0022	0.0025	0.0940	-0.1138	0.0257	2.2632	-0.2947	285
Sweden	0.0026	0.0045	0.0970	-0.0868	0.0247	1.5896	-0.3063	285
UK	0.0021	0.0040	0.0687	-0.1081	0.0215	2.7878	-0.5364	285
Norway	0.0032	0.0045	0.0932	-0.1290	0.0263	3.2700	-0.6898	285
Denmark	0.0041	0.0050	0.0991	-0.0926	0.0249	1.8664	-0.1120	285
Ireland	0.0029	0.0051	0.1009	-0.1290	0.0269	3.2739	-0.5554	285
Portugal	-0.0002	-0.0004	0.0730	-0.1257	0.0307	1.2870	-0.3866	285
Greece	-0.0013	0.0015	0.1883	-0.1447	0.0481	0.7656	-0.0492	285
Spain	0.0011	0.0016	0.1125	-0.1262	0.0335	0.8962	-0.1072	285
Italy	0.0009	0.0017	0.1087	-0.1474	0.0354	1.3359	-0.2355	285
Latvia	0.0025	0.0015	0.1400	-0.1403	0.0271	5.5825	0.0348	285
Lithuania	0.0037	0.0021	0.1963	-0.1556	0.0265	16.0913	1.1206	285
Malta	0.0008	-0.0002	0.0922	-0.0563	0.0167	6.0532	1.0771	285
Estonia	0.0036	0.0005	0.1452	-0.1058	0.0273	5.2776	1.1207	285
Cyprus	-0.0073	-0.0036	0.3704	-0.2276	0.0726	4.0391	0.7062	285
Hungary	0.0018	0.0009	0.1507	-0.1664	0.0340	3.0920	-0.0314	285
Poland	0.0027	0.0034	0.1252	-0.1755	0.0274	7.3624	-0.6065	285
Romania	0.0038	0.0039	0.1091	-0.1327	0.0311	2.9826	-0.3950	285
Bulgaria	0.0024	0.0014	0.1609	-0.0753	0.0265	6.1807	1.2725	285
Slovakia	-0.0012	0.0012	0.1383	-0.1389	0.0251	8.2901	-0.7953	285
Slovenia	-0.0005	0.0008	0.0816	-0.0923	0.0266	0.4144	-0.1274	285

Table 3 shows that after the crisis ended stock markets tend to register a mean positive return. This suggests that the consequences of the financial crisis are not present anymore or that their impact has lost in value for almost all the countries included in the analysis. However, there are five countries that continue the trend registered during the crisis and record negative mean returns. These are: Slovenia, Slovakia, Cyprus, Greece and Portugal.

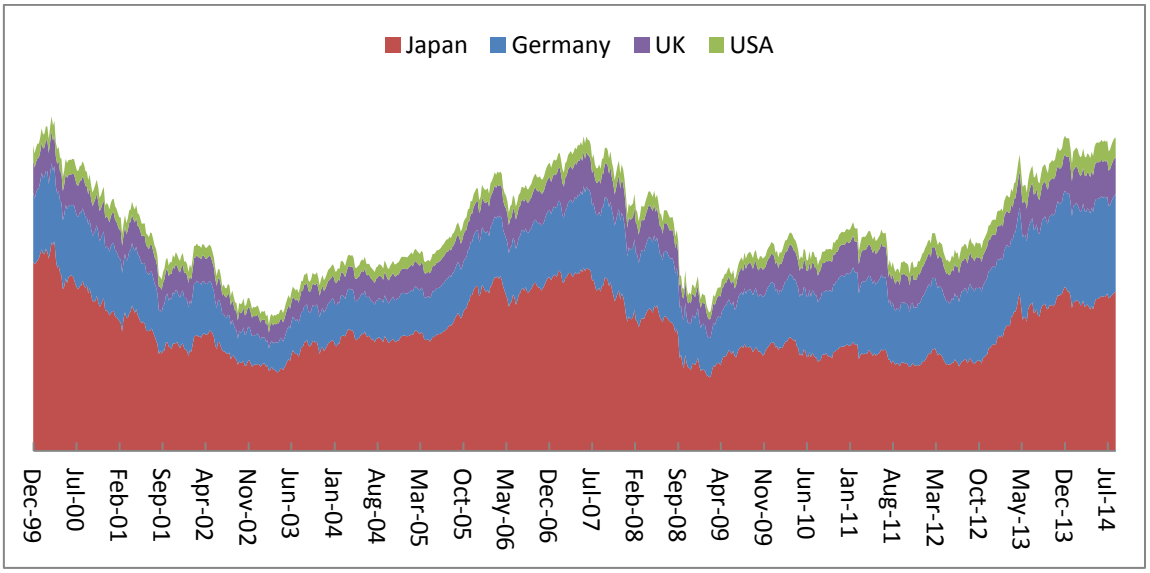

Figure 5: Aggregate stock market indices 2000-2014: Japan, Germany, UK and USA.

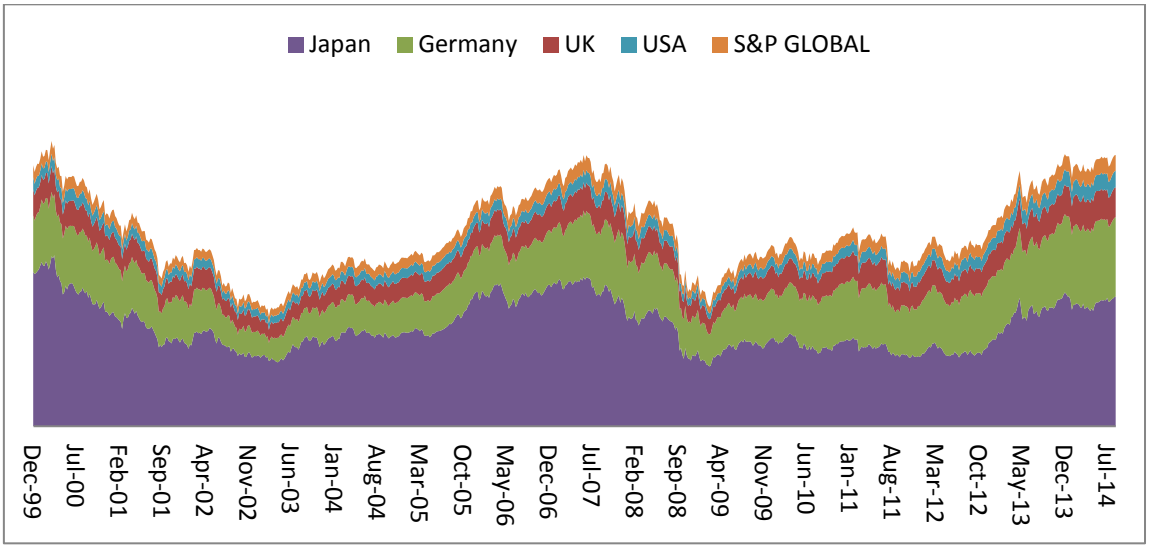

Figure 6: Aggregate stock market indices 2000-2014: Japan, Germany, UK, USA and the global stock index

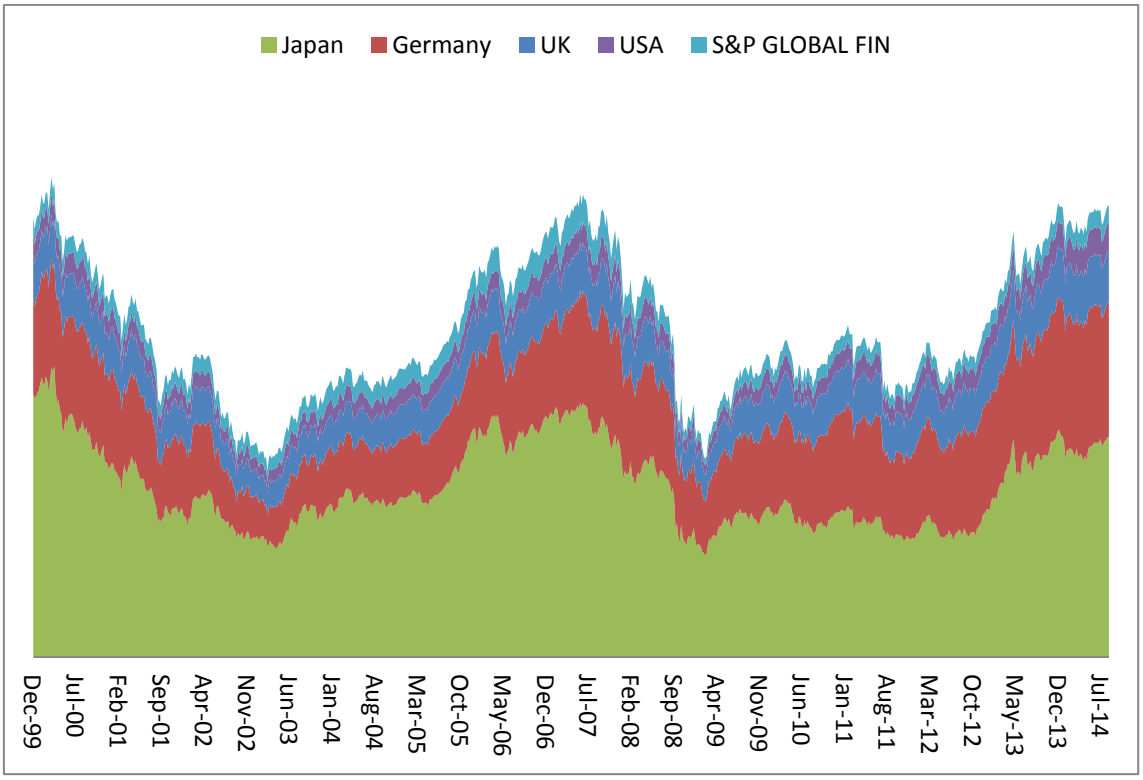

Figure 7: Aggregate stock market indices 2000-2014: Japan, Germany, UK, USA and the global financials stock index

Figure 5, 6, and 7 present the evolution of the major stock market indices, the global stock index and the global financials stock index. From the above mentioned figures it can be seen that stock markets tend to co-move in time and that their evolution is similar. This suggests that stock markets are integrated at certain levels and that during turbulent times the negative effects will be felt at the level of each economy and stock market in part. Taking a look at the graphs it can be seen that during the Global Financial Crisis, and in particular in September 2008, all stock markets registered significant and similar losses, suggesting the presence of contagion between markets. Previous literature (Longstaff, 2010; Baur, 2012; Guo et all., 2011) find significant co-movement between stock markets during the financial crisis. Moreover the results show the presence of contagion between markets during this period.

4.2. Methodology

This thesis uses two econometric models in order to quantify the level of dependencies between countries and the contagion that is transmitted from one economy to another in

the crisis period. The first econometric model proposed by Baur (2012) takes the following form:

(1) $$R_{M,i,t} = a + b_1 R_{W,t} + b_2 R_{W,t} D_t + e_{S,i,t}$$

(2) $$h_{S,i,t} = \pi + \alpha e^2_{S,i,t-1} + \beta e^2_{S,i,t-1} I(e_{S,i,t-1}<0) + \gamma h_{S,i,t-1}$$

(3) $$e_{S,i,t} = (h_{S,i,t})^{0,5} Z_{S,i,t}$$

(4) $$Z_{S,i} \sim N(0,1)$$

The system composed of equations (1) to (4) measures the degree of co-movement between a country portfolio (M) with a global portfolio (W) during a period of economic stability and during a crisis. The b_1 parameter represents the degree of co-movement in normal times and b_2 measures the degree of co-movement in the crisis period. The variable D_t is a dummy variable which takes value one if the observation is from a crisis period, and zero otherwise. The subscript M represents the country.

Since this paper aims to test the level of cointegration between countries in three different economic states: before the crisis, during the crisis and after the crisis, and to test for contagion the econometric model will take the following form:

(5) $$R_{M,i,t} = a + b_1 R_{W,t} + b_2 R_{W,t} D_{t,\ crisis} + b_3 R_{W,t} D_{t,\ post\text{-}crisis} + e_{S,i,t}$$

(6) $$h_{S,i,t} = \pi + \alpha e^2_{S,i,t-1} + \beta e^2_{S,i,t-1} I(e_{S,i,t-1}<0) + \gamma h_{S,i,t-1}$$

(7) $$e_{S,i,t} = (h_{S,i,t})^{0,5} Z_{S,i,t}$$

(8) $$Z_{S,i} \sim N(0,1)$$

The b_1 parameter represents the degree of co-movement in normal times, b_2 measures the degree of co-movement in the crisis period and b_3 measures the degree of co-movement in the post-crisis period. The variable $D_{t,\ crisis}$ is a dummy variable which takes value one if the observation is from a crisis period, and zero otherwise, while the variable $D_{t,\ post\text{-}crisis}$ is a dummy variable which takes the value of one if the observation is from the post-crisis period and zero otherwise.

Previous literature (Dungey & Gajurel, 2014; Chevallier, 2012) found out that the Global Financial Crisis originated in US, the epicenter being financial sector. Therefore, in order to estimate the global financial sector contagion, the second model proposed by Baur (2012) takes the form:

(9) $$R_{M,i,t} = a + b_1 R_{Fin,W,t} + b_2 R_{Fin,\,W,t} D_{t,\,crisis} + b_3 R_{Fin,W,t} D_{t,\,post\text{-}crisis} + e_{Fin,i,t}$$

(10) $$h_{S,i,t} = \pi + \alpha e^2_{S,i,t-1} + \beta e^2_{S,i,t-1} I(e_{S,i,t-1}<0) + \gamma h_{S,i,t-1}$$

(11) $$e_{S,i,t} = (h_{S,i,t})^{0,5} Z_{S,i,t}$$

(12) $$Z_{S,i} \sim N(0,1)$$

The system composed of equations (9) to (12) measures the degree of co-movement between a country's portfolio (M) with a global financial portfolio (W) during three different economic states. The b_1 parameter represents the degree of co-movement in normal times, b_2 measures the degree of co-movement in the crisis period and b_3 measures the degree of co-movement in the post-crisis period. The variable $D_{t,\,crisis}$ is a dummy variable which takes value one if the observation is from a crisis period, and zero otherwise, while the variable $D_{t,\,post\text{-}crisis}$ is a dummy variable which takes the value of one if the observation is from the post-crisis period and zero otherwise.

5. RESULTS

Previous literature (Forbes and Rigobon, 2002; Dungey et al., 2006; Chandar et all., 2009) describes contagion as being a significant increase in co-movement between two or more markets or asset classes, and a strong correlation coefficient in a crisis period when compared to a tranquil or benchmark period. However, Baur and Lucey (2009) state that the above mentioned condition is not enough to say that there is contagion between markets or asset classes because if there is a positive correlation change but the level remains in a negative correlation state, then the affirmation that there exists contagion fails to be accepted. Therefore, the authors define contagion as a significant increase in the correlation coefficient in a crisis period compared to a tranquil period evolving into a positive correlation level. This analysis concentrates on Baur et al. (2009) definition when analyzing the correlations between markets.

In order to make a clear picture regarding what happened during the financial crisis, how and to which countries the negative effects translated to, this paper divides the whole countries sample in 4 main groups: South and North America, Europe, Asia and Other Major Economies. Table 4 presents the relationship between major South and North American stock markets and the global stock index during three economic states.

Table 4: North and South America's aggregate stock market contagion

Country	Intercept	b_1	b_2	b_3	Contagion
USA (S&P 500)	-0.0002	0.9744***	-0.0601**	-0.0707***	No
	(0.880)	(0.000)	(0.011)	(0.000)	
USA (Dow Jones)	-0.0015	0.9007***	-0.0808***	-0.0769***	No
	(0.191)	(0.000)	(0.003)	(0.003)	
USA (Nasdaq)	0.0016	1.1906***	-0.2718***	-0.2326***	No
	(0.283)	(0.000)	(0.000)	(0.000)	
Brazil	-0.0065	1.2075***	-0.0719	-0.2446***	No
	(0.101)	(0.000)	(0.382)	(0.003)	
Canada	0.0022	0.7503***	0.0677	-0.0650*	No
	(0.165)	(0.000)	(0.112)	(0.077)	
Chile	0.0010	0.2540***	0.3655***	0.1955***	Yes
	(0.695)	(0.000)	(0.000)	(0.000)	
Mexico	-0.0008	0.9004***	-0.0278	-0.2552***	No
	(0.764)	(0.000)	(0.641)	(0.000)	

*,**,*** significant at 10%, 5% and 1% respectively, p-values in parentheses.

From the above table it can be seen that all countries' aggregate stock markets register a positive correlation with the global stock market. The two most extreme values are registered by Brazil and Chile. Brazil's stock market records the highest co-movement interdependence with the global stock market, the value of the coefficient being 1.21, while Chile records the lowest correlation with global stock market index, approximately 0.24. The other countries register a median value equal to 0.94.

Taking the analysis to the crisis period it can be seen that the results construct an exactly opposite picture. All countries register a negative relationship between local stock markets and global stock index except Chile and Canada, with the latter being insignificant. This reveals that during the Global Financial Crisis the negative effects and contagion translated to Chile's stock market. Therefore, the thesis finds support in favor of the first hypothesis only in case of Chile, while for other countries this is not the case. However, the fact that other countries did not register a significant positive correlation coefficient does not mean that their economies did not feel the crisis' consequences.

The same trend continues to be recorded even after the crisis finished. All countries register a statistically significant negative correlation with global stock market while Chile records a positive value. This suggests that Chile's economy is still highly integrated with the global economy and that there still might be left some traces of contagion at the level of stock market. The second hypothesis which states that after the crisis the correlation coefficient between local stock market and global stock market is higher when compared to the pre-crisis period, finds statistical support just in Chile's case.

Table 5: Developed Europe's aggregate stock market contagion

Country	Intercept	b_1	b_2	b_3	Contagion
UK	-0.0011	0.8062***	0.0202	0.0502	No
	(0.428)	(0.000)	(0.577)	(0.136)	
Austria	-0.0014	0.5129***	0.6133***	0.6951***	Yes
	(0.774)	(0.000)	(0.000)	(0.000)	
Belgium	0.0009	0.8456***	0.0961	0.0786*	No
	(0.561)	(0.000)	(0.111)	(0.096)	
Denmark	-0.1072***	0.8588***	0.1734***	-0.1274**	Yes
	(0.003)	(0.000)	(0.001)	(0.034)	
Finland	0.0011	1.1552***	-0.2667***	-0.0708	No
	(0.572)	(0.000)	(0.002)	(0.413)	
France	-0.0028*	1.0958***	-0.0480	0.0199	No
	(0.079)	(0.000)	(0.279)	(0.675)	
Germany	0.0002	1.2189***	-0.1837***	-0.1253**	No
	(0.936)	(0.000)	(0.000)	(0.015)	
Greece	0.0041	0.7187***	0.2380***	0.3829***	Yes
	(0.190)	(0.000)	(0.006)	(0.000)	
Ireland	0.0049**	0.7478***	0.3960***	0.1316**	Yes
	(0.039)	(0.000)	(0.000)	(0.038)	
Italy	-0.0022	0.9434***	0.0013	0.2962***	No
	(0.336)	(0.000)	(0.980)	(0.000)	
Luxembourg	0.0039*	0.6630***	0.1287*	0.3497***	Yes
	(0.097)	(0.000)	(0.068)	(0.000)	
Netherlands	0.0000	1.0710***	-0.1128**	-0.0586	No
	(0.993)	(0.000)	(0.038)	(0.253)	
Norway	-0.0001	0.7941***	0.2382***	0.1072**	Yes
	(0.946)	(0.000)	(0.005)	(0.049)	
Portugal	0.0019	0.5553***	0.1392**	0.2625***	Yes
	(0.509)	(0.000)	(0.020)	(0.000)	
Spain	0.0017	1.0122***	-0.1765***	0.0949	No
	(0.456)	(0.000)	(0.003)	(0.193)	
Sweden	-0.0001	1.2115***	-0.2675***	-0.3159***	No
	(0.949)	(0.000)	(0.000)	(0.000)	

*,**,*** significant at 10%, 5% and 1% respectively, p-values in parentheses.

In order to present a clearer picture about the correlation between European countries' stock markets and global stock market during different economic states this thesis divides European countries in two groups: Developed Europe and Emerging Europe. Table 5 presents the regression results for the Developed Europe group.

The results reveal that there is a positive relationship between all countries included in the group and the global stock market index. The coefficients take values from the interval [0.5129; 1.2189]. The lowest value corresponds to Austria while the highest value is registered by Germany. Moving forward, during the financial crisis the situation changes significantly the results tending to divide the countries in two subclasses:

countries in which is registered a significant contagion and countries which did not register a significant co-movement with the global index. In the first subclass goes: Austria, Denmark, Greece, Ireland, Luxembourg, Norway, and Portugal. These countries register a significant increase in co-movement between their stock market and the global stock market. The values range between 0.1287 (Luxembourg) and 0.6133 (Austria). The thesis finds economic and statistic support in favor of these countries. The other subclass registers a negative or insignificant co-movement with the global stock index. This means that investors which placed their money in these countries during the financial crisis managed to protect at least partially their investments, while those who invested in countries from the first subclass remained exposed to losses which translated from US market into these markets.

After the crisis, the situation tends to take a slightly different turn. The results reveal an increase in co-movement between these countries and the global stock index when compared to the crisis period. This can be explained by the fact that the Global Financial Crisis originated in the US and therefore the European countries felt its consequences as a foreign shock while the after crisis period is marked by an important event for Eurozone: the sovereign debt crisis which originated internally and affected the majority of the members. The countries which register an increased correlation coefficient are: UK, Austria, Belgium, France, Greece, Ireland, Italy, Luxembourg, Norway, Portugal, and Spain. Denmark turns from positive significant coefficient during the crisis to negative significant coefficient after the crisis. Sweden maintains its isolated status even after the crisis serving as a good protection against this increased co-movement phenomenon registered at the level of majority of countries. The second hypothesis finds support only in case of: Austria, Belgium, Greece, Ireland, Italy, Luxembourg, Norway, and Portugal.

Table 6: Emerging Europe's aggregate stock market contagion

Country	Intercept	b_1	b_2	b_3	Contagion
Bulgaria	0.0026 (0.275)	0.0645 (0.160)	0.7880*** (0.000)	0.1542** (0.012)	Yes
Czech Republic	-0.0079** (0.050)	0.6098*** (0.000)	0.3886*** (0.000)	0.2383*** (0.001)	Yes
Cyprus	0.0132** (0.013)	0.6831*** (0.000)	0.4458* (0.052)	0.5050* (0.059)	Yes
Estonia	0.0003 (0.915)	0.3818*** (0.000)	0.1199** (0.048)	0.0618 (0.371)	Yes
Hungary	-0.0071 (0.240)	0.6759*** (0.000)	0.1545* (0.070)	0.2178*** (0.003	Yes
Lithuania	0.0000 (0.990)	0.0637 (0.202)	0.3780*** (0.000)	0.2991*** (0.000)	Yes
Malta	0.0021 (0.337)	0.0943*** (0.003)	-0.0912* (0.093)	-0.1119** (0.040)	No
Poland	-0.0006 (0.849)	0.6383*** (0.000)	0.1905** (0.025)	0.1411** (0.013)	Yes
Romania	0.0010 (0.791)	0.0606 (0.408)	0.7249*** (0.000)	0.6803*** (0.000)	Yes
Slovenia	0.0017 (0.702)	0.0334 (0.639)	0.8299*** (0.000)	0.5186*** (0.000)	Yes
Latvia	0.0037** (0.045)	-0.0077 (0.750)	0.5199*** (0.000)	0.2193*** (0.001)	Yes
Slovakia	-0.0004 (0.867)	0.2167*** (0.000)	-0.2715*** (0.000)	-0.1197 (0.123)	No

*,**,*** significant at 10%, 5% and 1% respectively, p-values in parentheses.

From the perspective of Emerging Europe group, Table 6 reveals that 8 out of 12 countries have a significant positive correlation between their local stock market indexes and the global stock index, while 4 countries register an insignificant or negative correlation coefficient. During the crisis period the situation changes considerably, the results identifying a considerable increase in co-movement between these countries' stock indexes and the global index, resulting in a significant contagion at the level of Emerging Europe countries. The correlation coefficient ranges between 0.1199 and 0.8299 in absolute value. The country which registered the highest level of contagion is Slovenia. Its correlation coefficient evolved from an insignificant 0.0334 to a highly significant 0.8299. Those investors who had exposure to Slovenia's economy lost completely their diversification benefits and suffered considerable losses. Only two countries from this group registered a significant decoupling from the global economy during the Global Financial Crisis: Malta and Slovakia which recorded a significant negative correlation coefficient, -0.0912 and -0.2715 respectively. Therefore the thesis finds support in favor of the first hypothesis for all countries except Malta and Slovakia.

Moving to the post-crisis period the results reveal a decrease in correlations between the countries included in the table and the global index when compared to the crisis period. However, the still positive significant coefficients suggest that there might be left some traces of contagion in the markets and that the stock markets of these countries co-move with the global stock index, and are vulnerable to international shocks. Malta and Slovakia continue to record a negative correlation with Estonia following the trend and going from positive significant correlation during the crisis to positive but insignificant correlation after the crisis. The second hypothesis is not supported just in case of these three countries. Comparing Emerging Europe countries group with Developed Europe group it can be seen that the first group was affected more by the financial crisis and suffered a higher degree of contagion while the contagion phenomenon was registered in a fewer developed countries.

Table 7: Asia's aggregate stock market contagion

Country	Intercept	b_1	b_2	b_3	Contagion
China	-0.0101**	0.1013	0.2152*	0.3319***	Yes
	(0.019)	(0.160)	(0.094)	(0.001)	
Hong Kong	-0.0018	0.7892***	0.4573***	0.0966	Yes
	(0.505)	(0.000)	(0.000)	(0.188)	
India	0.0019	0.4346***	0.4026***	0.1631*	Yes
	(0.700)	(0.000)	(0.000)	(0.088)	
Indonesia	0.0017	0.2611***	0.6103***	0.2513***	Yes
	(0.616)	(0.000)	(0.000)	(0.000)	
Japan	-0.0047	0.7121***	0.2395***	0.0647	Yes
	(0.459)	(0.000)	(0.000)	(0.347)	
Korea	-0.0013	0.9737***	-0.0838	-0.2774***	No
	(0.537)	(0.000)	(0.311)	(0.000)	
Taiwan	-0.0009	0.7264***	0.0769	-0.0950	No
	(0.671)	(0.000)	(0.435)	(0.203)	
Thailand	0.0041	0.4939***	0.0770	0.0557	No
	(0.274)	(0.000)	(0.264)	(0.529)	

*,**,*** significant at 10%, 5% and 1% respectively, p-values in parentheses.

Another important and major investment region is Asia. Table 7 reveals that all the countries included in this group have a strong positive correlation with the global stock market except China, which seems to be isolated from the global economy. The highest correlation value is registered by Korea (0.9737). During the crisis the image changes considerably. Hong Kong, India, Indonesia and Japan register a highly significant co-movement with the global index. China records just a week co-movement, the correlation coefficient being significant just at 10 per cent. On the other side Korea,

which had the highest correlation coefficient before the crisis, during the crisis its stock market decouples from the global markets, the correlation coefficient becoming negative but insignificant. Taiwan and Thailand do not register any contagion during the Global Financial Crisis. Therefore, the first hypothesis is not supported just in case of Korea, Taiwan and Thailand.

The post-crisis period reveals that only India and Indonesia still have a significant positive correlation coefficient. However, when compared to the crisis period the values are lower. China, on the other hand, registers an increase in correlation for the post-crisis period. This is explained by the increasing role that China has started to play at the level of global economy, and its evolution to a major player on stock markets. Similar results are found by Yang et all. (2014). Hong Kong and Japan's correlation values come close to their pre-crisis levels. The second hypothesis finds support just for China, India and Indonesia.

Table 8: Other countries group aggregate stock market contagion

Country	Intercept	b_1	b_2	b_3	Contagion
Australia	0.0039	0.4373***	0.4016***	0.2579***	Yes
	(0.128)	(0.000)	(0.000)	(0.000)	
New Zealand	0.0008	0.2261***	0.1137**	0.1028**	Yes
	(0.749)	(0.000)	(0.028)	(0.012)	
Russia	-0.0061	0.8460***	0.4393***	0.5089***	Yes
	(0.140)	(0.000)	(0.000)	(0.000)	
South Africa	0.0006	0.7580***	0.1209**	-0.0517	Yes
	(0.758)	(0.000)	(0.019)	(0.310)	

*,**,*** significant at 10%, 5% and 1% respectively, p-values in parentheses.

The other countries group reveals that there is a positive relationship between stock market of these individual countries and global stock market. The highest correlation is registered by Russia (0.8460). The period corresponding to the Global Financial Crisis is characterized by a statistically significant positive correlation at the level of each country finding support in this way to the existence of contagion in their stock markets. The most affected seems to be Russia and Australia. The first hypothesis finds support for all countries.

The period after the crisis is characterized by lower correlations between local and global stock markets when compared to the pre-crisis period. However, for three

countries the correlation is still positive and significant. Russia seems to co-move more and more with the global stock market and economy. Its correlation coefficient after the crisis increased, registering a significant positive value equal to 0.5089. Only South Africa registers a negative correlation coefficient even though not significant. Therefore the second hypothesis is not supported only in case of South Africa.

Because it is a unanimous opinion that the Global Financial Crisis originated in the US and started from the financial sector, this thesis further analyzes how the consequences of the crisis translated from the global financial sector to each country's stock market in part and contaminated them. Table 9 presents the results for the major economies from North and South America.

Table 9: North and South America's financial sector contagion

Country	Intercept	b_1	b_2	b_3	Contagion
USA (S&P 500)	0.0017	0.5307***	0.1385***	0.2406***	Yes
	(0.103)	(0.000)	(0.001)	(0.000)	
USA (Dow Jones)	-0.0001	0.5421***	0.0342	0.1458***	No
	(0.930)	(0.000)	(0.361)	(0.000)	
USA (Nasdaq)	0.0030**	0.4068***	0.3411***	0.4375***	Yes
	(0.031)	(0.000)	(0.000)	(0.000)	
Brazil	-0.0081*	0.4735***	0.4158***	0.3642***	Yes
	(0.078)	(0.000)	(0.000)	(0.000)	
Canada	0.0041**	0.4453***	0.1272**	0.1455***	Yes
	(0.019)	(0.000)	(0.041)	(0.000)	
Chile	0.0004	0.1518***	0.4167***	0.2508***	Yes
	(0.874)	(0.000)	(0.000)	(0.000)	
Mexico	0.0013	0.4782***	0.1620***	0.0486	Yes
	(0.631)	(0.000)	(0.005)	(0.446)	

*,**,*** significant at 10%, 5% and 1% respectively, p-values in parentheses.

The results from the above table show that there is a significant positive correlation between each country’s stock market and the global financial index. When analyzing the period corresponding to the Global Financial Crisis it can be seen that the correlation coefficients for all countries are positive and highly significant which suggests that there is contagion coming from financial sector to the entire stock market. The most affected is Chile and Brazil. The first hypothesis finds support in case of all countries. Moving to the post-crisis period the situation is slightly different. All countries except Mexico register significant positive correlations. For Canada and US

the values of the coefficients are even higher when compared to the crisis period. Therefore, the second hypothesis finds support for all countries except Mexico.

Table 10: Developed Europe's financial sector contagion

Country	Intercept	b_1	b_2	b_3	Contagion
UK	-0.0004	0.4981***	0.1581***	0.2240***	Yes
	(0.785)	(0.000)	(0.002)	(0.000)	
Austria	-0.0033	0.4104***	0.5423***	0.6918***	Yes
	(0.496)	(0.000)	(0.000)	(0.000)	
Belgium	0.0014	0.6356***	-0.0850*	0.1423***	No
	(0.359)	(0.000)	(0.085)	(0.000)	
Denmark	0.0038	0.5403***	0.2527***	0.0604	Yes
	(0.206)	(0.000)	(0.001)	(0.325)	
Finland	0.0031*	0.6115***	-0.0105	0.3261***	No
	(0.079)	(0.000)	(0.908)	(0.000)	
France	0.0010	0.7622***	-0.2790***	0.1368***	No
	(0.531)	(0.000)	(0.000)	(0.007)	
Germany	0.0016	0.8139***	-0.4772***	0.0601	No
	(0.352)	(0.000)	(0.000)	(0.229)	
Greece	0.0057*	0.5457***	0.1442	0.3874***	No
	(0.088)	(0.000)	(0.132)	(0.000)	
Ireland	0.0047*	0.5831***	0.2696***	0.1529**	Yes
	(0.075)	(0.000)	(0.005)	(0.014)	
Italy	-0.0001	0.7408***	-0.0871	0.3037***	No
	(0.981)	(0.000)	(0.136)	(0.000)	
Luxembourg	0.0046*	0.5016***	-0.0204	0.3920***	No
	(0.056)	(0.000)	(0.821)	(0.000)	
Netherlands	0.0010	0.6608***	-0.0294	0.1751***	No
	(0.507)	(0.000)	(0.675)	(0.001)	
Norway	0.0004	0.3822***	0.4576***	0.4267***	Yes
	(0.848)	(0.000)	(0.000)	(0.000)	
Portugal	0.0032	0.4125***	0.1143*	0.2753***	Yes
	(0.229)	(0.000)	(0.061)	(0.000)	
Spain	0.0035	0.7557***	-0.2809***	0.1748***	No
	(0.122)	(0.000)	(0.000)	(0.007)	
Sweden	0.0014	0.7179***	-0.0593	0.0066	No
	(0.448)	(0.000)	(0.361)	(0.913)	

*,**,*** significant at 10%, 5% and 1% respectively, p-values in parentheses.

The results reveal that there is a positive relationship between all countries included in the group and the global financial stock index. The coefficients take values from the interval [0.3822; 0.8139]. The lowest value corresponds to Norway, while the highest value is registered by Germany. Moving forward, during the financial crisis the situation changes significantly, the results tending to divide the countries in two subclasses: countries in which is registered a significant contagion and countries which did not

register a significant co-movement with the global index. In the first subclass goes: UK, Austria, Ireland, Denmark, Norway, and Portugal. These countries register a significant increase in co-movement between their stock market and the global financial stocks. The values range between 0.1147 (Portugal) and 0.5423 (Austria). The first hypothesis finds support for these countries, attesting significant contagion in the markets. The other subclass registers a negative or insignificant co-movement with the global stock index. This suggests that investors which placed their money in these countries during the financial crisis managed to protect at least partially their investments, while those who invested in countries from the first subclass remained exposed to losses, which translated from US like a storm who does not know limits.

After the crisis the situation tends to take a slightly different turn. The results reveal an increase in co-movement between these countries and the global stock index when compared to the crisis period. This can be explained by the fact that the Global Financial Crisis originated in the US and therefore the European countries felt its consequences as a foreign shock, while the after crisis period is marked by an important event for Eurozone: the sovereign debt crisis which originated internally and affected the majority of the members. The countries which register an increased correlation coefficient are: UK, Austria, Belgium, Finland, France, Greece, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, and Spain. Denmark turns from positive significant coefficient during the crisis to positive coefficient but insignificant after the crisis. Sweden maintains its isolated status even after the crisis serving as a good protection against this increased co-movement phenomenon registered at the level of majority of countries. The thesis finds support in favor of the second hypothesis just for: UK, Austria, Belgium, Finland, France, Greece, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, and Spain.

Table 11: Emerging Europe financial sector contagion

Country	Intercept	b_1	b_2	b_3	Contagion
Bulgaria	0.0026	0.0294	0.8039***	0.1820***	Yes
	(0.264)	(0.390)	(0.000)	(0.002)	
Czech Republic	-0.0057	0.4535***	0.2830***	0.2924***	Yes
	(0.119)	(0.000)	(0.000)	(0.000)	
Cyprus	0.0146***	0.6444***	0.1646	0.3449	No
	(0.006)	(0.000)	(0.504)	(0.123)	
Estonia	0.0002	0.2264***	0.1414*	0.1680**	No
	(0.931)	(0.000)	(0.054)	(0.018)	
Hungary	-0.0072	0.4638***	0.1220	0.3335***	No
	(0.207)	(0.000)	(0.145)	(0.000)	
Lithuania	-0.0003	0.0657**	0.3063***	0.2914***	Yes
	(0.893)	(0.028)	(0.000)	(0.000)	
Malta	0.0023	0.0672***	-0.0591	-0.0833	No
	(0.315)	(0.003)	(0.288)	(0.111)	
Poland	0.0002	0.3818***	0.2235***	0.3047***	Yes
	(0.932)	(0.000)	(0.010)	(0.000)	
Romania	-0.0004	0.1231**	0.6539***	0.6103***	Yes
	(0.922)	(0.020)	(0.000)	(0.000)	
Slovenia	0.0002	0.0649	0.7686***	0.5125***	Yes
	(0.957)	(0.262)	(0.000)	(0.000)	
Latvia	0.0045***	-0.0249	0.5280***	0.2397***	Yes
	(0.004)	(0.187)	(0.000)	(0.000)	
Slovakia	-0.0005	0.0617	-0.1303*	0.0359	No
	(0.831)	(0.124)	(0.070)	(0.649)	

*,**,*** significant at 10%, 5% and 1% respectively, p-values in parentheses.

From the perspective of Emerging Europe group Table 11 reveals that 8 out of 12 countries have a significant positive correlation between their local stock market indexes and the global stock index, while 4 countries register an insignificant correlation coefficient. During the crisis period the situation changes considerably, the results identifying a considerable increase in co-movement between these countries' stock indexes and the global index, resulting in a significant contagion at the level of Emerging Europe countries. The correlation coefficient ranges between 0.1220 and 0.8039 in absolute value. The country which registered the highest level of contagion is Bulgaria, followed by Slovenia. Its correlation coefficient evolved from an insignificant 0.0294 to a highly significant 0.8039 and 0.0649 to 0.7686 respectively for Slovenia. Those investors who had exposure to these two economies lost completely their diversification benefits and suffered considerable losses. Only one country from this group registered a significant decoupling from the global economy during the Global Financial Crisis: Slovakia which recorded a significant negative correlation coefficient, -0.1303. Malta, Cyprus and Hungary have positive but insignificant correlation

coefficients. Therefore the first hypothesis finds support for all countries except Malta, Slovakia, Cyprus and Hungary.

Moving to the post-crisis period the results reveal a decrease in correlations between the countries included in the table and the global index when compared to the crisis period. However, the still positive significant coefficients suggest that there might be left some traces of contagion in the markets and that the stock markets of these countries co-move with the global stock index and are vulnerable to international shocks. The second hypothesis ddoes not find support in case of Slovakia, Malta and Cyprus. Comparing Emerging Europe countries group with Developed Europe group it can be seen that the first group was affected more by the financial crisis and suffered a higher degree of contagion while the contagion phenomenon was registered in a fewer developed countries.

Table 12: Asia financial sector contagion

Country	Intercept	b_1	b_2	b_3	Contagion
India	0.0030	0.3238***	0.3574***	0.2050**	Yes
	(0.571)	(0.000)	(0.000)	(0.022)	
Indonesia	0.0022	0.1475***	0.6429***	0.3282***	Yes
	(0.534)	(0.000)	(0.000)	(0.000)	
China	-0.0100**	0.1207**	0.1336	0.2825***	No
	(0.021)	(0.027)	(0.307)	(0.004)	
Hong Kong	-0.0014	0.5545***	0.2651***	0.1795**	Yes
	(0.597)	(0.000)	(0.001)	(0.013)	
Japan	0.0010	0.3993***	0.4121***	0.2991***	Yes
	(0.868)	(0.000)	(0.000)	(0.000)	
Korea	0.0003	0.4978***	0.1200	0.0748	No
	(0.888)	(0.000)	(0.184)	(0.347)	
Taiwan	0.0005	0.4060***	0.1961**	0.1329*	Yes
	(0.830)	(0.000)	(0.043)	(0.064)	
Thailand	0.0035	0.2667***	0.2321***	0.2137**	Yes
	(0.369)	(0.000)	(0.000)	(0.018)	

*,**,*** significant at 10%, 5% and 1% respectively, p-values in parentheses.

Table 12 examines the relationship between the global financial index and the local stock market index for each country in part. The results reveal a positive relationship before the crisis, Hong Kong registering the highest value (0.5545), while China the weakest and just partial significant (0.1207). This is explained by the fact that Hong Kong is an important financial center in Asia and has strong relations with financial centers from all around the globe. During the crisis 6 out of 8 countries register a

positive and significant correlation coefficient proving the existence of contagion at the level of their stock market. The highest level of contagion is registered by Indonesia (0.6429), followed by Japan. Korea and China record positive coefficients but insignificant, which means that the contagion registered at the level of China in Table 7 came mainly from other sectors than financials. The first hypothesis is supported for all group members except China and Korea.

Moving forward, the period after the crisis is characterized by a decline in the co-movement between global financial stock market and all local stock markets except China. China continues to register a relatively high positive correlation coefficient when compared to the pre-crisis period, and higher than during the crisis. This suggests that Chinese stock market and economy in general tend to become more and more integrated with the global economy. This is not surprising keeping account of the fact that China has taken the place of US as the leading global economy, and is the biggest stock market in Asia. In the same order of thoughts, the positive and significant correlation coefficients registered at the level of each country suggests that these economies are still highly integrated and sensible to global shocks, and they have not recovered completely from the financial crisis. The only country which seems independent from global financials is Korea. Therefore, the second hypothesis finds support for all countries except Korea.

Table 13: Other countries group financial sector contagion

Country	Intercept	b_1	b_2	b_3	Contagion
Australia	0.0014	0.3161***	0.3909***	0.2879***	Yes
	(0.564)	(0.000)	(0.000)	(0.000)	
New Zealand	0.0016	0.1434***	0.1302***	0.1482***	Yes
	(0.528)	(0.000)	(0.004)	(0.000)	
Russia	-0.0062	0.3697***	0.8219***	0.8927***	Yes
	(0.149)	(0.000)	(0.000)	(0.000)	
South Africa	0.0015	0.3995***	0.2604***	0.2113***	Yes
	(0.426)	(0.000)	(0.000)	(0.000)	

*,**,*** significant at 10%, 5% and 1% respectively, p-values in parentheses.

Taking the analysis to the level of other four major global economies: Australia, New Zealand, Russia, and South Africa, Table 13 presents similar results with those from Table 8. There is a positive relationship between each country's stock index and global financial index with Russia having one of the highest values. During the crisis all

countries record positive significant coefficients, which demonstrate that financial contagion is present at the level of each country's stock market. Russia registers the highest value which is almost triple when compared to the pre-crisis period. The first hypothesis is supported at the level of the entire group.

After the crisis the situation does not change for Russia, which registers even a higher correlation level than during the crisis. The same is true for New Zealand while Australia and South Africa tend to destroy the trend created during the crisis. A lower but still positive and significant coefficient is registered. The second hypothesis is supported for all countries.

Moving forward this thesis analyzes the impact that the European Sovereign Debt Crisis has had on the European countries. Because this crisis affected and started at the level of individual governments, the thesis analyzes how the confidence in capacity of governments to repay their debt, measured by foreign government Credit Default Swaps (CDS), evolved during the crisis and which one were affected the most. Figure 8, 9, 10, and 11 present the evolution of CDS spreads in developed, emerging European countries as well as in GIIPS countries.

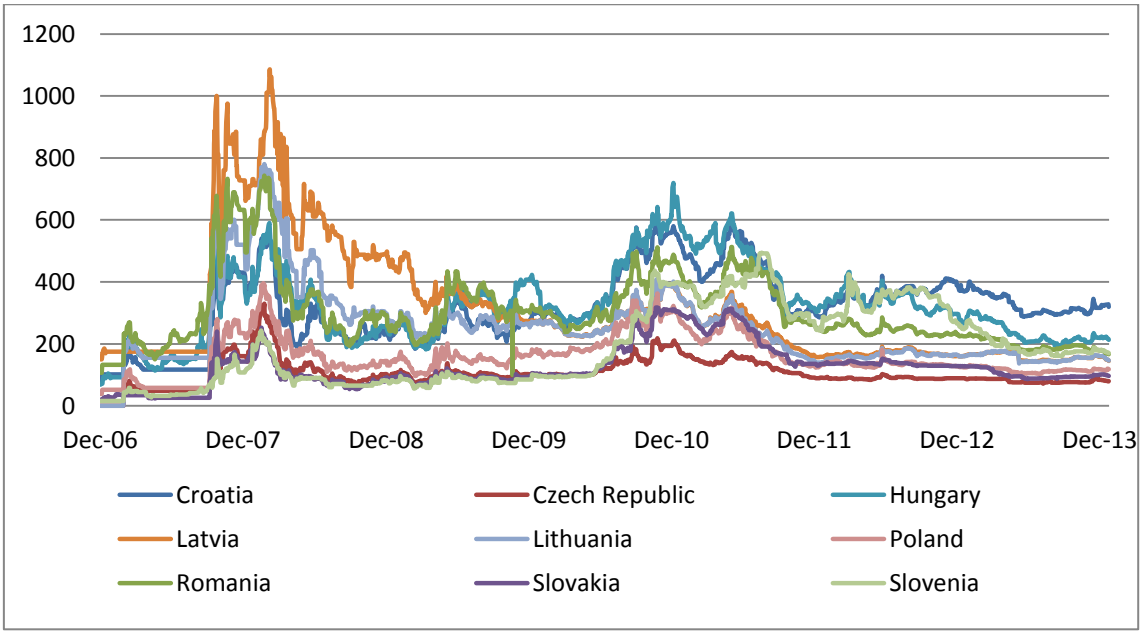

Figure 8: Evolution of CDS spreads in Emerging Europe countries

From Figure 8 it can be seen that during a crisis or an uncertain period the CDS spreads tend to increase, reflecting a loss in confidence that governments will be able to repay their debt in time and without any difficulties. An interesting fact reflected in Figure 8 is that Emerging European countries were affected more by the Global Financial Crisis from 2007-2009 than by the European Sovereign Debt Crisis, fact proved by the level of CDS spreads, which during the 2007-2009 were higher than during the 2010-2012 period. The less affected country is Czech Republic, while Croatia was affected the most, its CDS spreads rising from 300 basis points at the end of 2009 to 700 at the beginning of 2011. This means that the consequences of the crisis which originated in the GIIPS countries translated to other European countries very quick.

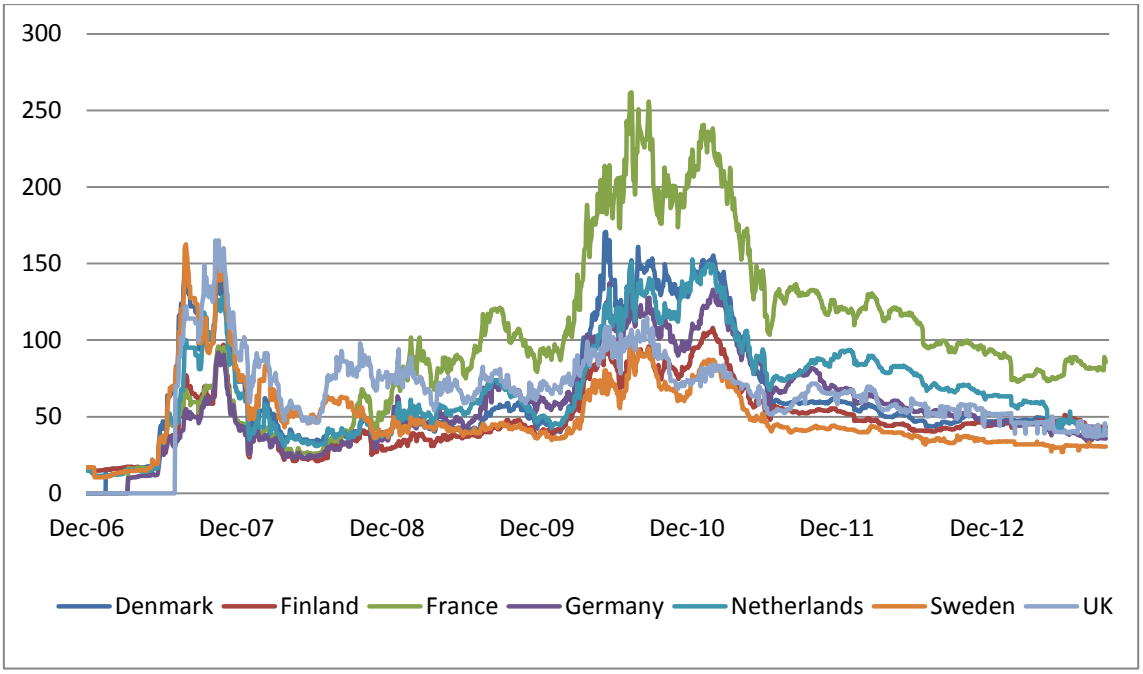

Figure 9: Evolution of CDS spreads in developed Europe countries

Analyzing the situation in developed European countries, Figure 9 presents a slightly different picture. While emerging countries were affected more during the Global Financial Crisis, the developed European countries registered higher CDS spreads during the European Sovereign Debt Crisis. The values range between 40 basis points at the end of 2008 to 260 basis points at the peak on the third quarter of 2009. The less affected seems to be the Nordic countries: Sweden, Denmark and Finland while the most affected is France. The situation remains the same at the end of 2014. This sustains the fact that some contagion has been transferred from peripheral Europe to the core

Europe. An explanation why this happened is that in order to save the GIIPS countries from collapse and incapacity of repaying their debts the European countries implemented a bailout program meant to financially support the economy of the countries. Therefore they raised money by taking more debt on their own balance sheets, which made investors and financial institutions to be worried that these countries are becoming at their turn too indebted, resulting in the end in a CDS spreads increase. These results are in line with those of Ludwig (2014).

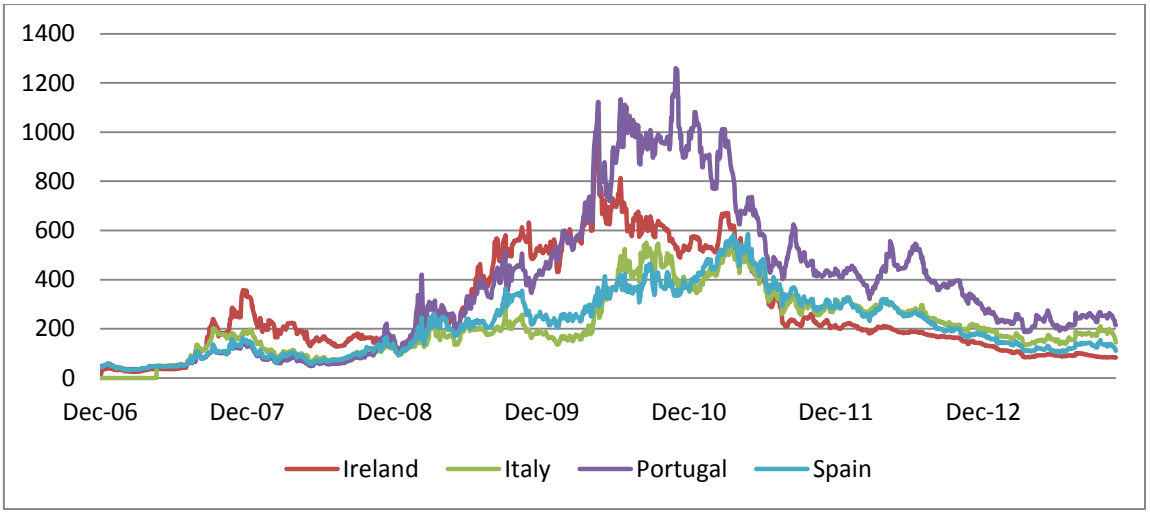

Figure 10: Evolution of CDS spreads in GIIPS countries.

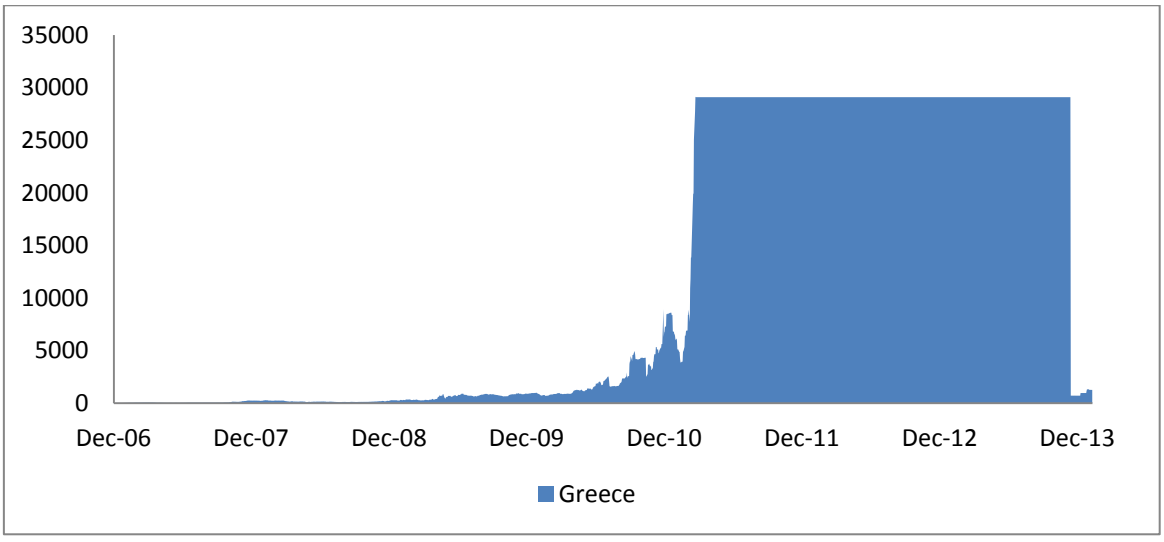

Figure 11: Evolution of CDS spreads for Greece.

Moving forward and taking the analysis at the level of GIIPS countries' economy from Figure 10 and 11, it can be seen that the problems started to appear in September 2008, after the collapse of Lehman Brothers. The CDS spreads started to increase gradually until middle of 2009, while at the end of 2010 they sky-rocketed. The countries most affected are Greece and Portugal. Their CDS spreads raised more than 25000 basis point for Greece and 1200 for Portugal. The situation started to ameliorate after first quarter of 2011 for Portugal, Spain, Italy and Ireland, while for Greece it took a lot more time. Just at the end of 2013 the CDS spreads came back to a more or less normal value.

In summary, the European Sovereign Debt Crisis affected all the bloc members and the consequences translated at the level of each country's economy. Developed countries were affected less thanks to their big and powerful economies, while emerging countries felt the consequences more in depth. Currently Europe has to implement well thought and planed measures to revive its economy and to become again a powerful global player.

6. CONCLUSION

This thesis analyzes the spread of the Global Financial Crisis and that of the European Sovereign Debt Crisis to other countries and members. Moreover, it tests if after the crisis finished, the economy and the correlations between countries came to their pre-crisis levels. In order to analyze the relationships between countries and to test for contagion an asymmetric GARCH model is implemented. The paper takes a global perspective and analyzes 45 stock markets by arranging them in different groups for an easy and clear understanding.

The results reveal that during the Global Financial Crisis the correlation coefficient between individual stock market indices and global stock index increased significantly, resulting in contagion at the level of the majority of the countries included in the analysis. Even though the crisis started locally, in just one country, it expanded very fast, translating its negative effects to other countries, regions, continents. Similar results are found when analyzing the correlation between individual stock market indices and global financials stock index. This suggests that the Global Financial Crisis originated in the financial sector and translated its effects to other sector and countries. An interesting phenomenon is registered at the level of Europe. The paper reveals that emerging Europe countries were affected more and in a bigger number than the developed countries. Similar results are found for the European Sovereign Debt Crisis. Emerging countries were affected more, their CDS spreads registering higher values than those of developed countries.

After the crisis the situation tends to change. The co-movement between countries and global stock index tends to decrease in value and to loose in significance. However, when compared to the pre-crisis levels, markets register higher correlation coefficient, which suggests that the level of integration between countries continues to increase, that there may be some contagion left in the markets, and that the economies are struggling to recover. The same is true for European countries after the Sovereign Debt Crisis.

This paper completes the previous literature by analyzing how the Global Financial Crisis and European Sovereign Debt Crisis changed the correlations between countries and which countries were affected the most. While previous literature focuses mainly on the period before and during the crisis this paper takes into account also the post-crisis period and its effects.

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