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**DOMESTIC AND CROSS-BORDER EFFECTS OF  
GLOBAL FINANCIAL CRISIS**

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**ABSTRACT**  
**DOMESTIC AND CROSS-BORDER EFFECTS OF GLOBAL FINANCIAL**  
**CRISIS**

**Beyza OKTAY**

This study aims to construct a thorough analysis of the latest global financial crisis of 2008. Study approaches the subject starting from the fundamentals of financial crisis and its contagion. Focusing European economies, namely Germany, France, Italy, Greece, Spain, Portugal and United Kingdom; it is aimed to construct a comprehensive and comparative analysis especially for the intercountry contagion of the turmoil. Following the theoretical and informative chapters regarding the crisis and contagion concepts as well as the macroeconomic and financial performances of the seven selected countries (France, Germany, United Kingdom, Greece, Portugal, Spain, Italy) at the onset of the crisis; the thesis is followed by three empirical studies.

Firstly, the existence of contagion from the United States to Europe has been analyzed and verified with the application of DCC-GARCH methodology. Dynamic conditional correlations have been constructed among the economies which have shown significant increases in the post-crisis period and approved a possible contagion.

Subsequent to the analysis of contagion, global macroeconomic variables which might have effects on those dynamic correlations have been tested by quantile regression. Four global conditional variables have been selected as volatility index, TED spread, gold price and oil price. Volatility index results which were negatively explaining the dynamic conditional correlations reflected the slow recovery of European economies after crisis, especially for Portugal and Greece. The fluctuations in these markets were based on their own fundamental risks. Gold prices tend to influence the correlations positively in pre-crisis, while the influence was negative in the post-crisis period. The increase in gold prices attracted investors to diversify their portfolios. Since the relationship between the gold prices and correlations is affected negatively after the crisis, increases in gold prices

cause the markets (US and Europeans) to deviate from each other. Oil price results have shown a positive effect on the correlations after the crisis. The countries in the analysis are developed European economies which watch oil prices closely since it is an essential input for their production processes. Therefore, post-crisis positive effect of oil prices on correlations demonstrates European economies' dependency to oil because of their economic characteristics.

Lastly, the macroeconomic policies of European and American Central Banks have been investigated in order to evaluate the efficiency of asset purchase policies on the European economies' macroeconomic and financial indicators such as GDP growth, unemployment, interest rate and stock markets. The results indicated that European Central Bank asset purchases have shown insignificant results on the selected indicators while the FED's asset purchases had more sound effect on the European countries' macro and financial variables. However, the effects of the policies were not immediate and sounded. The relatively late and weak reaction of ECB have been affective in this progress. Eventually European economies has struggled with a debt spiral which they could not manage and lead the economies enter a new turmoil, European Debt Crisis.

**Key words:** Global Financial Crisis, Contagion, DCC-GARCH, VAR, Quantile Regression, Monetary Policies, Central Banks

**ÖZ**  
**KÜRESEL FİNANS KRİZİNİN ÜLKE İÇİNDEKİ VE ÜLKELER ARASI**  
**ETKİLERİ**

**Beyza OKTAY**

Bu çalışma, 2008 yılında yaşanan son küresel finansal krizin kapsamlı bir analizini yapmayı amaçlamaktadır. Çalışma, finansal krizin temellerinden ve bulaşıcılığında başlayarak konuyu incelemektedir. Almanya, Fransa, İtalya, Yunanistan, İspanya, Portekiz ve Birleşik Krallık gibi Avrupa ekonomilerine odaklanılarak; özellikle çalkantının ülkeler arasındaki bulaşıcılığı için kapsamlı ve karşılaştırmalı bir analiz yapılması amaçlanmaktadır. Kriz ve bulaşma kavramlarının yanı sıra seçilen ülkelerin krizin başlangıcındaki makroekonomik ve finansal performanslarına ilişkin teorik ve bilgilendirici bölümlerin ardından; tez üç ampirik çalışmayla devam etmektedir.

İlk olarak, Amerika Birleşik Devletleri'nden Avrupa'ya bulaşmanın varlığı, DCC-GARCH metodolojisinin uygulanmasıyla analiz edilmiş ve doğrulanmıştır. Kriz sonrası dönemde önemli artışlar gösteren ve olası bir bulaşmayı onaylayan, ekonomiler arası dinamik şartlı korelasyonlar kurulmuştur.

Bulaşma analizinin ardından, bu dinamik korelasyonları etkileyebilecek küresel makroekonomik değişkenler kuantil regresyon yöntemi ile test edilmiştir. Volatilite endeksi, TED faiz farkı, altın fiyatı ve petrol fiyatı küresel koşullu değişkenler olarak seçilmiştir. Dinamik koşullu korelasyonları olumsuz biçimde etkileyen VIX endeksi sonuçları, kriz sonrası Avrupa ekonomilerinin -özellikle Portekiz ve Yunanistan'ın- yavaş toparlanmasını yansıtmaktadır. Bu piyasalardaki dalgalanmalar kendi temel risklerinden kaynaklanmaktadır. Altın fiyatları kriz öncesinde korelasyonu olumlu yönde etkilerken, kriz sonrası dönemdeki etki ise olumsuzdur. Altın fiyatlarındaki artış, yatırımcıları portföylerini çeşitlendirmeye yönlendirmiştir. Altın fiyatları ile korelasyonlar arasındaki ilişki krizden sonra olumsuz etkilendiğinden, altın fiyatlarındaki artışlar piyasaların (ABD ve Avrupalılar) birbirinden uzaklaşmasına neden olmaktadır. Petrol fiyatı sonuçları,

krizden sonra korelasyonların olumlu yönde etkilendiğini göstermektedir. Analiz edilen ülkeler, üretim süreçleri için temel bir girdi olduğundan, petrol fiyatlarını yakından izleyen gelişmiş Avrupa ekonomileridir. Bu nedenle, petrol fiyatlarının korelasyonlar üzerindeki kriz sonrası olumlu etkisi, seçilen ekonomilerin ekonomik özelliklerin nedeniyle petrole olan bağımlılığını göstermektedir.

Son olarak, seçilen ekonomilerin GSYH büyüme oranı, işsizlik, faiz oranı ve menkul kıymet borsaları gibi makroekonomik ve finansal göstergeleri üzerindeki varlık alım politikalarının etkinliğini değerlendirmek üzere, Avrupa ve Amerikan Merkez Bankalarının makroekonomik politikaları araştırılmıştır. Sonuçlar, Avrupa Merkez Bankası varlık alımlarının seçilen göstergeler üzerinde anlamsız sonuçlar verdiğini, FED'in varlık alımlarının ise Avrupa ülkelerinin makro ve finansal değişkenleri üzerinde daha güçlü bir etkisi olduğunu göstermiştir. Bununla birlikte, politikaların etkileri hızlı ve sağlam olarak görülmemiştir. ECB'nin nispeten geç ve zayıf reaksiyonu bu durumda etkili olmuştur. Sonuç olarak, Avrupa ekonomileri, yönetemeyecekleri bir borç sarmalı ile mücadele etmiş ve ekonomileri yeni bir çalkantıya, Avrupa Borç Krizi'ne yönelmiştir.

**Anahtar Kelimeler:** Küresel Finans Krizi, Bulaşıcılık, DCC-GARCH, VAR, Kuantil Regresyon, Para Politikası, Merkez Bankaları

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## LIST OF ABBREVIATIONS

<b>ABCP</b>	:Asset-Backed Commercial Paper
<b>ADF</b>	:Augmented Dickey Fuller
<b>ARCH</b>	:Autoregressive Conditional Heteroscedasticity
<b>BEKK</b>	:Baba-Engle-Kraft-Kroner
<b>BRICS</b>	:Brazil Russia India China and South Africa
<b>BVAR</b>	:Bayesian Vector Autoregressive
<b>CAPM</b>	:Capital Asset Pricing Model
<b>CDS</b>	:Credit Default Swap
<b>CDO</b>	:Collateralized Debt Obligations
<b>CPI</b>	:Consumer Price Index
<b>DCC</b>	:Dynamic Conditional Correlation
<b>DSGE</b>	:Dynamic Stochastic General Equilibrium
<b>ECB</b>	:European Central Bank
<b>EME</b>	:Emerging Market Economies
<b>EMU</b>	:European Monetary Union
<b>FED</b>	:Federal Reserve
<b>FM</b>	:Factor Model
<b>FSI</b>	:Financial Stress Index
<b>GARCH</b>	:Generalized Autoregressive Conditional Heteroscedasticity
<b>GDP</b>	:Gross Domestic Product
<b>GFC</b>	:Global Financial Crisis
<b>GVIX</b>	:Greek Volatility Index
<b>IRF</b>	:Impulse Response Function
<b>JB</b>	:Jarque Bera
<b>KPSS</b>	:Kwiatkowski–Phillips–Schmidt–Shin

<b>LIBOR</b>	:London Interbank Official Rate
<b>LM</b>	:Lagrange Multiplier
<b>LSAP</b>	:Large Scale Asset Purchases
<b>MBS</b>	:Mortgage Backed Securities
<b>MSCI</b>	:Morgan Stanley Capital Index
<b>OLS</b>	:Ordinary Least Squares
<b>OPEC</b>	:Organization of Petroleum Exporting Countries
<b>PP</b>	:Philips Perron
<b>QE</b>	:Quantitative Easing
<b>QR</b>	:Quantile Regression
<b>SEE</b>	:Southern Eastern European
<b>SVAR</b>	:Structural Vector Autoregressive
<b>TAP</b>	:Targeted Asset Purchases
<b>TED</b>	:T-bill and EuroDollar
<b>TVP</b>	:Time Varying Parameter
<b>UK</b>	:United Kingdom
<b>US</b>	:United States
<b>VAR</b>	:Vector Autoregressive
<b>VDAX</b>	:Volatility of (German) DAX Index
<b>VIX</b>	:Volatility Index
<b>VSMI</b>	:Volatility Index for Swiss Market
<b>VSTOXX</b>	:Volatility Index for Stoxx50
<b>VXN</b>	:Nasdaq Volatility Index
<b>WWII</b>	:World War II

## 1. INTRODUCTION

The outburst of the financial crisis that has started in the United States in 2007 has been severe through its consequences and in a very short period, it has gained global characteristics as it spread worldwide and affected world economies at a record rate. It has gained the reputation of being a so-called “Great Recession”. The global economic decline has started as subprime turbulence in the United States housing market but evolved into a recession at the end of 2007.

The recession has been accepted as the first significant downturn since the Great Depression of 1929. The numbers of world gross domestic product (GDP) growth in the financial crisis years showed high deterioration in both the developing and developed world. The years of 2002-2007 were the boom years for the world economy but the situation became reversed after 2007. It has been confirmed that the rest of the world sneezes when the United States catches a cold, since other world economies went into recession one after another. All in all, the world has witnessed a recession for the first time since the second World War.

Since the crisis could not be foreseen and prevented in the beginning, the economics profession was blamed by economists such as Krugman and Galbraith (Galbraith, 2012; Krugman, 2009). Scholars have accused fellow economists to be blind to the early signals of the coming recession. However, the severity of the crisis was underestimated in 2008 both by economists and policymakers. There were a small number of economists who have tried to warn but could not reach the crowd. In a study (Bezemer, 2009), it is claimed that 12 economists and analysts have predicted the coming recession, but they could not manage to prevent what was coming (Verick & Islam, 2010).

Highly slowed GDP growth figures in world economies declared the need for long years to recover from the crisis. Even though some economies have not been affected by the crisis, in the beginning, the bankruptcy of Lehman Brothers in September 2008 has been a milestone date for all the world economies. After that date, all perceptions reversed

all over the world. Lending has stopped and liquidity dried up which has affected the global financial system deeply.

Before the crisis has broken, some key events of the financial economy are worth to mention. There was a very long period of credit expansion, low-risk premiums, high availability of liquidity, strong leveraging and climbing asset prices which have also contributed to a growing bubble in the real estate sector. Even though similar periods have been experienced in world history, the distinctive feature of this crisis was its global characteristics (Szekély & van den Noord, 2009)

Since the financial crisis rapidly developed and spread into the world as a global shock, it has resulted in several European bank failures and stock market declines. Credit has been tightened and international trade has slowed down. Interbank market virtually closed and risk premiums on interbank loans increased. Banks had a very serious liquidity problem. They faced with problems maintaining a reasonable liquidity level. Banks which had enough liquidity could meet their obligations while the other banks with inadequate liquidity could not manage to pay their obligations.

At the onset of the crisis, Europeans did not consider the consequences of the shock to be important since they thought that their economy would be immune to the financial crash. But this view has changed with the quick decline in economic activity in Europe. The situation which has started with a slowdown has been fueled by a rapid deterioration in global trade. The collapse in world trade threatened European exports. Additionally, unemployment increased dramatically which then started the complaints about the governments.

Many fiscal and monetary actions have been taken as the crisis threatened the world and these policy responses contributed to the recovery of the world economy. Massive amounts of capital have been injected into the financial system, banks have been nationalized, the interest rate has been cut and fiscal stimulus packages have been introduced which have increased the discretionary spending. However, the effects of those

reactions have affected the countries differently depending on their vulnerabilities (Verick & Islam, 2010).

Developed economies have fallen behind the developing economies in the sense of taking actions and returning to their pre-crisis levels of growth. Those slow growth periods and the slow recovery of developed economies caused them to struggle with the initial crisis effects and opened door to new financial problems. The European debt crisis is the one that happened right after the global financial crisis of 2007 and affected many European economies in the aftermath of the financial crisis.

The event that began as a housing bubble in one country transformed into a global financial and economic crisis. World's most established and largest banks and companies have declared bankruptcy or called for financial aid to be rescued. Under these conditions, the most important concern happened to be the contagion of the crisis from the United States to the other economies. European countries have developed and integrated financial systems, therefore they might be vulnerable to the shocks coming from the financial area. Capital market integration and contagion have been in the center of attention both by the scholars as well as the investors and policymakers. Investors were interested with the subject since the level of integration effects the riskiness of the portfolio, knowing these risks allow investors to diversify their portfolio with less correlated and less risky assets. Policymakers were interested in the subject since they would have liked to plan necessary policies in case of a crisis.

Hence, this thesis is an attempt to identify the existence of financial crisis contagion from the United States stock market to selected European stock markets by using multivariate dynamic conditional correlations generalized autoregressive conditional heteroscedasticity (DCC-GARCH) methodology. Existing European studies mostly concentrated on central European economies with a similar structure and economical basis. With the help of this study, it is aimed to cover European economies

which have been seriously affected by the financial crisis and which have distinct development levels, and individual financial and economic infrastructures.

Following the contagion effect proof of the United States subprime crisis in Europe, the mechanisms which are effective on the dynamic correlations between the equity markets will be identified subsequently. As the European economies' financial development seems to be high and financial markets are seen largely correlated to each other, it is expected that the channel of contagion has been through financial linkages. By also understanding the stock market structures of the selected countries, it is aimed to find the differences in the effect of the crisis on markets of different economies.

The last attempt will be to analyze the effects of policies implemented to recover from the financial crisis. This last step is thought to be useful to understand the mechanism to prevent an upcoming crisis.

The remainder of the thesis is organized as follows:

**Chapter 2** will be the literature survey section of the thesis. In this chapter, starting from the very basic definitions of the crisis itself; events occurring before a crisis, types of financial crisis and effects of the financial crisis on the real and financial economy will be discussed following the literature.

**Chapter 3** is organized as a descriptive section of the thesis about the European economies in the global financial crisis. It is aimed to give an insight into the selected economies' economic and financial performance before the crisis to have an idea about the path leading those countries into the global crisis. Additionally, since the contagion will be analyzed from the perspective of stock markets, financial developments of selected European economies will be discussed in a separate section.

**Chapter 4** is the empirical literature part which will be starting from defining the contagion. Consequently, causes of contagion, the distinction of the concepts of contagion, spillover and co-movements will be given following both theoretical and

empirical literature about the subject. As a further attempt, studies about the contagion and crisis transmission channels will be given to have an insight about the analysis done in the literature.

**Chapter 5** is organized as the analysis of the DCC-GARCH model to test the contagion effect of the global financial crisis on European economies. Firstly, the data selection process and data descriptions are given. Then, the DCC-GARCH methodology is introduced with its advantages. Lastly, the model is implemented, and the analysis results are given. According to the results, a possible contagion with the increasing dynamic correlations in the crisis period among the selected European equity markets and the United States has been verified.

**Chapter 6** is a complementary chapter of the previous DCC-GARCH contagion analysis. Following the results of the existence of contagion among the countries, the factors affecting the dynamic conditional correlations are still questionable. For this purpose, quantile regression analysis is constructed with financial as well as global variables which may have effect on the dynamic correlations. The effects of selected conditional variables on the correlations may not be obvious by the mean results of standard ordinary least squares (OLS) regression. Since financial crisis time period is the concerned phase, extreme points such as upper quantiles are matter of interest. By analyzing the pre-crisis and post-crisis effects of variables on the correlations on upper quantiles, more accurate results will be reached.

**Chapter 7** is designed to be the analysis of monetary policy actions after the global financial crisis. Following the analysis of financial contagion and contagion transmission, it is crucial to analyze the effects of monetary policies on the countries' fundamentals and financials. Policy implication of the crisis subject is one of the most crucial part of the financial crisis literature. Preventing a crisis before it happens may be possible by foreseeing and taking the necessary actions on time. In this context, the unconventional policy effects of both United States Federal Reserve (FED) and European Central Bank

(ECB) will be analyzed according to their effects on selected economies macro variables and selected financial variables.

**Chapter 8** is going to summarize the findings and conclusions regarding the literature survey and empirical chapters.

## **CHAPTER TWO**

### **2. LITERATURE SURVEY ON THE CONCEPT OF CRISIS**

“Crisis” is a commonly used, interdisciplinary word which is often used synonymously with the word “depression” in social sciences. Although it is not easy to make a common description for economical or financial crisis, it may be described as the circumstances where an economy moves from a stable situation to an unstable situation. In an economic sense, crisis affects states by some unforeseen events in macro-level whereas it affects the companies in micro-level.

Financial crisis as a type of an economic crisis, shows a deterioration in the financial markets where the adverse selection and moral hazard problems become much worse and financial markets do not allow the transition of funds to the most productive investment areas as a result of the crisis (Uzun, 2006). Financial crises can be defined as severe price instabilities in financial markets such as foreign exchange and stock markets or serious economic problems as a result of extreme increase of non-returnable credits in the banking system (Yıldirtan, 2004). Crises begin as a result of the speculative attacks those depend on the investors’ expectations that the country become risky and they are intensified by the strength of these speculative attacks (Eren & Süslü, 2001).

Many economists have developed different theories to explain the causes of financial crises. Economic theory which explains the financial crisis can be categorized by two main theories, namely the orthodox view and heterodox view. Approaches to explain economic crises differ in terms of the causes and the proposed solution to the fragilities. The school of thought which adopted Orthodox approach represented by the economists such as Friedman and Lucas, i.e. the development of the orthodox economic thought can be distinguished as the Classical Economy approach and its follow-up approaches (such as Monetarism and Neo Classical). This school believe in the self-correction mechanism of the market. On the contrary, heterodox view argues that the market cannot clear itself and financial crisis appear as an endogenous component of the

system. Each school has its own way to explain the crisis. One group thinks that the capitalist system reaches an equilibrium with its internal dynamics and what causes the crisis is off-system dynamics. Therefore, the crises are temporary instability. On the other hand, opposite approach is defending that the capitalist production has its own internal paradoxes and therefore crises are normal in terms of the functioning of the system.

In general, the discussions focus on whether the existence of government intervention in the economic and financial system is necessary or not. If the crisis happens when an approach defending government intervention (or vice versa) is in action, then the opposite approach criticizes the situation and the consequences. Then the wind becomes reverse. That's why, two economic schools of thought, namely Classical and Keynesians, will be concentrated in this chapter. Following the economic thought about the crisis, asset price and credit price effects on the occurrence of a financial crisis and types of financial crisis will be mentioned. Second chapter will be finalized with the effects of financial crisis on real and financial economy.

## **2.1. ORTHODOX (CLASSICAL) VS. HETERODOX (KEYNESIAN) APPROACHES TO THE CRISIS**

The classical school is regarded as the beginning of the economic thought with Adam Smith's revolutionary work called "Wealth of Nations". In his work, Smith focused mainly on the causes of the national income, forces of economic growth and policies to encourage growth. The assumption relies on the rationality of human. Individuals act upon their self-interest. Therefore, there is an optimal balance in the economy automatically with the help of "invisible hand".

Smith and Nicholson (1887) mentioned this mechanism in their work as:

*"As every individual, therefore, endeavors as much as he can both to employ his capital in the support of domestic industry, and so to direct that industry that its produce may be of the greatest value; every individual necessarily labors to render the annual revenue of the society as great as he can. He generally, indeed, neither*

*intends to promote the public interest, nor knows how much he is promoting it. By preferring the support of domestic to that of foreign industry, he intends only his own security; and by directing that industry in such a manner as its produce may be of the greatest value, he intends only his own gain, and he is in this, as in many other cases, led by an invisible hand to promote an end which was no part of his intention. Nor is it always the worse for the society that it was no part of it. By pursuing his own interest he frequently promotes interest of the society more effectually than when he really intends to promote it. I have never known much good done by those who affected to trade for the public good”*

In brief, the classical economy paid attention mostly on the individual. Freedom was the first aim, and individual was the main entity. Correspondingly, the French phrase *laissez-faire* was their motto and it literally means "let them do". So, it implies a free market economy with no or minimal government intervention.

Classical school started with Smith but there are many other successors such as John Stuart Mill, David Ricardo, Thomas Malthus and John Baptiste Say. These other economists presented their arguments about the question of distribution and surplus. Say's law was one of the important theories associated with the existence of surplus and its effects. According to Say's law<sup>1</sup>, supply creates its own demand. The economy is always capable of achieving the natural level of GDP. Therefore, a crisis because of surplus production is impossible. Even if there is a partial blockage in the economic process, it is evident that -due to the existence of the price mechanism- the balance between production and consumption will be restored. The classical approach, which regards equilibrium as a natural formation provided by the invisible hand of the natural order, temporarily perceives economic crises.

Monetarists explained the financial crises with banking panics. According to monetarist view, money supply decrease as a result of a banking panic and therefore economic activity shrunk. Banking panics comes after the public pessimistic opinion

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<sup>1</sup> (Say, 1803)

about the banks' ability to convert deposits into currency which relates the situation to liquidity. Bank and financial institutions failure is what comes afterwards that cause a bigger loss of confidence. Schwartz (1987) as another monetarist made a distinction between real crises and the situation which she called as pseudo-financial crises. According to her view, the events such as "*declines in asset prices of equity stocks, real estate, commodities; depreciations of the exchange value of a national currency; financial distress of a large non-financial firm, a large municipality, a financial industry, or sovereign debtors*" should not be accepted as real crises. If those situations are considered as a real crisis and if government intervene to the pseudo-financial crises, the results might be detrimental for the economy. If an unproductive firm face with difficulties in such an environment, it might be better for it to fail then to be bailed out with government interventions. However, economists such as Kindleberger and Minsky had broader view for the explanation of financial crises which include the situations listed above to be a reason alone or as a combination of some of them, for a crisis to occur.

In short, Classical and Neoclassical schools support the self-correcting characteristics of the financial system. According to them, financial turbulence happens only if there is an outside interruption. Invisible hand of Adam Smith is what brings the markets into equilibrium. Free markets are at the core which is the cure for all the problems. In such a system, government intervention is the cause of imbalances (Iwai, 2011). Neoclassicals think that interest rates and asset prices work for the efficiency of financial markets, relative wages work for the labor markets and exchange rate work for the trade balance (Ghani, 2013).

Additional emphasis might be credited to Mishkin who described financial crises by the asymmetric information, moral hazard and random selection. Mishkin (1992) described financial crises as a deterioration in the financial markets, where adverse selection and moral hazard problems have become considerably inferior; consequently, financial markets cannot effectively direct funds to those who have the most efficient investment prospects. According to him, five dynamics in the economy can lead to

financial crises by significantly causing adverse selection and moral hazard in financial markets. These are interest rate hikes, stock market drops, growing uncertainty, bank runs, and unexpected decreases in the aggregate price level. Classical economic thought was dominant till 1930s. Along with the Great Depression, Classicists were criticized as being long-term oriented and for not paying attention to short-term deficiencies. They were not able to explain the decline in economic activity and the increase in the unemployment in those years.

Keynesian school of thought has again come into the light after the latest United States (US) financial crisis since many mainstream macroeconomists couldn't explain what was happening at that time and could not predict the crisis. In order to make an introduction to Keynesian approach, it can be said that they accept involuntary unemployment and they do not accept Say's law, rational expectations, hyper-rationality, and efficient market hypothesis (Lavoie, 2016).

For financial crisis, Minsky and his hypothesis of financial instability will mostly be focused on, since particularly his name has been mentioned in this process. In 2008, so-called "Minsky Moments" has been talked over. As stated by Vercelli (2009), this term had many descriptions by various economists and financiers. He grouped some of these definitions as a point in time and on the contrary, a process of undetermined length. Vercelli (2009) listed some examples of definitions as: "the point where credit supply starts to dry up" and "the point at which a financial mania turns into panic" (Wolf, 2008). These definitions fit into the exact definition of the word "moment". On the other hand, some other definitions have been introduced as a process such as: "when over-indebted investors are forced to sell even their solid investments" (Lahart, 2007) and "when the Ponzi pyramid financial scheme collapses" (Davidson, 2008).

The heterodox view stresses the effects of business cycles on financial instability while explaining financial crises. In this context, Minsky's approach of "financial instability" rejects a stable growing economy. After years of long tranquil period, recession is an inevitable end. The last recession is one example of that. Lavoie (2016)

stated this fact with Minsky's own words as "each state nurtures forces that lead to its own destruction". Minsky argued that financial crises either involve sharp declines in asset prices, failures of large financial and nonfinancial firms (or both), deflations or disinflations, disruptions in foreign exchange markets, or some combination of all of these (Ghani, 2013).

As opposed to efficient market hypothesis, Minsky's approach is that financial markets cannot be always right, and financial crises are always possible. The controversial theory of Minsky was called Financial Instability Theory. According to the hypotheses of his theory, capitalism leaves the economic system prone to crisis as a normal functioning. External shocks have not been accepted as the core of a business cycle, instead internal components such as increasing interest rates are considered as a mean of shock.

Another view about the financial contraction and depression which is worth to mention under heterodox school of thought is debt deflation theory represented by Irving Fisher. He supported the idea that business cycle might be demonstrated by indebtedness and deflation. If any disruption happens in those components, all other economic variables will be affected by the negative effects. He considered debt-deflation (over indebtedness and then deflation) as the core of a depression.

Over indebtedness that the economist mentioned is explained by himself such that a status when households, firms and banks have scarce resources available to meet their obligations. As a beginning of a downturn, boom of a cycle is shown. With the effect of an external shock, boom of the cycle happens. However, entire process is debt financed by either banks or other financial intermediaries. Deposits increase and inflation occurs by the increasing money supply. Then comes the over indebtedness which the scholar mentioned about. After all liquidity crises are triggered and they evolve to debt crisis, banking crisis and depression. In the end, intervention by the monetary actors to calm the overall process is needed.

Kindleberger as another heterodox economist, has believed that all the crises have commonalities in nature. In order for a crisis to occur, he listed some stages to be followed.

First stage is an external shock which secondly generates a boom period with new opportunities and money supply increases. Speculation phase comes after the tranquil period. Over trading occurs and spreads from market to market which then gains an international characteristic. Next phase comes with some insiders to leave the market at its maximum point. Lastly, financial distress created is followed by the bankruptcies (Rosser, Rosser, & Gallegati, 2012).

## **2.2. EVENTS AFFECTING THE OCCURRENCE OF FINANCIAL CRISIS**

Financial crises have many appearances. They seem as multidimensional events and they are very hard to characterize with a single indicator. Exact causes of the crises have always happened to be an abstract subject. As stated by Claessens and Kose (2013), *“it sometimes appears to be driven by irrational factors such as sudden runs on banks, contagion and spillovers among financial markets, limits to arbitrage during times of stress, emergence of asset busts, credit crunches, and fire-sales, and other aspects related to financial turmoil.”*

Asset price and credit booms which eventually turn into busts are another two explanations for the financial crises those take part in the literature. Understanding the mechanism under the evolution of asset and credit prices from bubbles to busts is crucial in order to prevent them from being unsustainable.

### **2.2.1. Asset Price Booms and Bursts**

After 1929 stock market crash, asset booms have come into light in the past decades. The recovery in the US economy after the second World War (WWII), has shown that asset bubbles could be ignored since their effects were little and negligible. Similarly, after the burst of the internet bubble in 2000 or the stock market crash of October 1987, the economy has been affected mildly. This situation led the economists and policymakers to ignore the asset bubbles (Evanoff, Kaufman, & Malliaris, 2012).

On the contrary, there are other examples in the history showing that the disregarding the asset bubbles and busts can be dangerously harmful to the real economy. Two specific examples of this condition are the Great Depression of 1929 and the crash of Japanese stock and real estate markets. The spillover effect of bubbles has been highly severe and it has been seen that the bubbles should be carefully managed. Debates about the asset price bubbles and the necessity of management of the booms have been again raised after the financial crisis of 2007-2009 (Evanoff et al., 2012).

Although there are different types of asset bubbles, the most referred bubbles are the stock market and the housing bubbles. As Bernanke and Gertler (2000) stated in their work that real economic activity is affected by asset bubbles via the wealth effect on consumption and financial decisions of the firms are affected by asset bubbles via the asset appreciation on the balance sheets. As a conclusion, the authors commented that price stability and financial stability move together, so they offered that central banks should not react to asset price increases. However, experiences of the financial crisis has shown that macroeconomic stability is not enough for financial stability and central banks are offered to take action on asset price bubbles because of the damages they cause on the real economy (Kuttner, 2011).

The difficulty of foreseeing a bubble to burst or deflate on its own, was one of the concerns of the scholars in order to prevent an upcoming crisis. Additionally, the concern of preventing the asset bubble itself by monetary policy or the macro prudential regulations is disputable. Application of high interest rates may be one solution, but it has side effects on the economy such as an increase of unemployment. Therefore, macro prudential regulations have come as an alternative to the monetary policy.

Since the banking regulations as capital requirements and leverage caps were proved to be half measures in the latest financial crisis, the concept of counter cyclical buffers has been offered in order to prevent crisis before a bubble appears. According to this restriction, banks must put aside capital when there is a period of strong growth which will protect them when the wind is reversed. Banks can use that buffer to cover their losses

and continue to supply credit to the real economy. With the help of these regulations financial sector will have endurance and they will be more elastic in uncertainty periods. As a result, the goal is to prevent a financial crisis in the beginning.

Acharya and Naqvi (2011) have also studied the asset price bubbles and the banking sector's contribution to the development of the bubbles. They stressed out the importance of the excess liquidity which leads to aggressive lender behavior and finally causes a bubble. They again concluded with the need of macro prudential regulations before a bubble forms.

Two different ideas about the cause of asset price bubbles have been discussed in two different papers. First one is a historical analysis by Christiano, Ilut, Motto, and Rostagno (2010) to test the appropriateness of the monetary policy. The findings concluded that asset bubbles are formed during times of low inflation levels. Monetary policies to cut inflation by setting interest rates lower than the natural level, have actually fueled a bubble by destabilizing asset markets and macro economy. Second study by Geanakoplos (2012) reveals leverage as the major cause of bubbles. According to the results, the leverage levels were so high and also there were double leverage in repo market and in mortgage market which affected each other. Additionally, the existence of credit default swaps in the latest crisis, led also the pessimists to leverage beside the optimists. Because of these reasons, the crisis was inevitable, quick and also extensive since it swallowed up vast amount of people and businesses.

There is not a strong agreement on the causes of asset bubbles, or the tools to prevent them from forming. Also, there is not a strong consensus on the idea whether central banks should act against a bubble before it bursts or not.

### **2.2.2. Credit Price Booms and Bursts**

After the outburst of global financial crisis, US subprime mortgage market has been questioned from different views. Beside the explanations with asset price booms and bursts, credit market has also been a portion of this massive crunch of 2008. A sudden increase in credits has also been seen before the crises in past and recent periods of turmoil

followed by busts along with asset price corrections (Claessens & Kose, 2013). A decline in lending standards and expansion of risky credits by the over-venturesome lenders provoked the credit boom, which has been fueled by financial innovations, loose monetary conditions and increased competition (Dell'Ariccia, Igan, & Laeven, 2008).

As it is described in Claessens and Kose (2013)'s review about financial crises, credit booms can be explained by two major factors, namely shocks and structural changes. The effects of shocks can be categorized by productivity changes (positive productivity shocks can also be effective in credit booms), economic policies and capital flows. International capital flows lead to a cross border spillover effect. High amount of funds become available when there is significant amount of capital inflow in a national economy, which then cause flexible credit constraints and relax the debtors. In the latest crisis, significant amount of capital flow was linked to rapid increase in credit and again rapid growth in asset prices. Adaptable policies also had effect on credit booms when they take place for longer periods. Interest rates had the major role in the effect of policies on housing market. Borrowers tend to be more risk taker when there was a decline in interest rates. Credit standards and lending conditions were also happened to be loosen in these periods with the decline of policy rates and interest rates (Claessens & Kose, 2013).

The effect of lending standards and financial innovations -which are linked to the new credit options and opportunities- on credit boom has been studied by a small number of academicians. According to one study, the collateralization of loans has increased in times of contraction while the opposite was true in times of expansion (Asea & Blomberg, 1998). Other scholars concluded in their paper that the credit requirements for riskier borrowers declined in times of credit booms (Jimenez, Salas, & Saurina, 2006). A different analysis claimed that innovations in credit market is related with the lending standards (Lown & Morgan, 2006).

Ordinary behavior of asset and credit markets in normal periods differ from the crisis periods. Booms appear to be shorter, stronger and faster while busts appear to be longer, deeper and more intense than normal cycles. Another view has seen these crunches

to be not necessarily harmful and even to be beneficial for the real economy but actually this view was until the last crisis. Claessens and Kose (2013) mentioned about the adverse effects of busts on the real economy and stated that:

*“Asset price busts can affect bank lending and other financial institutions’ investment decisions and in turn the real economy through two channels. First, when borrowing/lending is collateralized and the market price of collateral falls, the ability of firms to rely on assets as collateral for new loans and financial institutions’ ability to extend new credit become impaired, which in turn adversely affect investment. Second, the prospect of large price dislocations arising from fire sales and related financial turmoil distorts decisions of financial institutions to lend or invest, prompting them inter alia to hoard cash. Through these channels, fire sales can trigger a credit crunch and cause a severe contraction in real activity.”*

### **2.3. TYPES OF FINANCIAL CRISIS**

First major crisis that capitalist economy has faced in the history was in 1929 with a global depression while the second wave of crisis was in the years of 1970-80. Developed economies has experienced oil, currency and debt crises in this period. Third wave of financial crises was in both developed and developing economies after financial liberalization policies. As a consequence of these policies, there has been short term capital movements and financial system became vulnerable to possible shocks especially in developing countries. According to C. Reinhart and K. Rogoff (2013) periods of financial sector growth and development will always cause waves of financial crises and many crises are consequences of excess financial liberalization. Before 1990s, the crises have been either currency or banking crises, but after 1990s financial liberalization, twin crises in which banking and currency crises has been experienced simultaneously, were in action.

According to Reinhart and Rogoff (2009), financial crises can be grouped into two broad categories as the ones those can be explained by quantitative definitions and the ones those can be explained by qualitative analysis. Currency and sudden stop crises belong into the first group while banking and debt crises belong into the second group. In the thesis, the same categorization will be followed as the authors and four main types of

financial crises will be focused; namely, currency crisis, sudden stops, foreign and domestic debt crisis and finally banking crisis.

### **2.3.1. Currency Crisis**

Currency crisis is one type of financial crises which take place in the literature with other types and mostly defined as “*a speculative attack on the currency resulting in a devaluation, or forcing the authorities to defend the currency by expending large amount of international reserves, or sharply raising interest rates, or imposing capital controls.*”(Claessens & Kose, 2013). Similarly, Chiodo and Owyang (2002) described currency crisis as again “*a speculative attack on a country’s currency that can result in a forced devaluation and possible debt default.*”. Athukorala and Warr (2002) referred to a definition of “*rapid outflows of financial capital in anticipation of a possible currency depreciation, inducing depletion of reserves, financial instability and subsequent economic contraction*”.

When there is a decline in the value of a country’s currency, the overall economic conditions are affected by these instabilities in the exchange rates. Investors’ expectations regarding the situation further influences the development of a crisis. They generally consider that authorities may finance the deficits by printing money or devaluing the currency. If a country cannot defend its currency, it is forced to decrease the value of its own currency. In order to achieve that, central banks spend their foreign reserves and buy their own currency. Eventually, devaluation takes place. When devaluation occurs with speculative attacks as in the definition of currency crises; output declines, inflation increases and financial markets deteriorate (Chiodo & Owyang, 2002).

After 1970s, currency crises became more frequent and more severe in the world. They originated both in industrial and developing countries. This situation increased the theoretical studies on this issue in order to analyze the causes and symptoms of crises and to find an early warning system (Çeşmecı & Önder, 2008; Ozkan, Türkşen, & Canpolat, 2008). In recent years, however, as more countries are adapting flexible exchange rate

mechanisms, currency crises those are linked to fixed exchange rate mechanism are not very frequent (Manasse, Roubini, & Schimmelpfennig, 2003).

Two common theories explaining the causes for currency crises are self-fulfilling panic theory and vulnerability theory. First theory explains this kind of crises as the panic reflecting the inherent instability in international capital markets. Animal spirits and contagion are explained as the two forces behind the crises. According to vulnerability theory, because of market overreaction, financial instability and collapse may be more harmful than it would have been warranted by the macroeconomic conditions of the economy at the crisis period. This theory blames the incorrect economic policies as the reason for the crises (Athukorala & Warr, 2002).

Banking and financial sector vulnerabilities have been argued as the sources for the currency crises by Nagayasu (2002). The author mentions that illiquid banks cause financial crises and argues that financial liberalization and short-term capital flows worsen the situation. Regarding the explanations of the currency crisis, three models are used during the past decades as first-generation models, second-generation models and third-generation models.

First generation models to explain currency crises are developed by Krugman (1979) and Flood and Garber (1984) which are then referred to as “KFG” models. This model explains the currency crises as a result of fixed exchange rate and excessive government debt. Investors start to judge the situation as if government will not be able to pay the deficits. If central bank decides to monetize the deficits, then there is high probability of inflation which result in high foreign outflows and speculative attacks. The speculative attacks on domestic money may get unbearable with the inability of central banks to defend their currency. This run on banks and eventually the run on the central bank cause the loss of liquid assets. The result is devaluation, and this leads to a collapse of the exchange rate system which eventually means a crisis.

In the second-generation models, self-fulfilling characteristics play an important role. Investors’ run on the currency is explained by the expectations that other investors

would also attack the currency. Additionally, first generation models could not explain the contagious character of the currency crisis. Second generation models explain contagion channels as trade channel, neighboring, macroeconomic similarity and financial channel.

Third generation models search how rapid deteriorations of balance sheets related to instabilities in asset prices, including exchange rates, can cause currency crises. In the Asian crisis of late 90s, macroeconomic problems were ignorable, but vulnerabilities of financial sector were serious. The balance sheet mismatches of the sectors caused the currency crisis. Banks are also crucial actors in the process. Over-borrowing by banks can increase since they trust on the bail-outs by the government which cause initially vulnerabilities and eventually the crisis (Claessens & Kose, 2013).

### **2.3.2. Sudden Stops**

A sudden stop is defined as *“a sharp fall in capital inflows relative to their past trajectory”* and they are not commonly faced by developed economies (Calvo, Izquierdo, & Talvi, 2006). Likewise, Calvo (2003) defined it as *“a large reduction in the flow of international capital”* while in another study it is explained by the sentence of *“an abrupt and major reduction in capital inflows to a country that has been receiving large volumes of foreign capital”* (Edwards, 2004).

Similar to the cases in third-generation currency crises models, sudden stops are also related to balance sheet mismatches but in this scenario, international factors play the major role. For instance, an upward change in international interest rates can cause sudden stops.

In fact, there is not a consensus in the literature about the causes of the sudden stops. It may be an external factor such as world interest rates or an internal factor such as a domestic political scandal, that can trigger sudden stop (Calvo, 2003). Any unanticipated small shock can cause a sudden stop in an economy. In an empirical study, Edwards (2004) analyzed the data for 157 countries and tried to find evidence of sudden stops along with current account reversals. In this study, he mentions that many economies have used their reserves effectively to escape from a current account adjustment. Theoretically, sudden

stops can occur without current account reversal if foreign reserves are used to maintain the level of the current account deficit (Bordo, Cavallo, & Meissner, 2010). Also some economies faced current account reversals but they did not experience a simultaneous sudden stop period (Edwards, 2004).

Financial openness as well as trade openness also have effect on the probability of sudden stop to occur. Financial openness leaves emerging markets vulnerable to external crises which in turn affect their domestic economic performance (J. P. Joyce & Nabar, 2009). In their empirical study on 32 developed and developing countries Calvo, Izquierdo, and Mejia (2004) concluded that trade openness and the existence of dollar liabilities in the banking system of a country are key factors in the occurrence of a sudden stop. The extent of liability dollarization is an important factor for the contagion of the turmoil to different sectors. Banking sector may be affected by the exchange rate depreciations since the value of their foreign liabilities relative to current assets may increase. This may lead to a banking crisis. Similarly, it can also cause debt crises if a government has liabilities on dollars but its revenues to service this foreign debt are in domestic currency. Both banking and debt crises can trigger currency crises since international reserves, which are crucial to subsidize the banking system's liabilities and government's balance sheet, are endangered (Bordo, 2006).

Sudden stop may be related to external creditors but a country's vulnerability to a sudden stop is about its domestic situation such as tariff and competitiveness policies and fiscal and monetary policies which are badly managed. Similar results have been achieved in a study of emerging economies for the analysis of determinants and output effects of sudden stops. The authors also found that the probability of sudden stops can be reduced by lowering the levels of hard currency liabilities (in relation to GDP), increasing the level of trade openness and sound monetary policies (Bordo et al., 2010).

### **2.3.3. Debt Crisis**

Countries' default reasons are one of the key issues to analyze especially for the developing countries. Both external (foreign) debt and internal (domestic) debt play an

important role in the default process. To give a definition of default is necessary before starting to give information about how countries default. The time when a country cannot meet its obligations either on paying interest rates or repaying principal, within any grace period specified is defined as a sufficient condition for a default. First missed payment or rescheduling of a principal or interest may be the beginning of a default as well as the time when a country declares that it will not be able to meet its debt obligations (Tomz & Wright, 2007).

Governments of developing countries suffer from lack of foreign currency since they need to import intermediate goods necessary for investment and production. Foreign borrowing is a solution for governments in those cases. They would either choose to increase taxes or print money which will cause political or inflationary issues, or they would borrow foreign money to satisfy the demand in the short run. This is one of the reasons for the increase of foreign debt (Berg & Sachs, 1988).

Advanced economies are different than emerging countries. They are considered as less vulnerable to any shock or even if a crisis is experienced, advanced economies are supported that they can recover fast. This was the idea before the latest financial crises of 2007-2008 since the recovery from the crisis was very weak in most of the European economies and it turned to be a sovereign debt crisis afterwards. Restructuring of debts, capital controls and financial repressions are the tolls that are counted to be solution for the debt crises in emerging countries while these same solutions thought to be improper for the developed countries. In reality, in most advanced countries, debt restructuring, financial repressions and higher inflation have been in the process of solving the problems of debt crises in the recent case (C. Reinhart & K. Rogoff, 2013).

Hence, financial repression has been raised as another method for advanced economies to deal with debts after 2008 financial crisis. Reinhart and Sbrancia (2015) defined financial repression with its several pillars such as: *creation and maintenance of captive domestic audiences, explicit or implicit caps on interest rates, direct ownership of banks or extensive management of banks and other financial institutions, restricting entry*

*into the financial industry and directing credit to certain industries*<sup>2</sup>. Holding interest rates low or negative in order to create cheap funding for government spending is what the government policies aim under the name of financial repression. With the measures applied, funds are channeled to the government. Quantitative easing policies and capping interest rates can be included in the methods used by western economies after the latest crisis. The role of financial repression as a cause of distortions being aside, it is perceived as a way to limit financial excess and reduce the occurrence of crises.

Mallucci (2015) emphasized the importance of the composition of foreign and domestic debt together and focused mostly on the domestic debt since the literature did not have a wide variety of studies dedicated to this part of country defaults. According to this study, importance of domestic debt comes also from its big portion in government debt.

It is not always true that economies default occurs when the economic conditions of a country is bad. In fact, bad economic conditions are considered as necessary but not sufficient condition for default. Tomz and Wright (2007) analyzed Argentina and Chile in their sample for the relationship between economic activity and default and concluded that these countries experienced default in good economic conditions, while they continue their debt services in times of turmoil. In case of output declines, not all the incidences in the history resulted with default (Tomz & Wright, 2007).

#### **2.3.4. Banking Crisis**

Banking crises are the most frequent type of financial crises throughout the history since banks might have risky in more than one side, such as credit risk, interest rate risk, liquidity risk. However, the causes and effects of the crisis may vary across countries and time periods (Hutchison & McDill, 1999). Von Hagen and HO (2007) included one report of International Money Fund in their study and described the banking crises as “*a situation in which bank runs and widespread failures induce banks to suspend the convertibility of*

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<sup>2</sup> For further explanation of the financial repression definitions and the explanations of the pillars, see “The Liquidation of Government Debt” written by Reinhart and Sbrancia (2015).

*their liabilities, or which compels the government to intervene in the banking system on a large scale.”*

These types of crises begin when there are extensive credit booms and end up with deep and ongoing recessions (Boissay, Collard, & Smets, 2016). The fragile characteristics of the financial sector and institutions make the crisis more frequent and probable. Weak economic conditions linked to high inflation and low growth contributes to the occurrence of crises in general while high interest rates increase the banking sector fragility (Demirgüç-Kunt & Detragiache, 1997). This fragility and the self-fulfilling characteristics may cause a coordination problem which then leads to bank runs. Large amount of liquidity is the concern of the financial institutions. That’s why, when large number of people withdraw their deposits with the belief of the bank’s insolvency, then other customers also follow them. This situation gets worse with the herding behavior. Banks cannot pay their liabilities that quick and face with bankruptcy (Claessens & Kose, 2013).

Worldwide capital account liberalization after 1970s provoked this kind of financial crises. The collapse of Bretton Woods system and the oil price crises started a global recession which then triggered financial sector problems. Before this year, there was a long-time gap without banking crises (C. M. Reinhart & K. S. Rogoff, 2013).

The problems in the asset markets such as the problems in subprime and mortgage loans, also play crucial role in a banking crisis. They seem like a hidden source of the crisis until it becomes visible when funding difficulties emerge. Following the difficulties that banks face, governments start some emergency policy actions to save the situation. This causes the depositors to be sceptic about the whole banking system which in turn result with the runs (Calomiris, 2009).

Actions have been taken to avoid these risks such as micro-prudential regulations, deposit insurance, central banks’ lender of last resort facilities and policy interventions of public sector. All these actions may also have adverse effects on the situation. When they are poorly implemented, they may be harmful and make the crises worse (Claessens &

Kose, 2013). Weak supervisory and regulatory policies increased the moral hazard problem. State guarantees encourages more leverage and institutions to take risks that they cannot bear themselves. Competitive environment was new to most of the financial institutions with newly introduced complex instruments and these institutions did not hesitate to increase their risk positions (Hutchison & McDill, 1999). This shows a moral hazard problem and “too big to fail” idea is lying behind this phenomenon which was the case also in the latest global financial crises of 2008.

When the banking system stops functioning, nearly all the markets of the economy gets affected which causes an overall crisis (Gorton, 2009). Credit flow to households and enterprises are being affected and therefore the investment and consumption is getting lower. Firms are being bankrupted with this disruption in their activities (Demirgüç-Kunt & Detragiache, 1997). Since banks are thought to be central to business activity, governments feel themselves obliged to rescue them from distress.

The results of governments’ bailout actions seemed suspicious to the researchers for various reasons. Dell’Ariccia, Detragiache, and Rajan (2008) listed these reasons in their study. Firstly, the causality of banking distress and economic distress must be identified. Second, it is important to determine if the causality is from banking to economic distress. Third, it is not certain that government actions will save the banks and prevent them to be harmful to the overall economy. It is crucial to find the effective actions. Fourth and the last thing to consider is to estimate the cost of intervention and to be sure that the benefits will worth the costs for the budget. Another study has also questioned the efficiency of government intervention with the cost-benefit point of view. Additionally, it stresses that these operations may cause distortions in risk management because of the expectations of further rescues which again comes to the moral hazard problem. Lastly, loosened monetary policy may cause inflation and as a result, it may cause a speculative attack to the currency which then turns into a currency crisis (Demirgüç-Kunt & Detragiache, 1997).

In their study Claessens and Kose (2013) listed the common features of the banking crises in literature as unsustainable asset price increases, credit booms, increase in marginal loans and systemic risks and lastly failure of regulation and supervision to keep up with financial innovation. Beside these common structures, there were also some new factors that led to the latest financial crises such as the role of new complex instruments in the financial sector, interconnectedness of domestic and foreign financial markets and financial institutions' high leverage ratios.

Macroeconomic instability which causes lending booms and asset price bubbles can also be included in the factors of banking crises. These factors were also effective in the latest financial crisis to be the worst in the history after Great Depression of 1930s.

#### **2.4. EFFECTS OF FINANCIAL CRISIS ON REAL AND FINANCIAL ECONOMY**

There are many commonalities among crises in terms of their consequences. Output losses and declines in macroeconomic indicators, such as investment and consumption can be seen in all types of crises. Financial effects also show a similar pattern among the different kinds of crises such as the movements in asset prices and credits.

In real terms, economic activity can be affected significantly, and crisis period can end up with recessions. These recessions which is linked to a crisis may last longer than other recessions. Output losses and declines in consumption, investment, employment and export/import may be more harmful. Similarly, recovery from crises happen to be slow and fragile which can take years to be fully recovered. This condition is linked to broken trust between the economic agents and the effects of weak demand and tight credit conditions. After a banking crisis, the costs for restructuring the sector can be too much. Also the debt crises which are related to the declines in gross domestic product are found to be more harmful to the economy than banking and currency crises, while currency crises are found to be contractionary sometimes (Furceri & Zdzienicka, 2012). When it is time for both the restructuring of the overall system and also the slow economy, public costs

are becoming higher because of high government spending and low tax revenues (Reinhart & Rogoff, 2009).

In financial terms, crises also have downward effects. Asset and equity prices can be affected negatively, and upward corrections can be very slow. Banking sector also may become suspicious and credit opportunities may be weaker than the normal tranquil times. Real economy is affected with the lack of credit from financial institutions. Sector is becoming narrower and recovery from the crises is becoming harder and slower.

Moreover, sudden stops have financial and real effects like other types of financial crises. Eichengreen and Gupta (2016) listed the financial effects in the order of occurrence as the depreciation of exchange rate, decline of reserves and fall in equity prices. Consequently, GDP growth begins to slow down as it is the case for investment, and current account becomes stronger.

The consequences after a crisis is also different among countries. In most of the cases emerging economies drew a worse picture with the overall losses to be higher but in fact, in recent crises advanced economies also faced with many difficulties and recovery period has been very long which is still a concern for some economies.

## **CHAPTER THREE**

### **3. EUROPE IN THE GLOBAL FINANCIAL CRISIS**

In this chapter, seven European countries (France, Germany, United Kingdom, Greece, Portugal, Spain, Italy) will be evaluated according to their economic and financial situations before and during financial crisis. It is aimed to understand the individual conditions of the economies which lead them to be harmed by the financial crisis. Some countries such as Greece and Portugal have seemed to be affected more which indicates that those economies have already some vulnerabilities on their fundamentals. Descriptive analysis with the actual data is utilized in order to make comprehensive and comparative analysis about the countries. Additional analysis of stock markets will be held in a separate section to fully visualize the financial developments.

#### **3.1. THE BACKGROUND OF THE US FINANCIAL CRISIS**

World economy has witnessed many forms of financial crises throughout the history. Even if financial crises are introduced as unusual events, they are very frequent, especially after 1970s. Oil crises of 1973 and 1979, Latin American debt crisis of 1982, Black Monday of 1987, Tequila crisis of 1994 and finally the global financial crisis of 2008 have been the most dramatic examples of the downturns.

The latest financial crisis of 2008 has been regarded as the most extreme turbulence since the Great Depression of 1929. 21<sup>st</sup> century has witnessed interest rates to be in the lower bound, this was a circumstance of the high liquidity provided by one of the biggest economies in the world, China. Current account deficits of economies were highly financed by the economies with high current account surpluses such as China. This situation had effects on the saving-investment balance. Moreover, foreign exchange reserves held by these economies had maintained the low exchange rates.

By the gradually falling interest rates following 2001, credit growth has been accelerated and asset prices have increased. The conditions were contributing to asset

bubble with monetary policies of the US and UK, holding the short-term interest rates low and encouraging the banks and financial institutes for more gains by taking high risks. Financial innovations paved the way for those agents to create complex investment instruments.

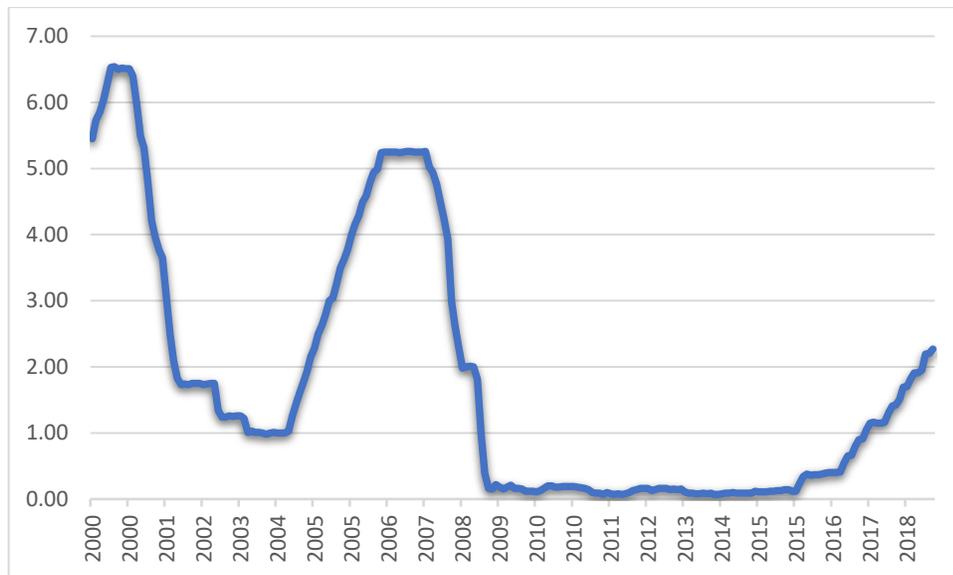
Household lending has accelerated along with the increases in house prices. House prices have overvalued while the borrowing has expanded sharply. The primary cause of the financial crisis was the deregulation in the finance sector. There were no rules which were strict enough to prevent financial actors to think rationally. Banks have started to use financial derivatives very commonly. Derivatives are the contracts that derive their value from an underlying asset. It is not necessary that the contract seller to own the underlying asset. Most famous type of the derivatives are collateralized debt obligations (CDOs) which have been considered as one of the reasons of the global financial crisis. Two types of CDOs are asset backed commercial papers (ABCP) and mortgage backed securities (MBS). MBSs are based on mortgages and when the housing market collapsed after 2006, MBS and ABCP have also collapsed.

In this deregulated environment, bad credit risk households could reach to loans by the financial intermediaries which have caused the institutions to face adverse selection problem. The mortgages provided for those people were called sub-prime. Furthermore, banks have created interest-only loans. Those loans were adjustable rate mortgages and their interest rates rise as the FED fund rates rise. The people who couldn't afford conventional mortgages were approved to take interest-only loans and were offered mortgages. This mechanism which has been formed by the banks was accepted as the trigger of the crisis. After the FED started to increase interest rates, those bad credit risk people could not pay their debts. By many scholars and finance experts, the global financial crisis is connected to the US sub-prime mortgage lending.

Sub-prime mortgages have not been evaluated as a threat because, even if they fail to pay the mortgages, the payments might be done by selling the houses and there would be no harm to anybody. Increasing trend in the house prices were convincing people about

the safety of their positions. As far as the people believed that they were wealthy, they claimed more mortgages which increased the demand further and made a significant contribution to housing bubble. However, as the interest rates started to increase, growing demand for the housing stopped and started to decline. This led home prices to fall.

The effects of the growing bubble could be observable after a short period of time. Figure 3.1 shows the evolution of the US Federal Funds rates after 2000. For the period of 2004 to 2006, FED funds rate increased almost five times which caused the loan holders to default on their debts. June 2006 was the last time that FED increased interest rates and it started to cut the rates after September 2007 through the end of 2008. Those actions brought the interest rates near to zero lower bound. In this process, investors realized that “mortgage-backed securities” has lost their value and house prices decreased rapidly. Mortgage delinquency rates hit to highest levels in history which can easily be depicted from the Figure 3.2.

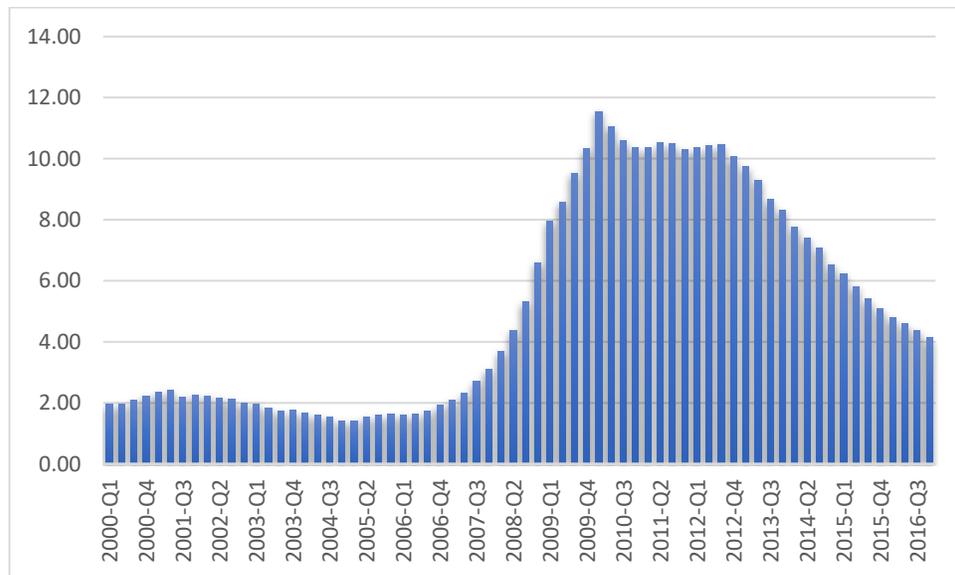


**Figure 3.1 : US FED Federal Funds Rate (2000-2018)**

Source: US Federal Reserve Bank of St. Louis

One of the most significant features of the latest crisis was “complex financial instruments”. Financial innovation has caused a bigger problem since the financial

products were complex and non-transparent. True pricing of these products became impossible and they were not sold on markets. As indicated by Crotty (2009), “*the value of securities not sold on markets may exceed the value of securities that are. Eighty percent of the world’s \$680 trillion worth of derivatives are sold over-the-counter in private deals negotiated between an investment bank and one or more customers.*” Those highly risky and complex products consisted of derivatives, forward contracts, hedging activities, etc. The actual problem of this system was that the economy was not based on real economic actions, instead it was based on vast amount of debt which was unsustainable for a long period.



**Figure 3.2 : Mortgage Delinquency Rates**

Source: FRED-Federal Reserve Bank of St. Louis Database

MBS valuation was impossible because of this complexity. Banks and hedge funds had derivatives on their hands which they did not know which part of them were worthless and how they would value the worthy parts. As a result of this uncertainty, banks stopped lending to each other.

Early signals of a greater disaster have been given. Reliability among the financial institutions have been interrupted and lending has stopped suddenly. An investment bank has stated<sup>3</sup> that the depositors cannot withdraw their money since the banks cannot value the assets in their funds. This press release was simply “scary” indicating that the lending has come to an end among the financial intermediaries. The situation was explained as “credit crunch” which means “*a crisis caused by a sudden reduction in the availability of liquidity in the financial markets*” (Gökay, 2009). Those situations have created the banking crisis in 2007. The market values of financial organizations such as AIG, Bear Sterns, City Bank and Lehman Brothers, decreased significantly following the expansion in mortgage foreclosures.

With the intention of solving those problems, financial and legislative authorities agreed to interfere by injecting liquidity to boost the economies. However, this attempt worsened the situation. In the third quarter of 2008, stock markets collapsed and became very instable which left people in a position of uncertainty about future threats.

There were many critics about the predictability of the upcoming crisis since it was very big in its effects and reflections all over the globe. Dell’Ariccia, Igan and Laeven (2008) reported about the majority of the banking crises in the last quarter century that they have been experienced after fast credit growth period. Nevertheless, all the expansion period does not have to cause a crisis. Lending growth followed by a crisis was 50% of the cases while credit expansion followed by a crisis was only 20% of the cases. The corrupted lending conditions were the primary causes of this situation. The factors those caused weak lending conditions were listed as:

- 1) *The size of the credit boom was the determinant of the decline of the lending standards.*

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<sup>3</sup> The press release which is announced on BNP Paribas official website can be found on the following link: <https://group.bnpparibas/en/press-release/bnp-paribas-investment-partners-temporaly-suspends-calculation-net-asset-funds-parvest-dynamic-abs-bnp-paribas-abs-euribor-bnp-paribas-abs-eonia>

- 2) *Rapid appreciation rate of house prices was effective since the lenders were so self-confident about their ability to liquidation and repayment in case of default.*
- 3) *The change in the market structure by the entrance of large institutions was the determinant of the decline of the lending standards.*
- 4) *Banks' initiative about loan sales have driven the lending standards downward when large proportions have been sold to lenders.*
- 5) *Easy monetary conditions were also seen as one of the determinants.*

Even if the rapid increase in sub-prime loans has been blamed for causing the crisis, many professionals think that the system itself is the actual cause of the downturn. Regulation of the financial system is vital for discouraging the corrupted lending.

The global crisis of 2008 was the most intense financial failure in the period after WWII. Most of the key financial centers around the globe have been affected by the collapse in international trade since 1930s. This economic downturn was surrounding all the regions of the globe, especially the Europe (Helleiner, 2011).

### **3.2. EUROPE-WIDE SPREAD OF THE US FINANCIAL CRISIS**

As a result of the collapse of the US housing market and the bursting of the US mortgage bubble, the signal of a global financial crisis which would be effective in many developed and emerging economies all over the world, is given.

Although the crisis has started to arise in August 2007, it rapidly exercised a control over the American economy. The US mortgage market was getting weaker, but nobody was aware of what was coming next. It was the collapse of Lehman Brothers in September 2008 which has woken the people up. Later, some of the world's biggest banks and insurance companies declared bankruptcy while some others were "too big to fail" and had to be rescued. After only one month, credit flows froze and lender confidence dropped. This resulted in a considerable downturn in the market value of investment

portfolios. The confidence loss in the market triggered a credit crunch and liquidity shortage, meaning that the crisis grew larger than what had been predicted (Harkmann, 2014). In the end, the crisis spread into the world and economies dropped into recession one after another.

Some European countries ascertained to be highly vulnerable to the sudden shocks. This period was the second phase of what has started in the US. European sovereign debt crisis highlighted Eurozone with some negative facts which can be listed as: In April 2010, questions about the sustainability of government debt in Europe have arisen when Greece asked for financial aid. Greece is followed by Ireland and Portugal. Policymakers wanted to take an action and support these countries to prevent spillovers into the Europe. In 2012, Spain and Cyprus requested some form of support (Harkmann, 2014).

One of the most important features of the 2008 financial crisis is that the crisis's quick spread over the other sectors of the economy as well as other countries. Many economists, experts and academicians have started to discuss whether a financial contagion or spillover effect of global crisis was on the way. Even if the depth of the effects of financial crisis on different economies is connected with the level of integration of their financial markets, the expectations are on the side of all economies to be affected in a different way since their financial systems' development levels are different from each other (Morales & Andreosso-O'Callaghan, 2014).

### **3.3. ECONOMIC PERFORMANCES OF THE SELECTED EUROPEAN COUNTRIES in 21<sup>ST</sup> CENTURY**

As the global financial crisis developed and spread into the world, especially to Europe, results have been observed as bank failures and stock market crashes. Credit has tightened, and trade volume has dropped. As a result, world has come up with a new era of a slowdown. In fact, European economy was seen immune to financial turbulences. The perceptions were on the side of believing in the real economy which has improved by export growth and secure financial positions of households and businesses (Szekély & van

den Noord, 2009). These beliefs changed in September 2008 with the collapse of Lehman Brothers.

Global financial crisis affected European economies deeply and caused structural problems in the functionalities of their economies. Portugal, Ireland, Italy, Greece and Spain, which used to be called as “PIIGS” by the time, were the first infected economies by the crisis. Greece was the first economy which has given signals of debt crisis. Italy and United Kingdom (UK) have joined those countries later. Third group consisted of bigger economies which also had debt problems after global financial crisis. In this thesis, Germany and France are included in the analysis as powerful economies inside the European Union.

The extent to which the financial crisis has affected a country depends heavily on its initial condition and its vulnerabilities to the risks. For that reason, it is considered beneficial to analyze countries’ individual conditions before the financial crisis and since the onset of the financial crisis.

In brief, performances of the selected European countries will be analyzed in Section 3.4 with the help of some important macro indicators; such as growth, inflation, unemployment and balance of payment. Infected European Union economies have shown rapid disruptions in their macro indicators by the time. A wide time period is focused from the year of 2002, which will be the beginning year of empirical analysis of the next chapter, to the end of 2016 which will be the ending year of the empirical analysis period. Additionally, financial development of the selected economies will be reviewed at the end of this chapter since the focus of the contagion studies are on the stock market correlations. Next sub-sections will be the analysis with the actual data.

### **3.3.1. Growth Performances**

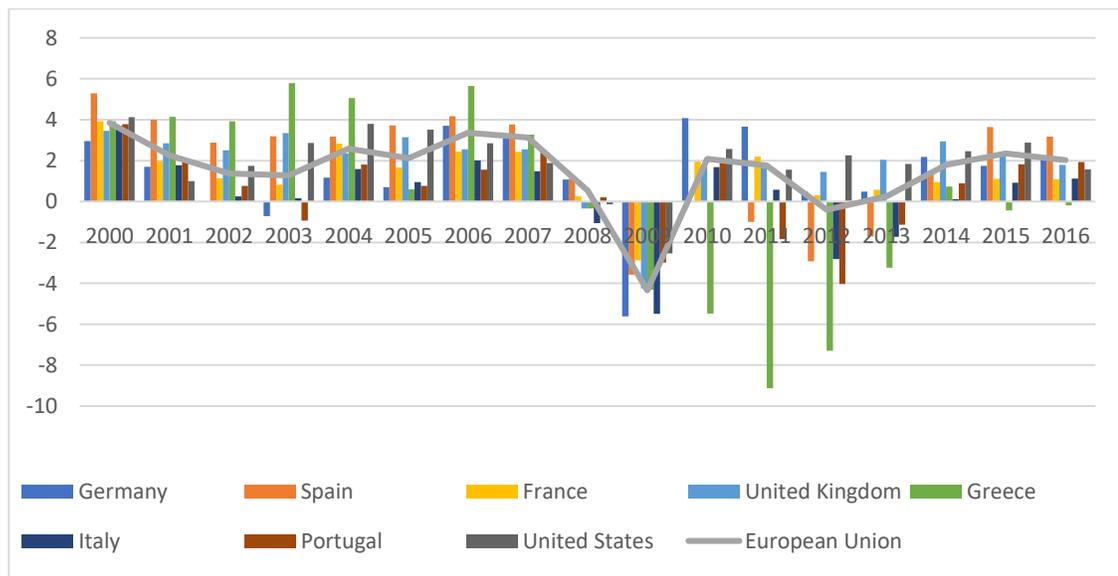
Annual percentage growth rates of gross domestic products can be used to give an idea about growth performances of the selected European economies. Especially per capita GDP is a standard for performance of a modern economy. Most European countries

had serious problems after the crisis. Countries which had problems after 2008, showed over the average performances before the financial crisis, such as Spain and Greece. Even though Greece was the most problematic economy inside the union after crisis, economic growth performance of Greece was always declared over the European Union average (EU average is included in the figures for comparative analysis).

All the European countries in the sample have shown positive growth performances before the crisis period (Figure 3.3). Only exception was Portugal and UK in 2003. This pattern continued till the crisis struck in 2007. GDP growth rates passed through a clear decline starting from 2008. This declining trend has reached to a peak point in 2009. In 2010, all economies experienced a recovery in terms of growth and reached to positive rates again. The only exception was Greece which has experienced even more declines in the coming years because of the debt crisis that it has prompted. Starting from the second quarter of 2010, Greece has faced negative rates of 5.11%, 7.86%, 9.03% and 10.22% consecutively. Even if the severity of the crisis was deep for all, each economy experienced the effects of the crisis according to the individual situation of the country itself since all the economies had its own dynamics and fundamentals. Due to the significant declines in the domestic demand and unexpected import performances of the country, declining growth was inevitable for Greece. Domestic demand was repressed by the increasing unemployment and the declining disposable incomes as a result of the salary cuts in the private sector.

More precisely, declines started to be in effect on growth rates of European economies because of the global financial crisis. Still some countries managed to have positive growth rates, namely Portugal, Spain, France and Germany. Nevertheless in 2009, all countries declared negative rates of growth. After this point, Greece had serious economic and financial problems and could not manage to recover. This fact led the global financial crisis to become European debt crisis and after 2010, countries such as Portugal, Italy and Spain also involved in the debt spiral.

The contributions of consumption, investment and net exports to the GDP differs among the countries by the selected time period. While these measures can be analyzed individually, it is going to be summarized as European Union average performance in this section. Inside the European Union, net exports' positive contribution to growth comes from the export increase. But in terms of investment, the situation was totally different. Gross fixed capital formation has fallen sharply. Before 2007, there was a period of overinvestment, especially in the construction and dwelling sector but after the crash of 2008, this fact has been reversed. That's why, sharp fall in the gross fixed capital formation was commented as a reaction to overinvestment to those problematic sectors (Balcerowicz, Łaszcz, Rzońca, & Kalina, 2013). The share of consumption in GDP growth was not worth to mention on average. That's because, as much as the private consumption has been cut, government consumption has been increased which has covered the gap.

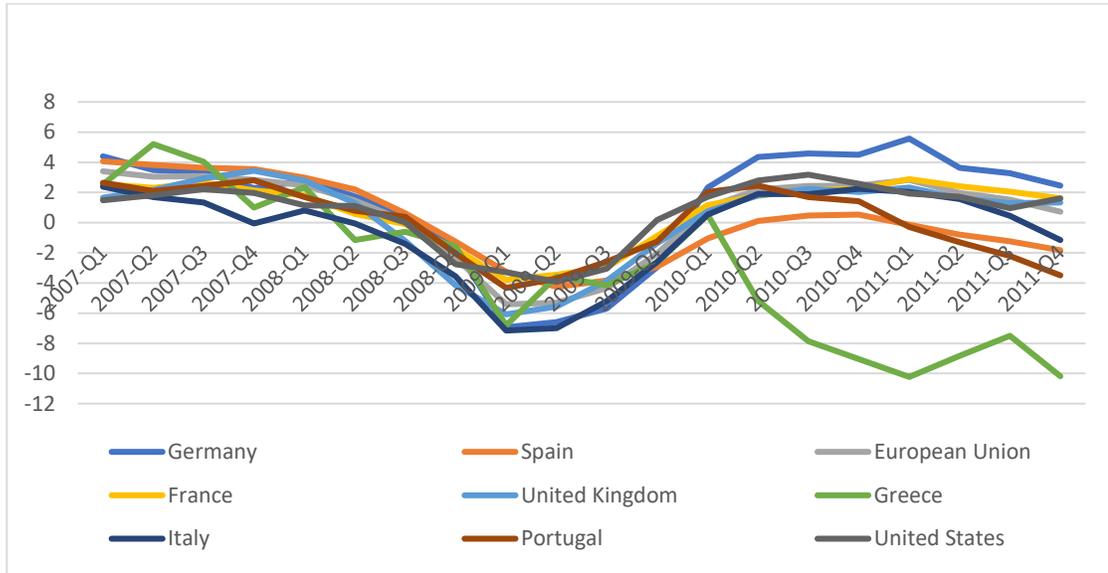


**Figure 3.3 : GDP Growth Rates**

In Figure 3.4, the financial crisis period (from 2007 to the end of 2011) is focused with quarterly data of GDP growth rates. In order to have a clear view of the magnitude of the financial shock, crisis period might be analyzed more closely. Most of the selected European countries have started to contract by the 2<sup>nd</sup> quarter of 2008. Countries like Italy

and Greece have faced with declining rates by the year of 2007 and they were the first economies who entered the recession by the second quarter of 2008. Italy has digressed from 2.5% growth performance of the 1<sup>st</sup> quarter of 2007 and entered a declining trend. France and United Kingdom followed those economies in the next quarter and when the time was 4<sup>th</sup> quarter of 2008, all the economies in the sample experienced negative growth rates.

As the core country, US has faced the recession starting from the last quarter of 2008, it has entered a period of recession with growth rates of -2.8%, -3.3%, -3.9% and -3.0% respectively (according to FRED Federal Reserve Bank of St. Louis data). Similar conditions have been in case for the other selected economies such as Spain, Portugal, Germany, United Kingdom and France. Greece and Italy have shown early warning signals with declining rates by 2007 and finally Spain, Portugal and Greece have experienced another period of recession also after 2010 with the effect of European debt crisis which has erupted following the global financial crisis. The condition of Portugal has been highly affected by the decreasing domestic demand which then increased the unemployment to record levels. Italy joined those economies soon after. After seven quarters with positive growth rates, 4<sup>th</sup> quarter of 2011 was turned to be negative again for the Italian economy. Negative expectations about the labor market and uncertainty in the financial markets discouraged individuals from consumption and investments. These conditions lead the economies to a stalemate even for the coming years.

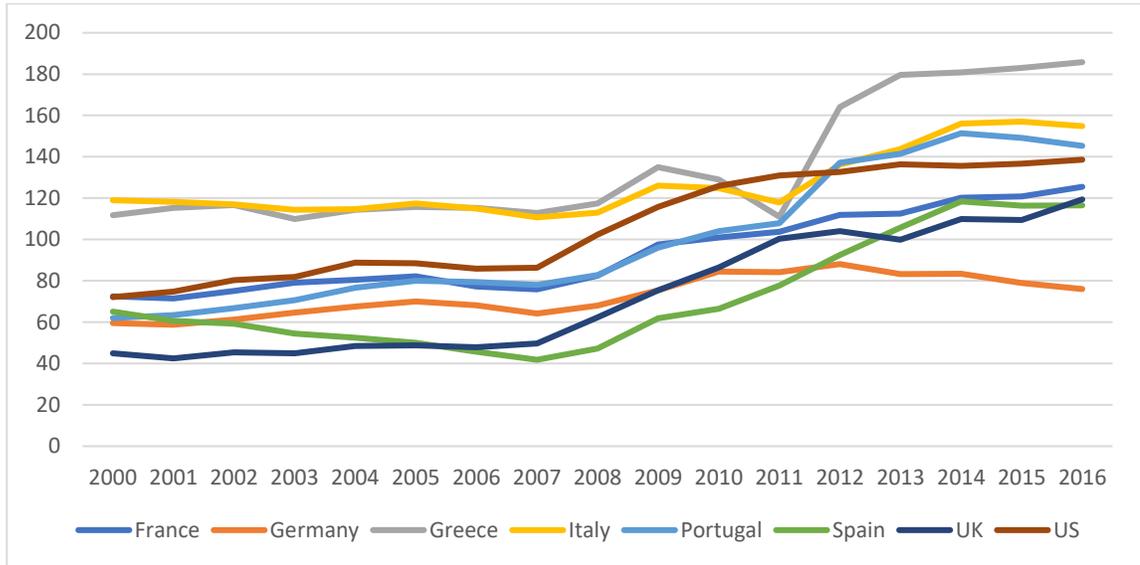


**Figure 3.4 : Quarterly Data of GDP Growth Rates**

Source: OECD Database

In fact, the experienced crisis in individual countries has led them to make reforms to accelerate their economies, which then accelerated growth, such as the decline of competitiveness in Germany. Italy and France did not make any strong reforms to correct their positions in times of historical crisis, so there had been no times of strong growth acceleration (Balcerowicz et al., 2013). In fact, the important thing is to have sustainable growth which Greece could not manage. Before financial crisis, Greece also had periods of strong growth but contrary to other European partners, Greece growth was not sustainable since it was based on indebtedness of public and private sectors. This fact led the next debt crisis.

Credit boom, as the leading factor for the financial crisis to happen, had been very strong before 2007. Those credit booms have been considered as a factor to accelerate growth, except for Portugal that did not experience important growth acceleration after credit boom period. On the contrary, Italy and France did not experience credit booms but still had serious problems. These economies were the exceptions of the general case.



**Figure 3.5 : Government Debt (%GDP)**

Source: OECD Database

Additionally, government debt to GDP ratios had played an important role in the deepness of the coming crisis as projected by the Figure 3.5. Government debt is a significant indicator since it affects the recovery process after a recession. Although the debt ratios moved very similar in all countries until 2007, Germany, France and Italy have shown a more stable view. Still, France had higher debt ratios even if it is stable while Italy had huge debt ratios which were above 100 percent. Greece was the most remarkable economy in terms of the high government debt that it was struggling. The most important reason that the crisis spilled over the European continent was the Greece's economic conditions. Especially the dependency of economic growth to external debt played the main role on the crisis of Greece.

The numbers have proved the deep financial troubles which were on the way. Nevertheless, Germany has been different. The difference between Germany and other economies was Germany's reaction to the indebtedness. German government has chosen to introduce reforms in labor market which has led to growth acceleration in the end.

	2006	2007	2008	2009	2010	2011	Maastricht Criteria
<b>France</b>							
Government debt/GDP	77.27	75.94	82.50	97.57	101.00	103.81	60%
Budget deficit/GDP	-2.4	-2.6	-3.3	-7.2	-6.9	-5.2	-3%
<b>Germany</b>							
Government debt/GDP	68.26	64.18	68.08	75.47	84.45	84.18	60%
Budget deficit/GDP	-1.7	0.2	-0.2	-3.2	-4.2	-1	-3%
<b>Greece</b>							
Government debt/GDP	115.23	112.78	117.45	135.01	128.97	110.91	60%
Budget deficit/GDP	-5.9	-6.7	-10.2	-15.1	-11.2	-10.3	-3%
<b>Italy</b>							
Government debt/GDP	115.01	110.70	112.99	125.98	124.88	117.94	60%
Budget deficit/GDP	-3.5	-1.5	-2.6	-5.2	-4.2	-3.7	-3%
<b>Portugal</b>							
Government debt/GDP	79.41	78.10	82.76	96.11	104.07	107.85	60%
Budget deficit/GDP	-4.3	-3	-3.8	-9.8	-11.2	-7.4	-3%
<b>Spain</b>							
Government debt/GDP	45.68	41.81	47.21	61.81	66.56	77.69	60%
Budget deficit/GDP	2.2	1.9	-4.4	-11	-9.4	-9.6	-3%
<b>United Kingdom</b>							
Government debt/GDP	47.83	49.66	62.27	75.46	86.56	100.31	60%
Budget deficit/GDP	-2.8	-2.6	-5.2	-10.1	-9.3	-7.5	-3%

**Table 3.1 : Individual Performances of European Economies Compared to Maastricht Criteria**

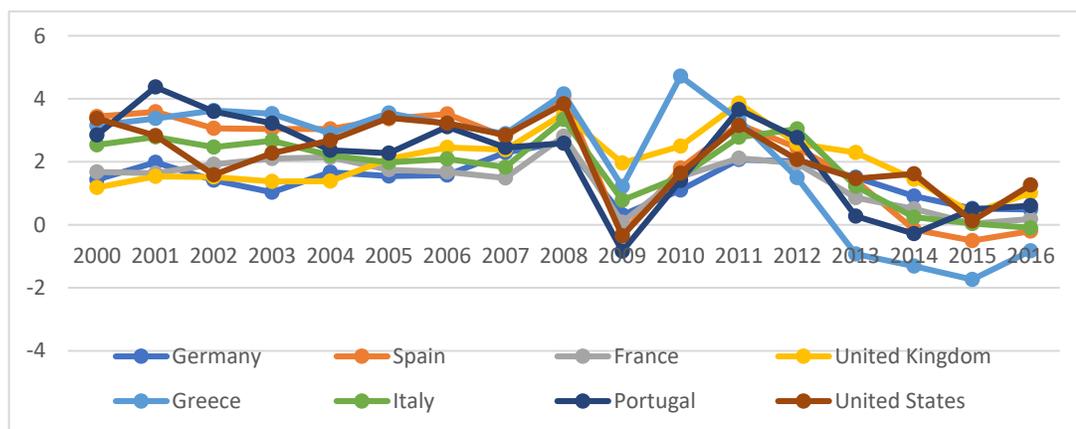
Note: Government debt source is OECD Database, Budget Deficit source is Eurostat Database.

Additionally, according to the convergence criteria for the European economies as the Maastricht Treaty with the European Union claimed, for the sustainable and sound public finances, the ceiling for budget deficit is 3% (i.e. government deficit cannot exceed 3% of GDP) while the ceiling for public debt is 60% of GDP (i.e. government debt cannot exceed 60% of GDP). Table 3.1. shows the individual performances of European countries compared to Maastricht Convergence Criteria. Minus signs for budget deficit/GDP ratios indicate a deficit situation while the positive signs indicate surplus condition for the

economies. Contrary to the requirements, in 2009 all the countries in the sample have shown exceeded figures about the related indicators as the numbers shows in Table 3.1. Government debt to GDP ratio of Spain was 47% in 2008 while it has joined the other countries in 2009 with a government debt ratio higher than 60% of its GDP. As for budget deficit to GDP ratios, Germany and Spain were on the surplus side while the situation got reversed in 2009<sup>4</sup>.

### 3.3.2. Inflation Performances

Maastricht Criteria, which concerns the European economies, dictates that the inflation level of a country inside the European Monetary Union must not be 1.5 percentage points more than the average of three member economies which have the least inflation rates. Price stability is another important point that is emphasized.



**Figure 3.6 : Inflation Performances of Selected European Economies**

<sup>4</sup> In total, there are four convergence criteria regarding the economics. First one is the price stability which requires the inflation rate of a single country to be less than 1.5% above the rate of the three best-performing member states. Second one is the sustainable public finances which is related to government deficit and government debt to GDP ratios. According to this criterion, government deficit cannot be higher than 3% of GDP while government debt cannot be higher than 60% of GDP. Third one is about exchange rate stability which indicates that member states must not devalue their currency and they must have participated in the exchange rate mechanism for two consecutive years without severe tensions. Last one is about the long-term interest rates which requires the rates to be lower than 2 % points above the rates of the three best-performing member states. (Source: European Union official website: [www.europa.eu](http://www.europa.eu))

Figure 3.6 shows the inflation rates of the countries for the period between 2000-2016. Looking at the period before the financial crisis, a stable inflation rate can be observed among the economies. However, between 2007 and 2008, there was an increasing movement in inflation levels. Among the countries, Germany had the least change in inflation between the years of 2007-2008 while Portugal even showed no increase in the numbers. In 2009, all the countries experienced a sharp drop in inflation levels. In fact, this situation was a consequence of the global contraction all around the world. Financial stimulus plans adopted by each individual state might have been effective on these sharp declines.

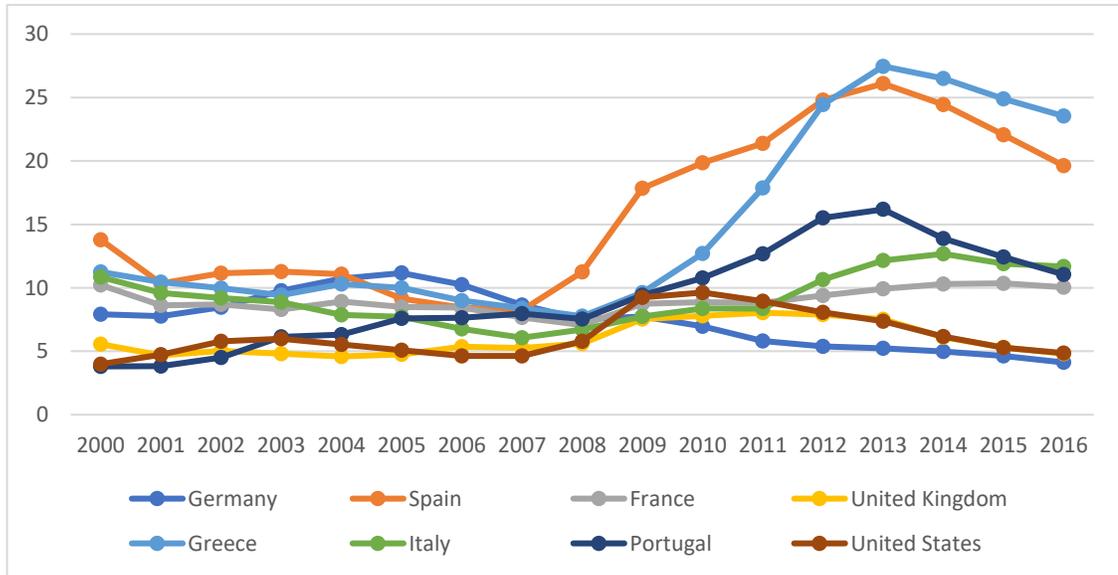
Before the financial crisis, Portugal had inflation rates around 2.5% which have declined to negative numbers (-0.83%) in 2009. Then the country's rates have gradually increased until 2012, which then experienced negative numbers for the inflation. Italian economy initially had increasing inflation levels because of the financial crisis like the general view for the European economies. The inflation rates in Greece was the highest among the seven European countries before the sharp decline after 2008. The rebound in the rates was quick and sharp in 2010. With the effects of contraction in the economic activity and cuts in the wages, the inflation rates declined to negative numbers in the subsequent years.

The movements for the other economies were similar to each other. That's to say, another peak can be observed in the numbers starting with Greece reaching to its maximum in 2009. When the year was 2010, all the countries faced high levels of inflation with Greece leading the way. Still, it can be depicted from the figure that, more or less all the countries have shown a similar pattern for the inflation movements.

### **3.3.3. Unemployment Performances**

In the euro area, unemployment has been the most crucial problem to be solved after the crisis in Europe, declines in GDP growth has been accompanied by very sharp increases in unemployment levels. Especially some countries, such as Spain (with an

increase from 8% in 2007 to 17% in 2009 and 26% in 2013), Portugal (with an increase from 7% in 2008 to 9.5% in 2009 and 16% in 2013) and Greece (with an increase from 7% in 2008 to 9.5% in 2009 and 27% in 2013) again can be observed as the most challenging economies in Europe.



**Figure 3.7 : Unemployment Performances of Selected European Economies**

Economic activity has been slowed down after the financial crisis. Labor market has adjusted itself to the new situation with the labor cuts. So, employment rates have dramatically fallen all around the Europe. According to a European Commission report, European labor market’s performance was very good until the crisis has just awoken. With the help of women and older workers’ attachment to the working life, employment rate was approaching to Lisbon standards of 70% of the workforce. In the meantime, the theorem of the Philips Curve which is indicating a trade-off between inflation and unemployment has not been experienced in the European economy (Szekély & van den Noord, 2009).

The end of 2008 and especially the year of 2009 was a major turning point for unemployment levels. As the economic activity declined, unemployment levels have been affected more. Spain is an example for this case whose economic activities were slowed

very significantly after the onset of the financial crisis. Germany had high levels of unemployment before the crisis but then it showed a continuous decreasing number of unemployment. C. Y.-Y. Lin, Edvinsson, Chen, and Beding (2013) attributed this situation to the positive effect of the short-time work mechanism agreed both by management and the trade union.

The extent to which the financial crisis has affected a country depends heavily on its initial condition and its vulnerabilities to the risks. So, the more relation with financial and housing markets, the more effects of first shocks. In the end, the crisis has been very effective in whole Europe. Some countries such as Germany implemented some policies in the labor market and this has just prevented the situation to get worse. But the output drops have increased the unit labor costs and made the unemployment got deeper. The stability in the number of unemployment rate for years has been reversed in just one year.

Among those countries Portugal, Spain, Italy and Greece need special emphasis. Greece was again the leading country in terms of unemployment numbers. At the onset of the crisis, the unemployment level was around 8%. In fact, the numbers of 2008 dropped behind 2007 but then, it increased gradually in the coming years. In 2012, Greece unemployment has beaten all the economies and reached to record high levels as 27%. Spain was another country which struggled with the unemployment levels even from the beginning of the crisis. At the onset of the turmoil, the rate was around 8% like Greece. However, the numbers have started to climb up to levels of 18% in 2009, 20% in 2010, 21.5% in 2011 and finally 26% in 2013. Spain was the country whose employment has been most deteriorated. Spanish labor system has strong segmentation which gives rise to dual structure (Yilmaz, 2013). On the one side there are long-term contracted employees while on the other side there are short-term employees. First group has social benefits, labor rights and job security, however the second group lacks social security and high turnover ratio with the seasonality. This dual structure opens a path to easy dismissal of the second group. The boom of temporary jobs and employees caused structural problems in the labor market as the conditions worsened.

Portugal and Italy were other two countries whose unemployment situations were in two-digit numbers after the 2008 crisis. In Portugal, unemployment rates evolved from 7.5% pre-crisis levels to 16% unemployment levels in 2013. Similarly, in Italy the pre-crisis level of unemployment was 6% in 2007 which evolved to around 13% in 2013-2014. Highest rates of unemployment levels in the European countries for the last decades have been experienced with the latest global financial crisis and European debt crisis.

### **3.3.4. Current Account Balances**

In context of balance of payment performances of individual countries, the interaction between global imbalances and financial crisis is worth to mention. Both academicians and politicians care about global imbalances in trade and capital flows in order to fully understand the crisis. Persistency of the situation after 1990s caused the blames on imbalances. Current account surpluses of emerging economies were the financiers of current account deficits of developed countries, especially the US. Since the US financial market was open and very developed, it attracted capital inflows from emerging economies. Emerging economies' large saving surpluses let them to have this role in world economic system. Capital flows were one of the reasons of crisis to spill over the Europe, as well as other world economies.

Exchange rates and interest rates are other concerns. Since the crisis originated from the US, the currencies which are pegged to the US dollar would also drop. This condition would cause euro countries to be less competitive because of overvaluation of their currency. Also, the interest rate changes in the US affects the spillover of a possible crisis.

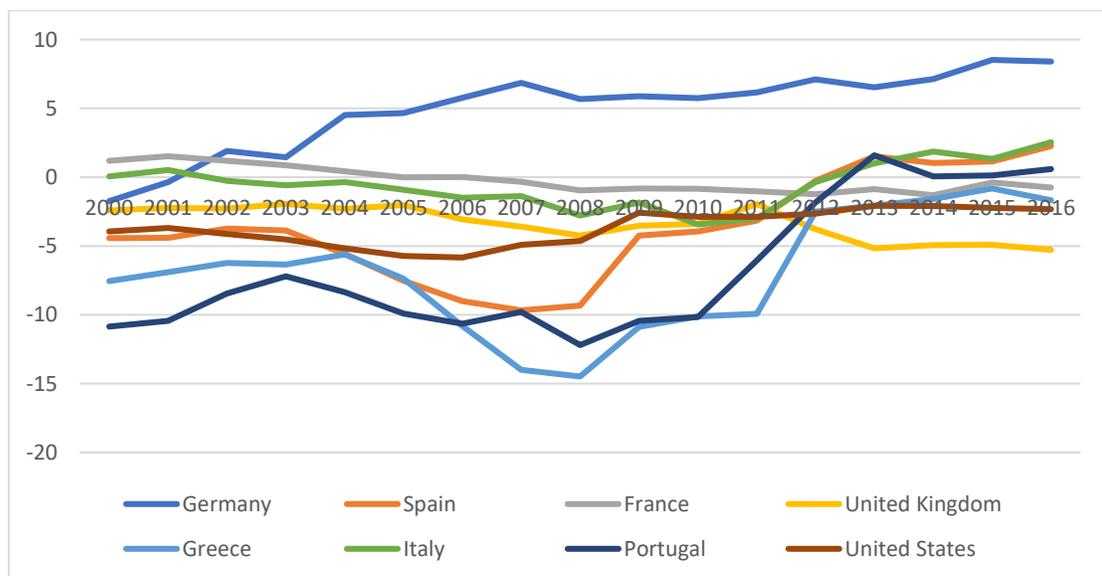
Current account shows basically the inflow and outflow of goods and services into a country. That's to say current account consists of transactions in goods, services, investment income and current transfers.

Current account imbalances are matter of concern till the 1990s because of high US deficits financed by large surpluses of emerging economies. The US has always used

the advantage of reserve money characteristics of its currency in the global market. It enjoyed this advantage while allowing large deficits in its account. On the other hand, emerging economies had large and growing current account surpluses thanks to their savings.

China is the number one creditor of US deficits. They owe this position to several situations in their economic life. These conditions were listed in European Commission’s report (2009) as *“their export-driven growth strategy, market conditions those force households to deposit savings with low interest rates, underdeveloped insurance system that force people to have too much precautionary saving and public support for enterprises to have high corporate savings”*.

The excess saving in the emerging countries has caused a global saving glut. Intentions for investment have dropped while the savings were hoarding. The capital has inflowed from surplus countries to the US which caused interest rates to drop, especially in the period of 2003-2007. This flow of saving has been the reason for risk-taking behavior and credit boom before the financial crisis.



**Figure 3.8 : Current Account Balances (%GDP) of Selected European Economies**

For the years before the financial crisis of 2008, four countries attracted attention about their performance of current account balances, namely Greece, Portugal, and Spain. UK may be added to the list, but its deficit was not as deep as the other four. Also, the crisis did not seem to have effect on the data for UK along with France and Italy.

Portugal has been a country which faced current account deficit throughout the years before financial crisis until the third quarter of 2012. The current account deficit as a percentage of GDP was around 10% in 2007 which further increased to around 12% in 2008. The numbers were showing a deficit until the year of 2013. In Spain, pre-crisis period represents high current account deficit especially after 2004. The deficit ratios have reached to around 10% in 2008 and this situation continued until 2012. Among the selected countries, Greece had the record high levels of current account deficits for both pre-crisis and post-crisis years. Even if the numbers have turned to be positive in 2015, it was not a sustainable development and did not last long.

### **3.4. FINANCIAL DEVELOPMENT**

As the world stock market capitalization has grown with a peak after 22 trillion dollars in 2002 till 60 trillion dollars in 2007, the importance of stock market indicators in analysis of financial development has increased dramatically. The same trend can be observed in the total stocks traded worldwide. The total value of stocks traded has rose from 28 trillion dollars in 2002 to 88 trillion dollars in 2007. The majority of the world's market capitalization and traded stocks are comprised of United States stock exchange values.

Broad definition of financial development gives an insight about a country's decision to permit and encourage financial activities such as increased foreign direct investment, increased stock market and banking activity. The importance of financial development comes from its ability to increase the efficiency of a country's financial system and eventually the economic activity (Sadorsky, 2011).

The role of stock markets in the financial developments of the countries clearly steal the role from bank-based indicators. Instead of analyzing the bank-based indicators like the ratio of bank deposits to GDP, market-based indicators such as the ratio of stock market value to GDP took place in the development analysis. Concentrated on the role of stock market development on economic growth, it surpassed the effects of banking system on growth (Arestis, Demetriades, & Luintel, 2001).

<b>Date</b>	<b>Germany</b>	<b>UK</b>	<b>France</b>	<b>Italy</b>	<b>Greece</b>	<b>Spain</b>	<b>Portugal</b>
2000	64.21	161.60	100.90	61.26	109.89	73.54	50.42
2001	59.13	141.92	94.03	55.15	60.87	76.85	43.55
2002	43.68	115.70	74.08	40.90	50.73	67.78	34.18
2003	37.90	108.79	68.47	37.92	46.22	70.36	33.25
2004	42.21	115.01	72.28	40.83	50.30	81.22	35.50
2005	41.78	115.95	75.70	42.98	54.52	82.09	34.74
2006	47.35	127.39	90.80	47.28	63.30	90.59	41.20
2007	56.43	129.11	101.17	49.77	75.41	108.91	51.24
<b>2008</b>	<b>45.06</b>	<b>94.38</b>	<b>76.18</b>	<b>35.38</b>	<b>53.32</b>	<b>88.80</b>	<b>40.62</b>
2009	34.20	94.01	62.02	26.33	29.84	77.30	33.50
2010	38.83	121.79	71.34	27.35	29.49	88.17	36.89
2011	35.83	118.69	62.38	21.93	18.25	75.89	30.43
2012	36.42	112.11	60.50	21.34	15.44	72.61	28.47

**Table 3.2 : Stock Market Capitalization to GDP**

When the stock market capitalization increases, a country's ability to mobilize capital and risk diversification will also increase. Liquidity is another significant factor while trying to understand the integration of domestic markets into the world markets. It is measured by the total value of shares traded to GDP (or market capitalization). Liquidity is inversely related with transaction costs and transaction costs prevent the stock markets to operate efficiently. The other factors affecting the stock market performance of the

countries are listed as, the presence or absence of excess volatility of market returns, excessive concentration and asset pricing efficiency (Arestis & Demetriades, 1997). Stock market capitalization and thus, the ratio of total value of all publicly traded stocks in a market to that country's GDP is presented with Table 3.2 for the period of 2000-2012. The overvalued stock markets of UK, France and Spain in 2007 resulted in a sharp decline in 2008 as other important European economies. Among the seven economies in the analysis, United Kingdom has one of the most important financial centers in the world and is famous by being one of the most important market-based economy of the world together with the US. Therefore, market capitalization ratios seemed to be as expected in Table 3.2.

Financial developments and financial institutions have ability to accelerate growth and this has been a subject of significant amount of study in the literature. Several channels have been listed suggesting the positive effect of financial development on growth of an economy. Levine (2005) has listed these channels as easing the exchange of goods and services through the provision of payment services, mobilizing and pooling savings from a large number of investors, acquiring and processing information about enterprises and possible investment projects, thus allocating savings to their most productive use, monitoring investment and carrying out corporate governance and lastly, diversifying, increasing liquidity and reducing intertemporal risk. These channels have effect on saving and investment and later growth. However, these effects of financial developments on growth of an economy differ among the countries with different financial structures, institutional features and conditions. In this context, it becomes significant to analyze the individual countries' financial development and more precisely stock market developments.

Investments funding opportunities increase as the stock market development enhances. It also offers an alternative to debt financing which is crucial for economies struggling with high debt ratios. Two main mechanisms that an active stock market enhance investment and economic growth comprised of the level effect and efficiency

effect (Minier, 2009). Level effect is recognized with stock market development accompanied by financial regulations which then increase investor confidence that also attract foreign investors. Even if the European countries had developed stock markets such as Paris Stock Exchange, Frankfurt Stock Exchange, Milan Stock Exchange and London Stock Exchange, one of the most important reasons of the latest crash was the financial deregulations in the system which lead the way for banks to introduce hedge funds and securities to sub-prime customers in an accelerating pace. Efficiency effect is recognized with increased diversification and liquidity which then increase the amount of investment going to higher return and higher risk investment projects (Sadorsky, 2011). This mechanism explains how the growth of an economy increases with the stock market development.

As a result, even if the concerned economies have developed stock markets and financial systems either as bank-based or market-based, financial deregulations and the spillover of a rapid distortion from the world's one of the leading economy might be effective in the adverse situation that European economies have faced. Debt ratios those feeding the economic growth and debt financing challenges, left the economies in a difficult position against a downturn.

## **CHAPTER FOUR**

### **4. EMPIRICAL LITERATURE OF CONTAGION AND CONTAGION CHANNELS OF GLOBAL FINANCIAL CRISIS**

The global financial crisis that has started with the collapse of subprime mortgage market in the US has rapidly developed and spread into the world as a global shock. It has resulted in several European bank failures and stock market declines. The most important feature of the crisis was its rapid international effect all over the world. The impact has been effective with a spillover to other countries as well as to the other sectors of the economies. Credit has been tightened and international trade has slowed down. Interbank market virtually closed and risk premiums on interbank loans increased. Banks had very serious liquidity problems.

Although the global financial crisis of 2008 has been declared as the most severe downturn in the world financial history since the Great Depression, the countries outside the US have seemed to isolate the effects of this external shock in the beginning. However, the collapse of Lehman Brothers has been a breaking point which has spread the effects of crisis rapidly (Kim, Kim, & Lee, 2015).

The external effects of a domestic crisis in a country depends on the size of this country in the economic and financial world. The affected country may be large or small but if the situation shows an emergency in terms of contagious effects, then the crisis country should be relatively large and well-integrated to the globe through trade or finance channels. Recent financial crisis showed this kind of characteristics with a turmoil in one of the biggest and developed economies in the world. The quick spread of the crisis to the rest of the world attracted the attentions of researchers, regulators and investors in analyzing the reality of contagion and interdependence.

Integration of the equity markets and thus contagion, has been in the center of the interest for both investors and policymakers. This situation makes the contagion

researches very crucial in order to understand the outcome in case of a crisis and allocate portfolios according to the correlations among the assets. From the side of the policymakers, it is important to implement necessary policies before the financial crisis or in case of a financial crisis.

Given the fact that financial crisis with its global characteristics and spreading behavior is a significant topic among researchers as well as policymakers, there is a diverse amount of literature examining the connection between financial crises and contagion effects. The studies differ from each other regarding interested time period and interested crisis, sample countries and chosen methodology. Two significant issues to be settled can be listed as whether contagion occurs between countries during financial crises and if so, through what channels adverse shocks propagate to other markets from the source market (Kim et al., 2015).

That's to say, existing studies in the literature have tried to verify a possible contagion from the crisis country to other economies in the sample basket. Once the spillover effect – or contagion if it exists – is verified, it becomes vital to predict the possibility of a future crisis and guard against it. At this point, it is crucial to detect transmission channels of the ongoing crisis. This second issue is more important from the policy perspectives while it has drawn smaller attention in the literature than the first question of the existence of contagion. The literature mostly focused on trade and financial channels of contagion.

After the stock market crash of 1987, the global characteristics of a crisis has come into light and attracted scholars. The study of King and Wadhvani (1990) has been one of the first and important work about the subject of how crises spread from the originating country, thus about the contagion effect. The Asian crisis of 1997 and the Russian default of 1998 have been other shocks which have been effective in the literature to study the characteristics of international stock market relations.

The content of the literature about contagion consists of the issue of defining the contagion, transmission channels of contagion and the possible mechanisms to protect a country from contagion. In this chapter, the literature will be reviewed based on these titles and it is aimed to cover the existing literature about the contagion analysis of the crisis periods and the transmission channels of contagion with different sample of countries, different time periods and different methodologies to flash a light to the empirical studies in this thesis.

#### **4.1. MAIN CAUSES OF CONTAGION**

The term of contagion is defined in various ways, but in simple terms, it is the existence of extreme interdependence between two economies during turmoil periods. Wyplosz (1996) analyzed the existence of contagion for currency crises and defined the contagion as *“an increase in the probability of a speculative attack on the domestic currency resulting from a speculative attack somewhere else in the world”*. Similarly, Masson (1998) summarized contagion as changes in expectations other than changes in an economy’s fundamentals. Edwards (2000) defines contagion as a situation where the extent and magnitude of the international transmission of shocks exceed what was expected by market participants. Samarakoon (2011) explained contagion briefly as the transmission of shocks from one market to another. It is stressed that the distinction between the effects of shocks during normal periods from that during crisis periods is important. Therefore, the definition is given as *“excessive impact of shocks of one market on another during a period of crisis”*.

Bekaert, Harvey and Ng (2005) define contagion as excess correlation, which is the correlation over and above what is expected. According to Fratzscher (2000) contagion is the transmission of a shock to a country because of its real and financial interdependence with countries struggling in a crisis.

In their paper, Forbes and Rigobon (2002) define contagion as *“a significant increase in cross-market linkages after a shock to one country”* while a distinction

between contagion and interdependence has been made additionally. This distinction is crucial while conducting an empirical analysis in order not to be mistaken about the period to choose for the analysis. A straightforward method is to choose a stable period of historic average and turmoil period after a crisis. According to the authors, the co-movement between the markets can be high during stable periods but in order to define the situation as contagion, co-movements should increase significantly after a shock to one market. If the co-movement was already high before the shock and continue to be high after the shock, then they describe the situation as interdependence, not contagion (Forbes & Rigobon, 2002).

The reason why a contagion from one country to another occurs can be studied under different categories. The causes of contagion may be explained by either a country's real or financial linkages which can be defined as fundamentals of an economy, or by investor behaviors. Fundamental-based linkages may not be harmful in normal times. The linkages can be referred to co-movements among the economies. However, the situation becomes opposite if those co-movements occur during turmoil times. In this case, the linkages may be defined as contagion. The existed literature shows that those macroeconomic and financial fundamentals may be helpful in explaining the occurrence and transmission of a crisis. Preventing a crisis in the beginning phase lies on understanding the reasons as well as the transmission mechanisms. Still, those fundamentals are not enough to fully explain the problem. In that case, other factors should be examined.

Second cause of contagion, which is related to investors' behavior, can happen any time without the need for a global shock. This type can be explained as an irrational investor behavior. Financial panics, herding behavior, loss of confidence and increased risk aversion may be the examples of irrational reasons for contagion.

#### **4.1.1. Fundamental Based Reasons of Contagion**

Fundamental causes will be summarized under two categories which are global shocks and local shocks. Global shocks are macroeconomic shocks which have international effects while local shocks are tying countries together with trade or financial links.

Common shocks which have global or international effect can be defined as global shocks and that may be one cause of contagion. For instance, changes in interest rate of a large economy (as the increase in US interest rates in 1980s and its effect on Latin American debt crisis) may be a common shock to other economies' macroeconomic indicators by affecting capital flows. Similarly, changes in the strength of a large economy's currency (as in the appreciation of US dollar between 1995 and 1997) may be a common shock to other economies' macroeconomic indicators by affecting export and import levels.

Andrews (2005) distinguishes the effect of common shocks among different clusters of economic units. According to that study, the impact of global shocks differs among population units. When a crisis hit stock markets, wealthy individuals will be affected more than the poor. Furthermore, there would be times that global shocks may have no effect on some population groups. This may also be true in country level. The degree of global shocks' effect on one country may depend on those countries. Same example of a stock market shock can be useful also for this case. The contagion may be more harmful to countries which have more developed stock market structure or countries whose market capitalization is bigger.

On the other hand; trade link and financial link can be considered as important channels in the economic integration of a country into the world market and consequently channels for contagion effects. In this context, importance of financial intermediaries comes to light in transmitting shocks such as bank credits in transmitting currency crisis. Additionally, when financial crisis occurs in one country, the situation has adverse

financial effects on another economy. Consequently, trade credits may decline, foreign direct investments may stop or decrease.

The existence of a common creditor for different countries is also a reason of a crisis to spill over from one country to another. In case of a crisis in one economy, financial market pressures may emerge in another economy since the creditor may restrict lending or recall loans. If creditors' portfolio consists of excessive lending to the mentioned economy and that economy's external liabilities to the creditor is in substantial amounts, then the contagious effect of portfolio adjustment will also be larger. Since this situation increases the financial vulnerability of the country, some countries may experience capital outflows in the wake of a crisis since their assets are considered riskier, more liquid and highly represented in the portfolio of creditors to the crisis country (Caramazza, Ricci, & Salgado, 2004).

Countries with more internationally traded financial assets and more liquid markets should be more vulnerable to contagion. Small, highly illiquid markets are likely to be underrepresented in international portfolios to be begin with and shielded from this type of contagion (Kaminsky, Reinhart, & Vegh, 2003).

As another important channel for crisis contagion, trade linkage covers large amounts of study in the literature. Local shocks gain global characteristics when other countries are affected through trade links or devaluations in the currencies. The contagion mechanism works with a sharp depreciation of the currency of a country struggling with crisis. Price competitiveness of the crisis country would increase which would then lead to trade spillover. Asset prices drop with currency depreciation and capital outflow massively, or because of a speculative attack, trade account weakens (Dornbusch, Park, & Claessens, 2000).

Beside trade linkages, competitive devaluations are another important factor for transmission of a crisis. When a country's currency is devaluated, that country's goods will be cheaper in international markets. From the crisis country's perspective, a

compression in the imports happens and from the trading partners' perspective, export competitiveness will be lost since their currencies are being under pressure. Currency fluctuations cause income effect in the third markets (Caramazza et al., 2004). This situation corresponds to the trade balance deterioration of the partners. Those partner economies would choose to devalue their own currency as a policy decision. In this case, the output will be affected positively since the exports will increase and current account will improve (Kaminsky et al., 2003).

#### **4.1.2. Investor's Perspective as a Reason of Contagion**

The degree of financial market integration of an economy determines the probability of spreading behavior of a crisis. The movement of asset prices and other economic variables show the integration of an economy in the world financial markets. If the country is closely integrated, then the prices and those variables move closely together. Similarly, if the integration is high, the contagious effects of a common shock to another country become more disruptive. On the contrary, if an economy has strict capital controls or cannot access international financing easily, those economies are considered as immune to the contagion.

Investors and their actions (rational or irrational) in the financial markets are other causes of a shock to spill from one market to another. Liquidity and Information Asymmetries is one of those reasons of contagion while another reason is herding behavior.

Countries with widely traded financial assets in global markets and with liquid domestic financial markets may be more vulnerable to contagion. Additionally, countries in which asset returns move highly correlated to returns of a crisis country in turmoil times may be more vulnerable to financial contagion.

From the investor's perspective, the presence of a crisis in one country is a strong reason for the investor to reconsider the riskiness of the portfolio. Investors check their portfolios' risk situation and tend to decrease their risk exposure. One way to do this

cautious attempt is to sell assets with highly volatile returns and which are positively correlated with the assets in the crisis country. This situation leads us to the liquidity problem as Calvo (1998) mentioned about a leveraged investor who is facing margin calls or such as hedge funds, needs to sell their asset holdings in other markets. Since there may be information asymmetries<sup>5</sup>, the assets can only be sold in very low prices. Therefore, investor's strategy of not to sell the assets whose prices have already fallen, and their secondary markets have become less liquid, but instead to sell the other assets, lead the prices of other assets to fall. Consequently, the trouble spreads across the markets.

Correspondingly, arbitrage is another factor leading to liquidity problems in financial markets in the extreme cases such as the crisis times. Shleifer and Vishny (1997) have studied about the limits of arbitrage and mentioned about the funds those become responsive to past performance. In these extreme cases, prices deviate and performance-based arbitrage is becoming ineffective for the arbitrageurs who are fully invested. Arbitrageurs choose to bail out of the market. Especially risk averse arbitrageurs liquidate their positions because of the fear of further adverse price movements even if they do not have to. As a result, an adverse shock causes the returns to be lower and arbitrageurs liquidate their positions in other countries that are part of their portfolio, as they fear future withdrawals. This situation causes a downturn in one country spread to other countries which are not really related to this downturn directly.

Information asymmetries and imperfect information are other causes of contagion in the context of investor behavior. Because of the differences in investors' expectations, both rational and irrational reflections occur in case of an extreme event. If there is lack of information, investors expect a crisis in one country to happen in another country with similar fundamentals. If the conditions are similar in two countries, a crisis in one country tempt an attack to other country's currency. This is how a rational investor behaves.

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<sup>5</sup> Information asymmetries causes lemons problem. The lemons problem was put forward in a research paper, "The Market for 'Lemons': Quality Uncertainty and the Market Mechanism" by George A. Akerlof in the late 60s. For further information about the subject, please see the referenced study.

Investors' expectations show that two countries will face the same problems in case of a similar event. In this case, there is imperfect information situation since the investors cannot know the second economy's real fundamentals but instead take decisions based on the information revealed in other country.

Regarding the herding behavior, it can be summarized that; when investors do not have the full picture of the countries and the situation and when there is the limitation of costs of gathering and processing the information, investors choose to follow the patterns of informed investors. This is more advantageous for uninformed investors since better-informed investors have better idea of market information. Both informed and uninformed investors gather information from the investors who acted earlier. So, uninformed investors may neglect their own information if an informed investor choose to bail out of a country which causes huge capital outflows (Calvo & Mendoza, 2000).

#### **4.2. EMPIRICAL STUDIES ON THE CONTEXTS OF CONTAGION, SPILLOVER AND CO-MOVEMENTS**

Early literature about the crises has focused on the effects in a particular country and lack of information and analysis about the reasons of the uniformity in the world markets' downward movements. King and Wadhvani (1990) has published an important study to fill this gap in the literature. Even though all markets had different characteristics and economic situation, they all have been affected from the 1987 stock market crash. They claimed that contagion is a result of attempts of rational agents to gather information from price changes in other markets. Therefore, if a market is mistaken, it may have spreading behavior which at last increases the correlation after the crises.

In 1996 Eichengreen, Rose, and Wyplosz (1996) have studied the same topic for the historical currency crises by using the panel data from industrialized economies. Contagious effects of currency crises had been a significant problem following the Mexican crisis. They have verified the existence of contagion among those countries.

Contagion seemed to occur in countries those are linked by trade linkages. Similar macroeconomic situations seemed to play less role in contagion among the countries.

Similarly, Forbes and Rigobon (2002) have made distinction of contagion and interdependence in their work which they have also used the adjusted correlation model. Only significant changes were considered as a proof for contagion. The correlations between the markets can be high during stable periods but in order to define the situation as contagion, they should increase significantly after a shock. If it was already high before the shock and continue to be high thereafter, then it is described as interdependence instead of contagion.

Except the majority of GARCH methodology in the literature, Sojli (2007) conducted some other methods as the adjusted correlation model and full information model to test the existence of contagion of Russian crisis into Slovenia, Estonia and the Czech Republic. The models were to measure contagion by using changes in correlations as a result of unexpected shocks. Interdependencies have been found significant among the selected markets, but the results were not enough to claim for a certain contagion because of correlation undertaken.

Frank and Hesse (2009) examined the financial interlinkages between advanced and emerging countries with the help of DCC framework. The link has been constructed with the effects of proxies for general stress in the inter-banking market, market volatility and default risk of major financial institutions in advanced countries on stock market, bond spreads and CDS indices of emerging countries. They found strong correlations between US and emerging countries financial indicators and this correlation has shown an increasing pattern following the onset of the crisis.

Syllignakis and Kouretas (2011) have focused on the Central and Eastern European economies and applied DCC-GARCH methodology to weekly index returns of seven emerging markets in order to analyze the contagion effect of financial crisis. Significant increases in conditional correlations between the markets have been found for

the selected period. Additionally, domestic and foreign monetary variables have been detected as a factor affecting conditional correlations.

Ahmad, Sehgal, and Bhanumurthy (2013) analyzed financial contagion of selected economies on BRIICKS countries, namely Brazil, Russia, India, Indonesia, China, South Korea and South Africa in the period of Eurozone crisis. The decisions about the most contagious economies among the sample have been made with the application of multivariate DCC-GARCH methodology. Daily stock indices were used to understand the financial contagion over the selected economies. The crisis period has been decided not with a given data, but it has been detected with Markov Regime Switching model. They have found evidence on the existence of contagion due to herding behavior in stock markets of BRIICKS. Ireland, Italy and Spain are found to be the most contagious to the BRIICKS markets. Sample countries have shown contagion except for two countries those have confirmed the existence of interdependence but not contagion. Later, same authors have also investigated the same phenomenon on a different sample of GIPSI countries (Greece, Ireland, Portugal, Spain and Italy). Again, they have found the evidence of contagion from those crisis-ridden countries to other members of Eurozone and non-Eurozone economies (Ahmad, Bhanumurthy, & Sehgal, 2014).

Morales and Andreosso-O'Callaghan (2014) analyzed contagion effects of 2008 crisis with the data collected from 58 countries' equity markets which are aggregated regionally. GARCH model is implemented and time span was chosen as January 2003-May 2009 and this period was split into two sub-periods as crisis and non-crisis with the help of breakpoint tests. They found no sign of contagion effect of the crisis but instead commented on what they found as spillover effects originating from the US. This study claimed that they clarify the difference between contagion and spillover effects.

J.-K. Hwang (2014) analyzed the diffusion of US subprime crisis in to four Latin American stock markets using daily returns from 2006 to 2010. The period was divided into three namely, before, during and after crisis. DCC-GARCH model (Engle, 2002) is employed in order to check for conditional correlations. As a result, evidence of financial

contagion during 2008 financial crisis is found. Additionally, the correlations during crisis was found significantly different from the pre-crisis and post-crisis periods.

Jin and An (2016), studied the extent of contagion effects between BRICS and US stock markets. Multivariate GARCH specification and volatility impulse response approach is utilized. They found positive result about the interdependency of BRICS and the US by their volatilities. Additionally, they claimed that the magnitude and dynamics of the effects of the crisis are largely market specific. That's to say economies like Brazil, which has more exposure to the US, tends to be deeply affected by the crisis.

#### **4.2.1. Co-Movement Studies in the Literature**

Co-movements of different international markets had reactions to crisis periods. When these movements have been strengthened by the crisis, contagion probability of the subjects is increasing between those actors.

Different methodologies have been used by different scholars, especially before Engle (2002) introduced dynamic conditional correlations method. While studying on the 1987 crash, Meric and Meric (1997) analyzed the changes in co-movements of selected European equity markets by using Box M and principal component analysis. They finalized their work by verifying the significant changes in co-movements right after the turmoil period. It is aimed to contribute to literature with a long-term analysis for the co-movements by using monthly returns data of national equity markets since the existing literature had this gap.

Similarly, other scholars studied the co-movements of stock markets after the crash but focused on shorter periods of time. The studies concluded that co-movements have been strengthened after the crisis period. Arshanapalli and Doukas (1993) covered Japanese and US market with European equity markets and they have used co-integration analysis to compare time-series linkages between the selected markets before and after the crisis. They could not find any link of Japanese market to both US and other European markets in the analysis while US market was found to have impact on European stock

markets in the post-crisis period. Lau and McInish (1993) have used Box's M statistics for the data of European, Asian, Australian and US markets and found evidence for the co-movements of international markets while Lee and Kim (1993) in the same year publicized their work of co-movements by using factor analysis. They included twelve major markets and found evidence of contagion in global stock markets after the crash of 1987 with the result showing that cross-market correlations increased for many emerging markets during the crisis.

Harkmann (2014) studied co-movements through the dynamics of stock markets during financial crisis of 2008, which later manifested in Europe's sovereign debt crisis. Stock market indices are used in order to check the integration of financial markets. The countries to be analyzed was chosen as Bulgaria, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland and Romania. DCC-GARCH method was applied in the analysis. It was found that the European sovereign debt crisis had tendency to increase the correlations among different stock markets which suggested some contagion.

Another study was held by Duncan and Kabundi (2014) about volatility co-movement in world equity markets between 1994 and 2008. Global volatility factors are extracted for 25 developed and 20 emerging stock markets. A dynamic factor model (FM) was estimated using two-year rolling-window regressions. The results were consistent with the claim of the co-movement of variances during financial crisis periods in Asia (1997-1998), Brazil (1999), Russia (1998) and the United States (2000, 2007-2008). Furthermore, developed markets were found to be more integrated with world volatility.

Stock market co-movements were also recently studied by Yarovaya and Lau (2016). In their paper, they focused on the negative shock on UK stock markets. They found evidence of contagion for South Africa, Brazil and Mexico by applying asymmetric causality tests. Besides, India, Indonesia, South Korea showed interconnectedness rather than contagion.

#### **4.2.2. Contagion/Spillover Studies in the Literature**

Beside the literature for financial contagion and co-movements after negative shocks, there is a mass literature about spillover effects of negative downturns. In fact, most of the studies uses contagion and spillover concept interchangeably. There was little study with clear definitive distinction between the two concepts.

After the global financial crisis has been experienced by the world economies, extraordinary actions were taken in order to save European and Euro-zone countries. Long-term sustainability of those economies has been shaken as a result of the debt crisis coming afterwards. Since there was a slowdown in economic activity because of the global crisis, debt crisis has had deeper effects for the Europe. International markets which are related to Euro-zone economies had fear of spillovers and seek for greater sovereign risk premium. Antonakakis and Vergos (2013) has covered a relatively long period of time to cover two major crises in their analysis of sovereign bond yield spread spillovers. The study has concentrated on Eurozone countries and VAR-based spillover index approach has been conducted for the empirical purposes. European debt crisis period has been chosen to analyze the spillover effects of sovereign bond yield spread exposures within the Eurozone within the turmoil years. Conclusion of bond yield spread spillover has been reached and Belgium has been found to be the dominant transmitter, while Greece, Portugal and Netherlands are the dominant receivers of spillovers.

Kavli and Kotze (2014) have investigated the spillover effects in exchange rate returns and volatility for developed and emerging market currencies. Time span was chosen from 1997 to 2011. Researchers deeply analyzed the volatility spillovers by creating their own spillover index referencing the study of Diebold and Yilmaz (2009). They found that exchange rate returns increased steadily while volatility reacted more strongly. Diebold and Yilmaz (2009) proposed a quantitative measure of financial market interdependence which they called spillover index. In their study, they analyzed global equity returns and volatilities and showed that spillovers were crucial, spillover intensity

is time-varying, and the nature of the time-variation is strikingly different for returns vs. volatilities.

In their study; Kim, Kim, and Lee (2015) examined the spillover effects of global crisis on five emerging Asian countries by using financial asset returns. Multivariate GARCH method was applied which tests for both conditional correlation coefficient and the effects of its determining factors over time. Some evidence of financial contagion was found around the collapse of Lehman Brothers but in fact, it was a short-term spillover. They concluded with a policy remark indicating that emerging Asian countries should construct a financial stabilization mechanism against contagions since the effect of a short-lived spillover might have serious long-term negative results.

The concerns of financial and economic crisis led many scholars to investigate BRICS economies because of their importance as five of the world's most important emerging economies with their fast growth performance. One of these studies is held by Mensi, Hammoudeh, Nguyen, and Kang (2016) with a comprehensive analysis of both volatility spillovers, detection of structural breaks and also assessing the portfolio risks by using daily data of spot market indices. They have verified the structural break of Lehman Brothers collapse for the global financial crisis. Interlinkages among the economies have also verified the recoupling hypothesis.

#### **4.3. EMPIRICAL STUDIES ON CONTAGION CHANNELS**

The crisis or turbulence times shed light into the contagion which lead us to find the causes and channels for this problem. This is a crucial object to identify while examining the cross-country effects of the crisis. Importance of the subject is mostly about the policy implications. If the existence of contagion is verified, then the objective is to find the channels which the contagion is spreading through one country to another. The policy answers depend on the nature of what drives contagion. The implications differ from trade linkages to financial linkages, per se. When the analysis supports the existence of trade linkage between the countries, then a country may change the trade base or fix its

exchange rate; while in case of financial linkages, a country may impose capital account regulations.

Many studies are conducted on the transmission channels of the historical crises while trying to explain the reasons for the contagion. Scholars mostly concentrated on two channels, namely trade channels and financial channels. Both direct and indirect linkages of transmission are possible, and both subjects have found a place in the existing literature. Trade channel can make competitive devaluations possible across countries, while financial channel can be effective via the sell-offs that aim to restore capital-adequacy ratios and margin calls, selling of good assets due to lack of liquidity, and excess specialization in fund management possible across countries (Hernández & Valdés, 2001).

Another transfer channel which finds a place in the literature is fundamental linkages. Since it is very hard to control all fundamental linkages among the countries, it is recommended to analyze the financial variables of the countries and the correlations between those variables. The rationale behind this method is that if a shock to one economy causes the correlation of financial variables to increase then the situation causes a structural break in the fundamental relationship between those countries (Gelos & Sahay, 2001).

Samarakoon (2011) has given information about two contagion types. The scholar defined the *fundamental-based contagion* as the transmission of shocks that are driven by real or financial linkages, while the co-movement which is not the result of fundamentals and attributable to factors, such as financial panic, herding behavior and loss of confidence can be defined as *irrational contagion*. The study verifies bi-directional interdependence and contagion between the US and emerging stock markets with the data of daily index returns for 62 stock markets for the 10 years period including the financial crisis.

Gelos and Sahay (2001) focused mainly on the transition economies' experiences of the financial crisis by analyzing the spillover patterns and tried to take some policy actions accordingly. Some information about the historical milestones of transition

economies have been given as a beginning to the analysis for examination of the history of financial market spillovers since 1993 in Central and Eastern European economies, Russia and the Baltics. Transmission channels of crisis are summarized as trade linkages, financial linkages and lastly global shocks which simultaneously affect many countries. Those linkages are highly correlated and hard to be distinguished from each other. In the study, direct trade linkages had low effect on the transmission of the crisis while indirect linkages showed more significant results. According to financial market linkages, stock market correlations showed increasing pattern inside the analyzed period verifying the increased financial market integration.

About the difficulties of distinguishing the trade and financial linkages Claessens, Tong, and Wei (2012) blame scholars to concentrate on the aggregate macro data instead of firm-level micro data. The spread of the crisis happens by a combination of financial and trade factors. Consumer and firm expectations change which then lead to consumption and investment levels to change correspondingly. Scholars gave examples of a change in capital flows and demand for exports which affects both corporate sector performance and investment levels. The solution for this problem is given as to analyze the firm-level micro data for the transmission channels. Using stock market data can be one method to understand the different firm-level effects related to firm characteristics. Three channels have been described, namely business cycle channel, trade channel and financial channel. It is found that the trade and business cycle channels were the most significant in firm-level contagion, while trade linkages were the most significant in country-level contagion.

Sen and Atlay (2012) concentrated on the analysis of southeastern European (SEE) countries while trying to find the reasons of contagion of recent financial crisis. Significant drops in the export capacities and foreign capital flows of SEE countries are evaluated as the main reason of economic tightening. Second reason is given as the turmoil in global credit markets which has affected SEE countries' financial facilities negatively. The openness to flows of foreign direct investment has been indicated as a major cause of the transmission of the effects of the crisis for the selected economies.

Fratzscher (2000) has reported about three contagion channels, namely trade competition, financial interdependence and herding behavior. First channel is among countries which are the sides of a bilateral trade or make business in a third market as competitors. Second channel is among countries, which are again competitors in a third market, but instead of trade, the economies compete for bank lending. Financial linkages have been examined as direct, in which the institutions have large cross-border holdings and indirect, in which a common lender decision is in effect. Third channel is about the shifts in investor beliefs which are exogenous from fundamentals and interdependences.

Another study that include the investor beliefs as one of contagion channels has been published by Caramazza et al. (2004). According to scholars, investors would want to reconsider their portfolio situation in a country which is in crisis. That's why, this factor can play a major role on contagion. Additionally, and similar to the other literature studies, three other channels have been discussed as common shocks, trade linkages and financial linkages. Common shocks may have effect on the countries' currencies worldwide. When a country's currency is affected from a shock, its fundamentals may also deteriorate which then leads to a simultaneous crisis. As a next phase of currency depreciation, trade spillovers could harm trade partners. Another side of the story is the financial linkages. Investors would like to reduce their assets of a country in the crisis and therefore avoid from the risks. Those capital outflows may even occur in a phase that the country's fundamentals are still in a good shape. The reason is the increased financial vulnerability.

Van Rijckeghem and Weder (2001) tried to explain contagion by verifying spillovers through bank lending in order to test whether financial linkages were superior to the trade linkages, or not. The focus was on the emerging markets in the period of Russian, Mexican, Thai and Asian crisis. The common bank lender effect has been used to investigate contagion. If there is a common bank lender effect, then bank exposures in countries which have been affected by the crisis are large. During crisis periods, banks' expected losses are becoming significant. This case shows the contagion to other countries. The empirical analysis provided evidence that common bank lenders were

transmission channels of Mexican, Thai and Russian crisis. Additionally, the study clarified the existing question about the superiority between trade and financial linkages during crisis by showing strong correlation between the two in Asian crisis.

Min and Hwang (2012) analyzed the transmission channels of the US financial crisis to stock markets of four OECD countries after answering the question of the existence of contagion from US to the selected OECD countries. In order to find the channels, DCCX-MGARCH methodology was proposed with the inclusion of four exogenous variables, namely the daily credit default swap spreads, TED spreads, the VIX index and the relative stock market capitalization. The results suggest that an increase in the VIX stock market index increases conditional correlations, hence indicating a positive relationship. Conversely, increases in the TED spread and the relative stock market capitalizations caused reduction in the conditional correlations of the selected countries with the US, hence indicating a negative relationship.

Dimitriou and Simos (2013) explored the contagion channels of subprime crisis for US, European Monetary Union (EMU), China and Japan. Multivariate GARCH methodology has been employed with daily data of each equity market covering 15 years' time period with financial crisis in between while conducting the analysis. The contagion has been verified by the empirical support and various transmission channels have been introduced for the studied model. Direct and indirect effects of the crisis have been stressed and concluded that China has been indirectly affected from the crisis through Japan while the US had no direct effect on China. On the contrary, Japan and EMU economies have been directly affected from the US. About the transmission of financial crisis, scholars have found that Japanese markets showed spillover effects with China and EMU which expose indirect volatility transmission channels of US subprime crisis.

Bekiros (2014) has conducted an empirical research for the analysis of volatility spillovers and transmission mechanisms during the financial crisis and Eurozone debt crisis periods. Multivariate GARCH methodology has been used for the data of emerging equity markets. It has been concluded that equity markets have become more integrated

after turmoil periods. The study investigated for the linear and non-linear causal linkages among the US and Eurozone and BRICS countries and verified the relationships. Contagion has been detected mostly via trade channels during post-crisis period. In general US, Chinese, and Indian equity markets may be interrelated through investment, trade and macroeconomic fundamentals, while the US, Russian and Brazilian stock markets may be linked through the energy demand.

Distinctly; Bekaert, Ehrmann, Fratzscher, and Mehl (2014) reported a wide-spanning analysis of crisis transmission channels. They included five contagion channels, such as international characteristics of banking sector linkages, trade and financial linkages as a reduction of asymmetric information, changes in investor attitude for financial vulnerability and lastly the herding behavior. The scholars analyzed the subject from a very wide point of view from implemented financial policies to availability of public information to investors which may cause increased correlations in the end.

Gündüz and Kaya (2014) concentrated on the Eurozone countries and studied the variation of sovereign credit default swaps in times of financial crisis. The researchers found one-sided causality from credit default swaps uncertainty to stock market volatility which was indicated as a transmission mechanism from sovereign risk to the real economy. Also, by the analysis of dynamic conditional correlations, a potential spillover effect has been studied and a long-lasting and persistent co-movement among the Eurozone economies has been observed.

Grant (2016) focused on the analysis of two main contagion channels of trade and finance. The author mentioned about the importance of the subject since the crisis had greater impact on the countries other than the originated economies given the fact that those economies, which were more remote from the crisis areas by distance, trade and financial ties, have recovered after the crisis while closer countries continued to fall further. The empirical findings in the study suggest that trade channel had positive but minimal effect on the contagion for both far and near countries, similar for financial

channel for far countries. On the contrary, financial transmission has been found as the primary channel for the contagion to near countries.

Kang and Yoon (2018) examined the role of sovereign credit default swaps as a hedge against or safe heaven under crisis conditions. Bi-variate DCC-GARCH methodology is utilized in order to analyze the daily CDS and the Asian Morgan Stanley Capital Index (MSCI) data for four Asian stock markets spanning from 2002 to 2014. According to the findings, CDSs showed both strong and weak safe heaven characteristics during periods of high stock volatility. This characteristic depended on the individual stock markets and revealed different results among four countries. Additionally, during global financial crisis and European debt crisis, hedge and safe heaven role of CDSs increased.

## **CHAPTER FIVE**

### **5. EMPIRICAL APPROACH ON CONTAGIOUS EFFECT OF GFC ON SELECTED EUROPEAN ECONOMIES**

This chapter is an attempt to identify the existence of financial crisis contagion from United States stock market to seven European stock markets. Existing European studies mostly concentrated on central European economies with similar structure and economical basis. With the help of this study, it is aimed to cover European economies which have been seriously affected from the financial crisis and with distinct development levels and individual financial and economic infrastructures.

With the light of the existing literature about the contagion of financial crises on different geographical areas, it is aimed to verify the thesis that claims, “US financial crisis had contagious effects on European economies with a bound of stock markets.”. In order to test for the existence of contagion from the US to Europe, Dynamic Conditional Correlation-Generalized Auto Regressive Conditional Heteroscedasticity (DCC-GARCH) methodology is chosen as the technique to be applied. Stata statistical package has been utilized in the analysis.

#### **5.1. DATA SELECTION**

Co-movements are investigated with the help of dynamics of stock market indices. The use of stock indices as a measure of market co-integration is in line with the studies in the literature (Morales and Andreosso-O'Callaghan (2014), Syllignakis and Kouretas (2011) and J. K. Hwang (2014)). The data utilized in this paper involves a small selected group of advanced European countries' equity markets; a total of seven European markets accompanied with United States. The dataset consisted of stock indices of United States, United Kingdom, Germany, France, Italy, Spain, Portugal and Greece. S&P 500 Indices is selected to represent US equity market whereas CAC 40 – price index has been used for France, DAX 30 – price index for Germany, Athex – price index for Greece, FTSE MIB – price index for Italy, IBEX 35 – price index for Spain, PSI 20 – price index has

been used for Portugal and FTSE 100 – price index for United Kingdom (Source: Thomson Reuters Datastream). All stock market indices are used in US dollar terms and based on the daily closing prices and all are transformed into daily returns by taking the first difference of the natural logarithm of each index.<sup>6</sup>

In the high frequency time series data, unit root is a predictable behavior of the variances since the volatility is expected to be high and persistent. Augmented Dickey Fuller unit root test is implemented to check for stationarity of the data both in levels and first differences. The results for the unit root test are reported in Table 5.1. The null hypothesis indicates that the series are stationary while the null hypothesis is rejected at levels indicating the existence of unit root. However, the null hypothesis of unit root is rejected in the first differences.

Stock Markets	Level		Differenced (Returns)	
	Test Statistics	P-Value	Test Statistics	P-Value
<b>France</b>	-2.202	0.2026	-64.663	0.0000
<b>Germany</b>	-0.417	0.9073	-63.755	0.0000
<b>Greece</b>	-0.512	0.8896	-58.562	0.0000
<b>Italy</b>	-1.425	0.5703	-64.119	0.0000
<b>Spain</b>	-1.992	0.2901	-62.096	0.0000
<b>Portugal</b>	-0.968	0.7648	-57.693	0.0000
<b>United Kingdom</b>	-1.789	0.3857	-65.421	0.0000

*Note: Critical values for unit root test are -3.43 and -2.86 respectively at 1% and 5% levels.*

**Table 5.1 : Unit Root Test for the Stationarity of the Data**

Stock price series exhibit non-stationarity as most of the financial time series. Daily returns are calculated by taking the first difference of the natural logarithm of each stock-price index. This operation has produced a stationary process.

<sup>6</sup> The formula used in order to calculate the daily returns is :  $r_{i,t} = ( \ln(p_{i,t}) - \ln(p_{i,t-1}) ) \times 100$

## 5.2. THE ANALYSIS OF DESCRIPTIVE STATISTICS

In order to fully analyze the data, summary statistics of stock index returns data for the seven European economies, as well as the United States stock index returns are presented in Table 5.2. Thus, Table 5.2 exhibits the descriptive statistics on daily stock returns for all investigated countries.

The data sample covers daily returns from January 2002, through December 2016. Starting date for the analysis is chosen as the beginning of 2002 since that year has been a milestone date for the European economies as the euro has been declared as the common currency. The full time period under analysis contains wide time span possible in order to reach more accurate results.

Beside the full data, three additional periods have been identified as the pre-crisis, crisis and post-crisis periods. The descriptive models are constructed in accordance with the defined sub-samples. The pre-crisis period covers January 2002, through September 6, 2008. The crisis period is decided as from the failure of Fannie Mae and Freddie Mac (September 7, 2008) through the end of March, 2009 - the first repayment of Troubled Asset Relief Program (J. K. Hwang, 2014). Lastly, the post-crisis period covers April 2009 through December 2016.<sup>7</sup>

For simplicity, basic information about mean, standard deviation, skewness/kurtosis and Jarque-Bera normality test are reported in the table while Ljung-Box Q-Statistics and ARCH-Lagrange Multiplier (LM) tests have additionally been implemented during the analysis of serial correlation and appropriateness of GARCH parametrization.

All of the seven European stock markets except France and Italy have positive daily stock returns during the pre-crisis period. The ranging of mean stock returns differs from -0.0091 for Italy to 0.0162 for Spain. Standard deviations of stock market returns

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<sup>7</sup> The dates are partly inspired from the work of J. K. Hwang (2014) about Latin American economies while it has been updated according to European sample.

range from 0.8669 for Portugal to 1.4937 for Germany. Sharpe ratio ranking which shows the highest risk-return rate in pre-crisis period is Spain, Greece and Germany (first three highest scores).

Mean stock returns become all negative in the crisis period ranging from -0.424 for Greece (lowest mean return in the crisis period as expected) to -0.196 for United Kingdom (the least deteriorated mean return in the crisis period as expected from a developed stock market). The negative mean returns are associated to the increasing risk in the crisis period. Similar results are obtained from the standard deviation figures. In crisis period all standard deviations show an increasing pattern compared to all other periods. The figures ranges from 2.397 for Portugal to 3.4992 for US which is the originating country for the financial crisis. Among the European economies the highest standard deviation for stock returns belongs to Italy (3.262). Daily stock return averages for the post-crisis period are higher than the mean returns of all other periods for most of the countries. The exceptions are Greece and Portugal which have faced with prolonged difficulties after the crisis, thus had negative mean returns in the post-crisis period. Another exception is Spain which has higher mean return in pre-crisis period. All other economies have shown signs of a recovery in their stock markets. Similarly, standard deviations of European stock markets become lower in the recovery period without exception. However, Greek stock market does not show a remarkable evolution in standard deviation figures.

The Jarque-Bera (JB) test statistics is calculated by using skewness and kurtosis values and helps the researcher to evaluate the normality of the data. The null hypothesis of JB test is that the data is normally distributed. Table 5.2 reports about the normality of the stock returns by reporting skewness, kurtosis values as well as the JB statistics. JB test rejects the null hypothesis of normality with zero skewness and a fixed peak of three.

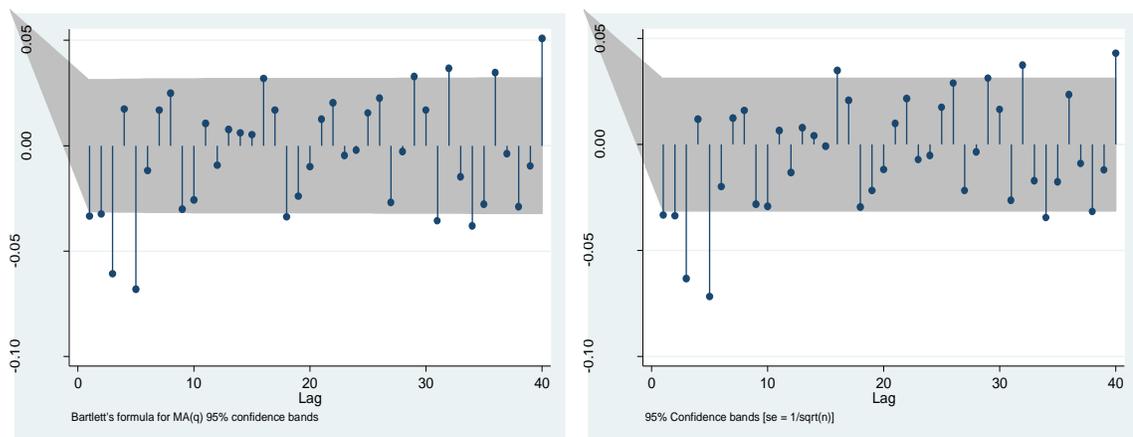
The tendency of high frequency financial data is to show fat-tailed distribution which is represented by a kurtosis value more than three. This situation with thick tails is

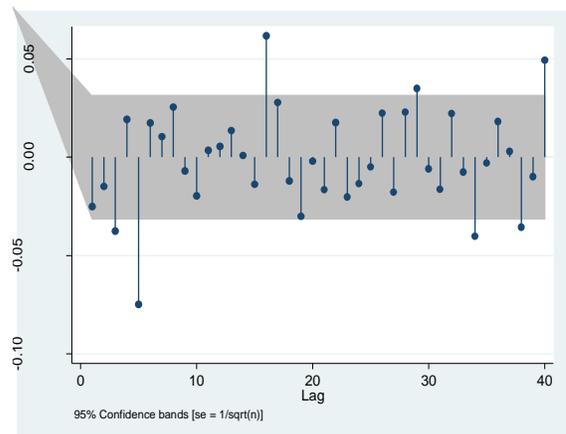
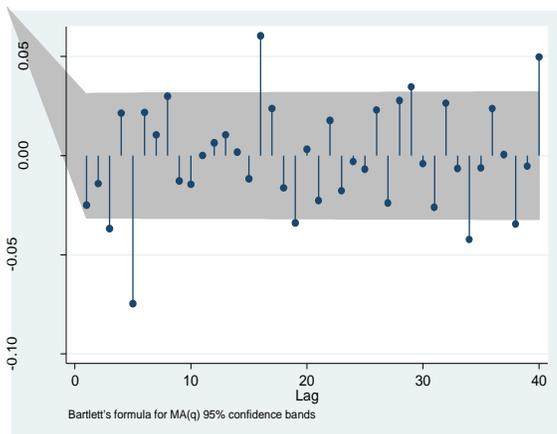
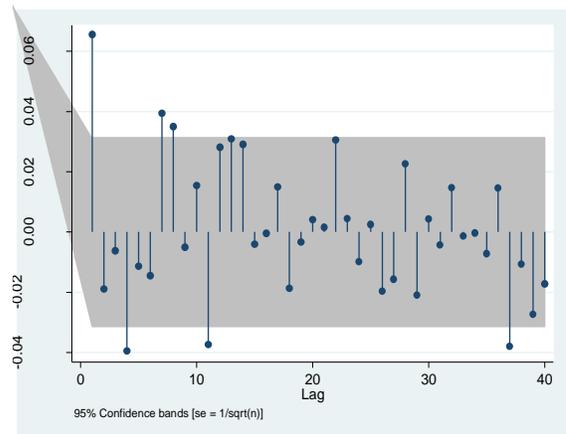
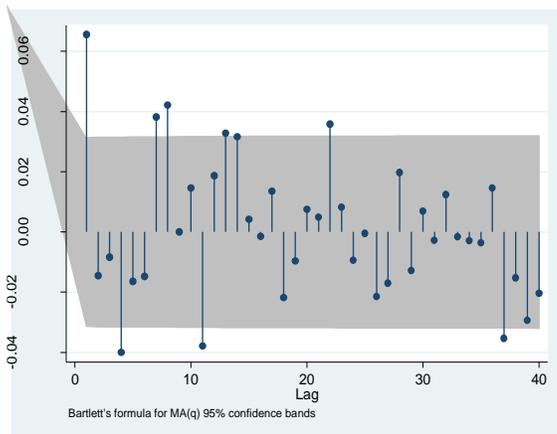
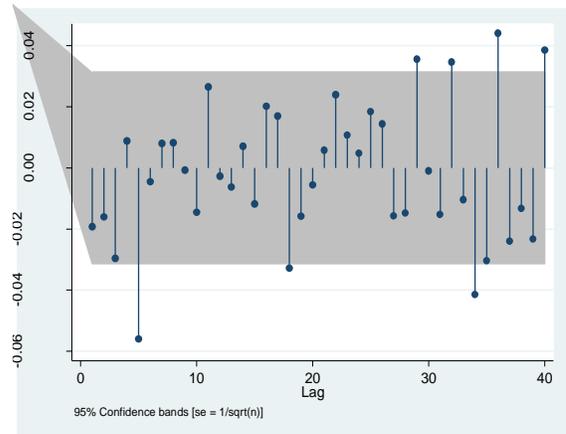
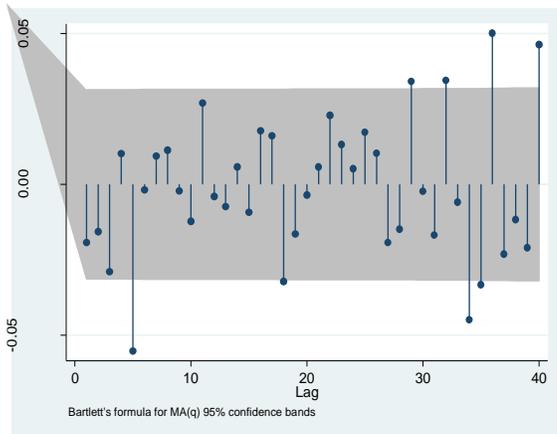
	France	Germany	Greece	Italy	Portugal	Spain	United Kingdom	United States
<b>MODEL A – Full Sample Period (January 01, 2002 – December 30, 2016)</b>								
<b>Mean</b>	0.0013	0.0204	-0.0356	-0.0132	-0.0131	0.0027	0.0080	0.0171
<b>Std. Dev.</b>	1.4675	1.4960	1.8767	1.5522	1.2028	1.4875	1.1916	1.2045
<b>Skewness</b>	-0.0033	-0.0053	-0.3705	-0.2054	-0.2681	-0.0830	-0.1369	-0.2279
<b>Kurtosis</b>	8.4039	7.8034	10.2673	8.2968	9.7067	9.7677	10.0980	12.9509
<b>Jarque-Bera</b>	4762.546	3762.733	8702.709	4603.054	7382.309	7474.003	8228.625	16182.73
<b>Probability</b>	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.000	0.000
<b>Observations</b>	3914	3914	3914	3914	3914	3914	3914	3914
<b>MODEL B – Pre-Crisis Sample Period (January 01, 2002 – September 06, 2008)</b>								
<b>Mean</b>	-0.0056	0.0098	0.0111	-0.0091	0.0037	0.0162	0.0002	0.0045
<b>Std. Dev.</b>	1.3552	1.4937	1.1407	1.1266	0.8669	1.2241	1.1661	1.0334
<b>Skewness</b>	-0.0553	-0.0667	-0.1276	-0.1314	-0.6307	-0.0984	-0.1850	0.1040
<b>Kurtosis</b>	6.8192	6.7428	6.3375	5.8914	7.3559	6.6674	6.8985	5.6119
<b>Jarque-Bera</b>	1060.845	1019.258	814.1604	612.5418	1494.388	980.1673	1114.357	498.8806
<b>Probability</b>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
<b>Observations</b>	1744	1744	1744	1744	1744	1744	1744	1744
<b>MODEL C – Crisis Sample Period (September 07, 2008 – March 31, 2009)</b>								
<b>Mean</b>	-0.273	-0.276	-0.424	-0.375	-0.206	-0.241	-0.196	-0.3012
<b>Std. Dev.</b>	3.212	3.072	2.871	3.262	2.397	3.027	2.966	3.4992
<b>Skewness</b>	0.403	0.567	-0.181	0.367	0.158	0.274	0.142	0.0962
<b>Kurtosis</b>	4.643	5.102	4.491	4.165	7.243	4.585	4.476	3.7538
<b>Jarque-Bera</b>	20.513	34.937	14.418	11.623	110.9	17.222	13.837	3.707
<b>Probability</b>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.1567
<b>Observations</b>	147	147	147	147	147	147	147	147
<b>MODEL D – Post Crisis Sample Period (April 01, 2009 – December 30, 2016)</b>								
<b>Mean</b>	0.0271	0.0511	-0.0475	0.0095	-0.0137	0.0089	0.0296	0.051
<b>Std. Dev.</b>	1.3538	1.3112	2.2552	1.6703	1.3169	1.5245	1.0177	0.9972
<b>Skewness</b>	-0.1442	-0.2284	-0.309	-0.3453	-0.2171	-0.1494	-0.1368	-0.3896
<b>Kurtosis</b>	6.2156	5.1509	8.2812	6.6894	6.199	9.6937	5.0404	6.8368
<b>Jarque-Bera</b>	878.6164	407.566	2383.215	1187.579	878.4817	3784.219	357.2262	1292.035
<b>Probability</b>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
<b>Observations</b>	2023	2023	2023	2023	2023	2023	2023	2023

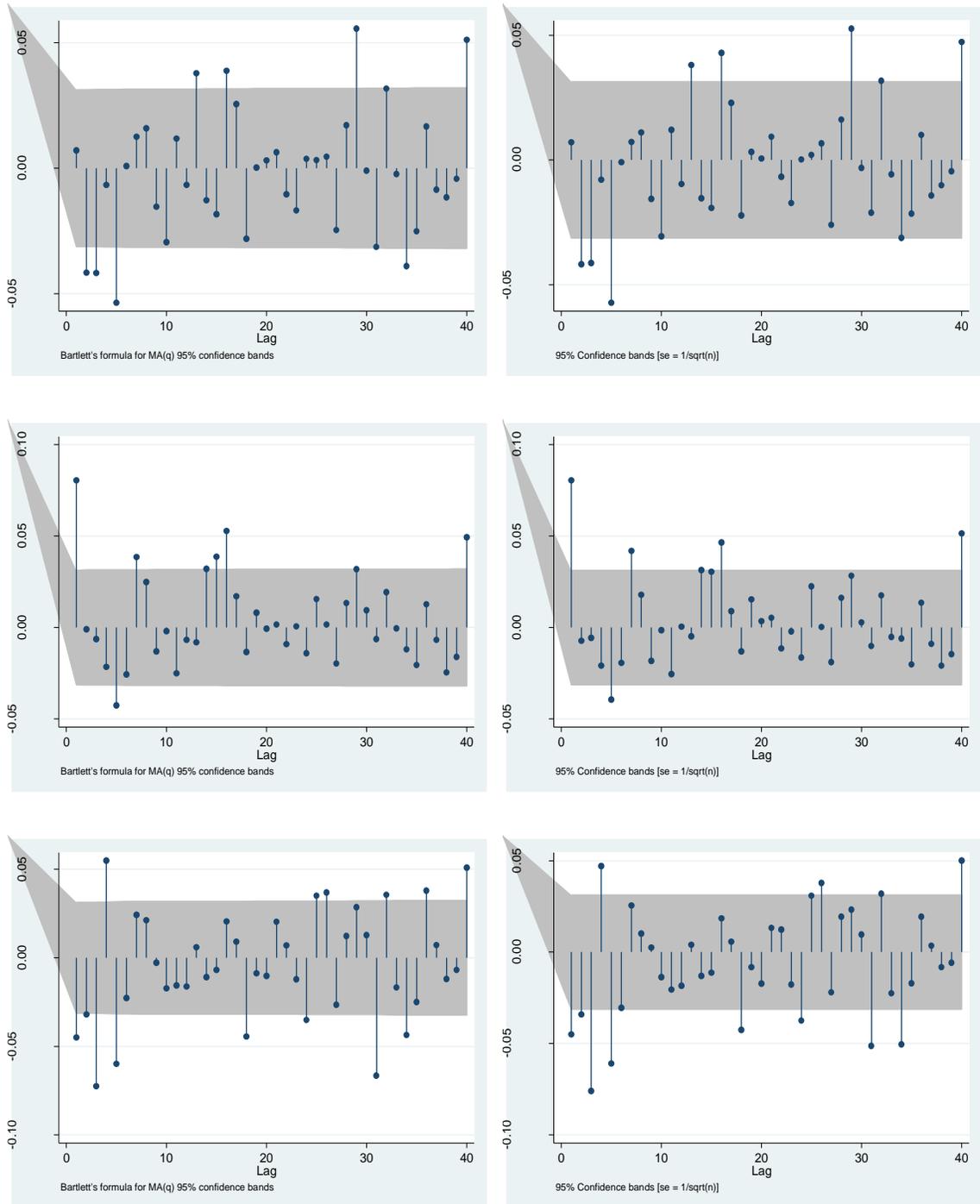
**Table 5.2 : Descriptive Statistics on Daily Stock Returns**

leptokurtic. Specifically, kurtosis coefficient of stock return data shows fat tails (leptokurtic) for all countries and in all the periods. The high values of kurtosis suggest the existence of big shocks, either positive or negative signs or the series of stock returns do not seem to be normally distributed. Again, non-normality is expected in high frequency time series. The results depicted from the descriptive statistics confirm the fact that daily returns data are not normally distributed but are leptokurtic and skewed.

Serial correlation in financial return series has been controlled with the use of partial autocorrelogram and autocorrelogram while checking for Ljung-Box Q statistics for the null hypothesis of no autocorrelation. Figure 5.1 plots the partial autocorrelogram and autocorrelogram with 40 lags of selected stock market returns and the upper bound of 95% Bartlett's confidence interval. The null hypothesis for the confidence interval indicates no autocorrelation. However, for all the stock market returns, Ljung-Box Q test statistics resulted with probability of 0.0000 which leads us to reject the null hypothesis of no serial correlation in the stock index squared returns for all the stock indices in the whole sample period.







**Figure 5.1 : Autocorrelations and Partial Autocorrelations for Stock Market Returns**

The pair-wise correlations among the stock returns is presented in Table 5.3. According to the table, Italian and French stock markets show highest correlation in pre-crisis period with a degree of 0.9102, while in the crisis period, United Kingdom and French stock markets were highly correlated with a degree of 0.9559. On the other hand, Greek and US stock markets show lowest correlations (0.2219 in pre-crisis period, 0.4143 in crisis period and 0.2689 in post-crisis period). In the post-crisis period, the most correlated stock markets turned out to be French and German. Additionally, the US, which is the source country for the crisis, has the lowest correlation with Greece and highest correlation with Germany in specific in the crisis period.

As it is expected and also confirmed with other studies (J. K. Hwang (2014) and Syllignakis and Kouretas (2011)), the correlations are likely to increase in crisis times which are highly volatile. The most dramatic increase in the correlations happen among the US and Greece (the correlation for pre-crisis period is 0.2219 and the correlation for the crisis period is 0.4143) and the US and Portugal (the correlation for pre-crisis period is 0.2885 and the correlation for the crisis period is 0.4740). In short, correlation coefficients during the financial crisis tends to increase as it confirms the literature. Nevertheless, the correlation analysis shows the importance of heteroscedasticity bias in testing the correlation changes.

Further analysis with Granger causality tests is made in order to prove the direction of volatility transmission among the countries. Table 5.4 shows the Granger Causality test result for the European stock markets during the financial crisis period. It can be depicted from the table that all European stock markets received volatility spillover from the US stock market during the crisis period. However, the volatility transmission is unidirectional. The US did not receive any volatility transmission from the other stock markets. Only the significant results have been reported in the table. Thus, European stock markets did not granger cause each other but they have been only affected by the US. This situation justifies the US as the factor in the European stock market declines.

	France	Germany	Greece	Italy	Portugal	Spain	U.K.	U.S.
<b>MODEL A – Full Sample Period</b>								
<b>France</b>	1							
<b>Germany</b>	.9378	1						
<b>Greece</b>	.4135	.3937	1					
<b>Italy</b>	.8932	.8462	.4240	1				
<b>Portugal</b>	.7553	.7074	.4331	.7619	1			
<b>Spain</b>	.8742	.8082	.4277	.8893	.7729	1		
<b>U.K.</b>	.8829	.8523	.3531	.7785	.6851	.7579	1	
<b>U.S.</b>	.6623	.6499	.2689	.6041	.5050	.5840	.6416	1
<b>MODEL B – Pre-Crisis Sample Period</b>								
<b>France</b>	1							
<b>Germany</b>	.8783	1						
<b>Greece</b>	.5204	.4727	1					
<b>Italy</b>	.9102	.8509	.4970	1				
<b>Portugal</b>	.5995	.5466	.4766	.5778	1			
<b>Spain</b>	.8852	.8111	.5097	.8599	.6331	1		
<b>U.K.</b>	.8857	.7755	.5123	.8365	.5865	.8202	1	
<b>U.S.</b>	.5134	.5813	.2219	.5078	.2885	.4647	.4575	1
<b>MODEL C – Crisis Sample Period</b>								
<b>France</b>	1							
<b>Germany</b>	.9018	1						
<b>Greece</b>	.7064	.6615	1					
<b>Italy</b>	.9370	.8391	.7141	1				
<b>Portugal</b>	.8473	.7443	.7446	.8275	1			
<b>Spain</b>	.9444	.8413	.7209	.9268	.8357	1		
<b>U.K.</b>	.9559	.8813	.7134	.9002	.8447	.9124	1	
<b>U.S.</b>	.5905	.6719	.4143	.5362	.4740	.5931	.5775	1
<b>MODEL D – Post Crisis Sample Period</b>								
<b>France</b>	1							
<b>Germany</b>	.9378	1						
<b>Greece</b>	.4135	.3937	1					
<b>Italy</b>	.8932	.8462	.4240	1				
<b>Portugal</b>	.7553	.7074	.4331	.7619	1			
<b>Spain</b>	.8742	.8082	.4277	.8893	.7729	1		
<b>U.K.</b>	.8829	.8523	.3531	.7785	.6851	.7579	1	
<b>U.S.</b>	.6623	.6499	.2689	.6041	.5050	.5840	.6416	1

**Table 5.3 : Unconditional Pair-Wise Correlation Matrix**

<b>Null Hypothesis:</b>	<b>Obs.</b>	<b>F-Stat.</b>	<b>Prob.</b>
RE_US does not Granger Cause RE_FRANCE RE_FRANCE does not Granger Cause RE_US	147	22.6084 1.27041	3.00E-09 0.2839
RE_US does not Granger Cause RE_GERMANY RE_GERMANY does not Granger Cause RE_US	147	8.49933 1.36759	0.0003 0.2581
RE_US does not Granger Cause RE_GREECE RE_GREECE does not Granger Cause RE_US	147	7.39122 1.39331	0.0009 0.2516
RE_US does not Granger Cause RE_ITALY RE_ITALY does not Granger Cause RE_US	147	15.9081 2.43117	6.00E-07 0.0916
RE_US does not Granger Cause RE_PORTUGAL RE_PORTUGAL does not Granger Cause RE_US	147	14.2877 0.69431	2.00E-06 0.5011
RE_US does not Granger Cause RE_SPAIN RE_SPAIN does not Granger Cause RE_US	147	15.1993 1.58413	1.00E-06 0.2087
RE_US does not Granger Cause RE_UK RE_UK does not Granger Cause RE_US	147	18.0546 1.19627	1.00E-07 0.3053

**Note:** RE\_US refers to daily return on the United States stock market, RE\_UK refers to daily return on the United Kingdom stock market, vs.

#### **Table 5.4 : Granger Causality Test Results**

All the mentioned characteristics of stock indices return series data recommends that a good model for return series should capture both serial correlation, time-varying variance, persistency, skewness and thick-tails. This situation suggests that GARCH parameterization might be appropriate for the conditional variance process. The next section will attempt to capture these characteristics of a dynamic time series data with multivariate dynamic conditional correlation GARCH model.

### **5.3. GARCH MODEL SPECIFICATION**

Increasing amounts of literature studies have proved a correlation between volatilities which has been shown by variances over the time series datasets. Volatilities

have displayed a contagious characteristic in crisis periods. This contagiousness means that volatility in one market is not only affected by its past volatility, but also the other markets' volatilities (Yang & Song, 2017).

Various methodologies have been implemented while studying the contagion subject in the literature such as correlation analysis, BEKK modelling, VAR analysis, regression analysis, factor model and co-integration model, etc. In order to capture the response of dynamic correlations among asset returns to the shocks, DCC-GARCH model (Engle, 2002) is employed. The study comprises the time-varying conditional correlations among selected European stock market returns. The DCC-GARCH model is useful in examining the possible spillover effects in stock markets during a financial crisis with the help of dynamic conditional correlations. Stock returns have the autoregressive and heteroscedasticity characteristics. That is one reason of superiority for using ARCH and GARCH models to estimate the volatilities of portfolio returns.

### **5.3.1. Advantages of GARCH Modelling**

In fact, many methodologies have been used in the literature to explain spillover or contagion effects of one domestic crisis on other economies, hence the global effect of a domestic shock. In Table 5.4, Seth and Sighania (2017) summarized the studies using different methodologies in their literature review work on the financial market contagion. As it can be depicted from the numbers, even there were many other methodologies used to explain the contagion problem in financial markets, the majority of the studies took advantage of DCC and GARCH modellings. This is not a coincidence indeed. DCC-GARCH estimation has many advantages over the other estimation methods. Three important advantages are worth to mention.

Financial time series data show features of heteroscedasticity and volatility clustering. These two features of the series have been a motivation for the ARCH models to be applied. Firstly, DCC-GARCH methodology estimates correlation coefficients of the standardized residuals. This is important that the model can handle the

<b>Methodology Used</b>	<b>No. of Times Used</b>
DCC	26
GARCH (Univariate or Bivariate)	26
Correlation	22
Regression Analysis	13
Causality Test	10
Vector Autoregression (VAR) Analysis	10
Factor Model	7
BEKK-GARCH	6
Johansen Cointegration	6
Impulse Response	6
Regime Switching Model	5
Variance Decomposition Model	5
Latent Factor Model	5
Vector Error Correction Model	2
Other*	25

\*Other: Parameter Stability Model, CAPM, Flight-to-quality, wavelet analysis, OLS, Co-skewness, Co-kurtosis, etc.

Note: Table is gathered from *Seth and Sighania (2016) Financial market contagion: selective review of reviews. Qualitative Research in Financial Markets*

### **Table 5.5 : Methodologies Used in Financial Market Contagion Studies**

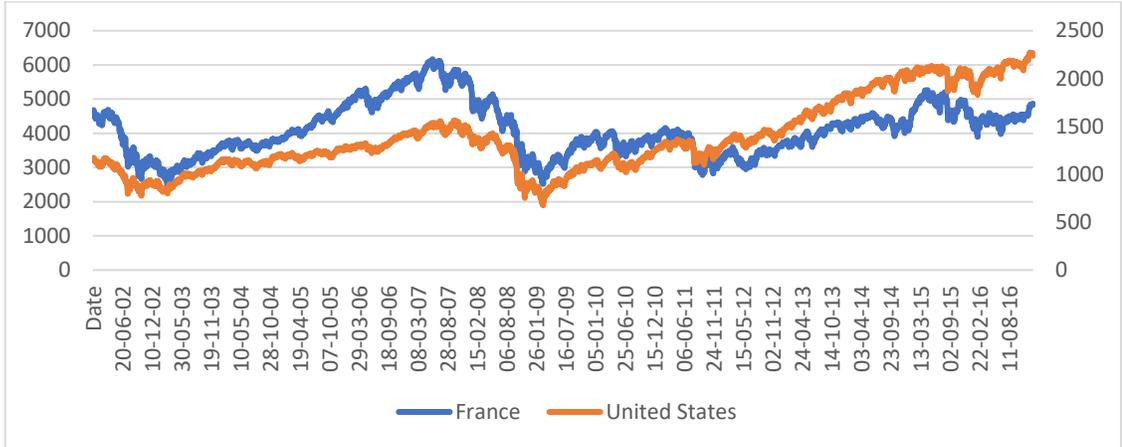
heteroscedasticity problem in a direct way. Correlation models also have big portion in the overall studies but DCC-GARCH methodologies have advantage over the correlation analysis since correlation models suffer from heteroscedasticity. The residuals are standardized, and the estimations are made for correlation coefficients of those standardized residuals. Therefore, the DCC-GARCH methodology solves the heteroscedasticity problem directly in the modelling process.

Secondly, there may be need for large number of parameters in ARCH modelling which violates the parsimoniousness principle. When more variables added in the variance equation, some of them may have negative estimated value which is not desirable and violating non-negativity constraints. GARCH model can be benefited to analyze multiple factors without adding too many parameters. This characteristic shows the parsimoniousness of the multivariate GARCH in parameter setting. The analysts can estimate up to 45 pair-wise correlation coefficient series in a single representation and they do not have to add too many parameters in the model setting. Lastly, the DCC-GARCH model permits to include additional explanatory variables in the mean equation to measure a common factor.

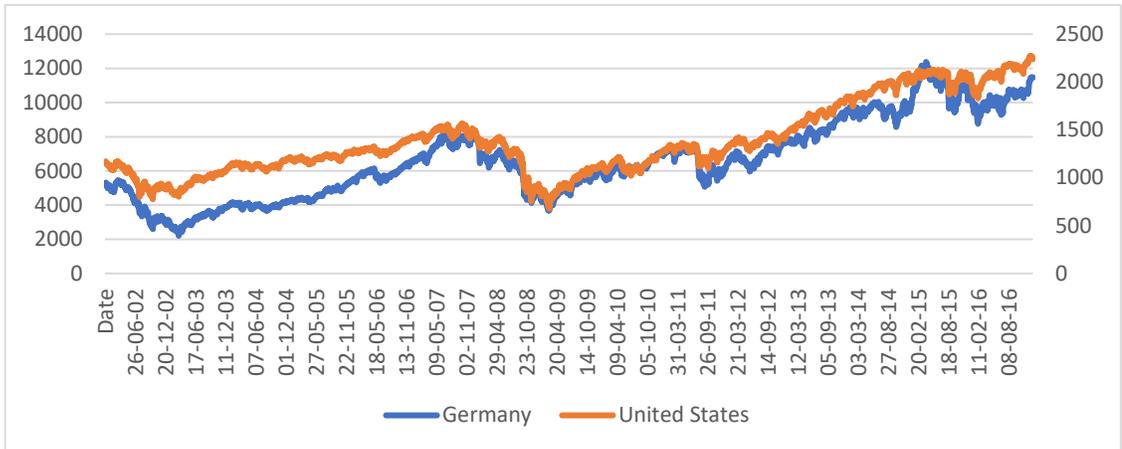
### **5.3.2. The Analysis of the Data Series**

GARCH (1,1) is the simplest and most robust form of the volatility models and it is sufficient to capture the volatility clustering in the financial time series data (Epaphra, 2016). ARCH and GARCH model specifications demand some prerequisites such as clustering volatility in the data and ARCH effect in the residuals. In order to analyze the movement in the indices inside the selected period closely and to check for clustering volatility in the data, stock indices of selected stock markets have been plotted in Figure 5.2 through Figure 5.8. Each stock market is projected to the accompaniment with the United States indices. Additionally, Figure 5.9 through Figure 5.15 plot the stock market returns for each European country in an attempt to analyze the volatility in the datasets.

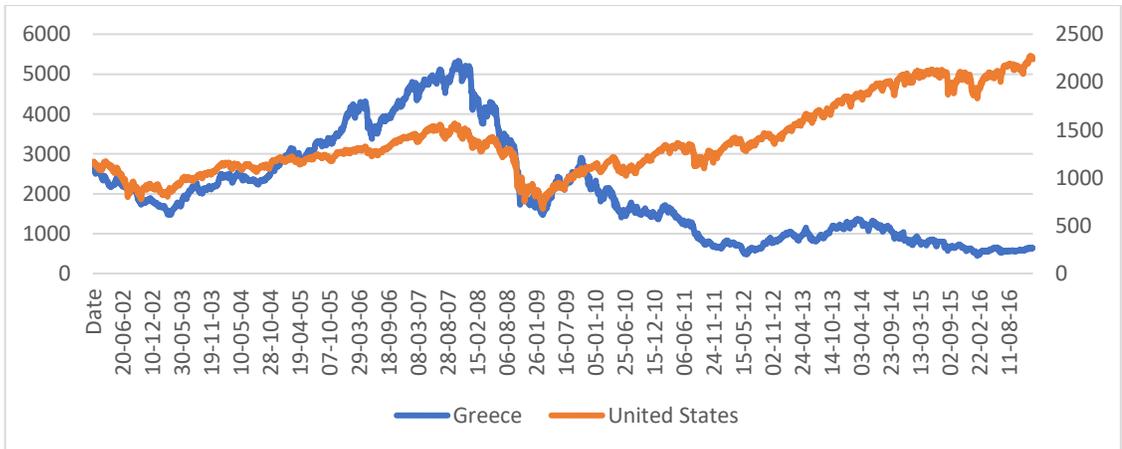
According to these plots, it can be concluded that all stock market indices show growth until the crisis time and they hit hard in the global financial crisis. Beside similar movement of stock returns in the crisis period, post-crisis period reveals different outcomes for countries such as Greece, Portugal, Spain and Italy. From the plots, it can be concluded that European debt crisis in the late 2009 has also been effective in the recovery process of these mentioned economies. After 2008 financial crisis, all the countries experienced a rise while the rise of the indices has been slowed down for these countries. Greece is considered as the leading source of contagion in European debt crisis



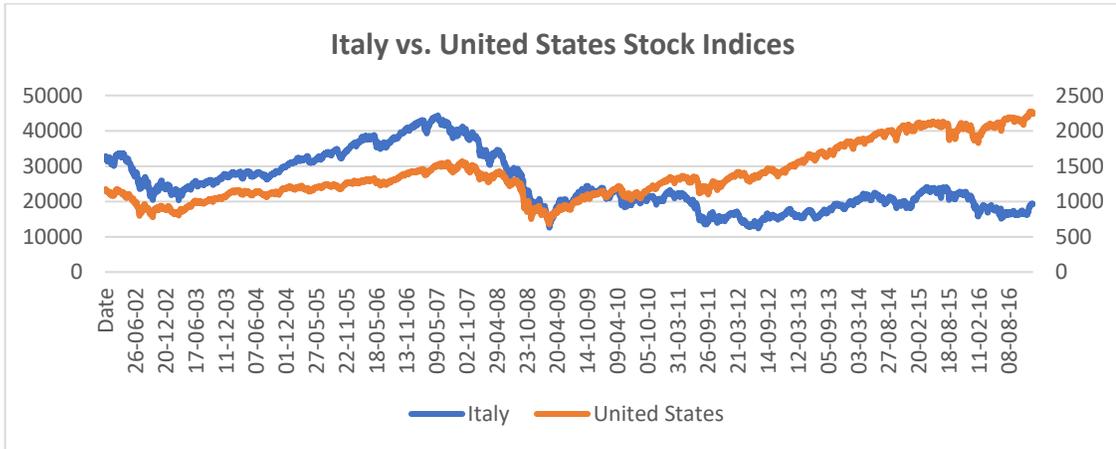
**Figure 5.2 : Stock Indices of France vs. US Market**



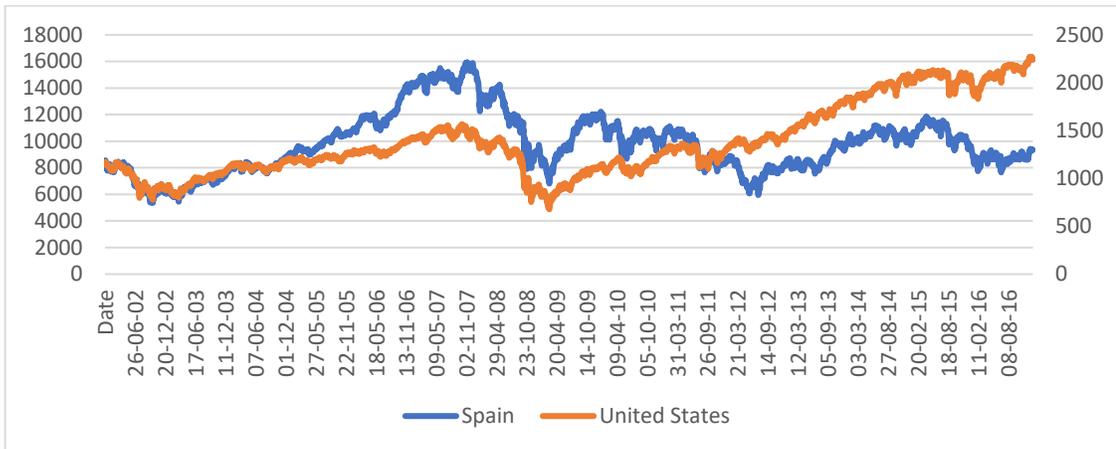
**Figure 5.3: Stock Indices of Germany vs. US Market**



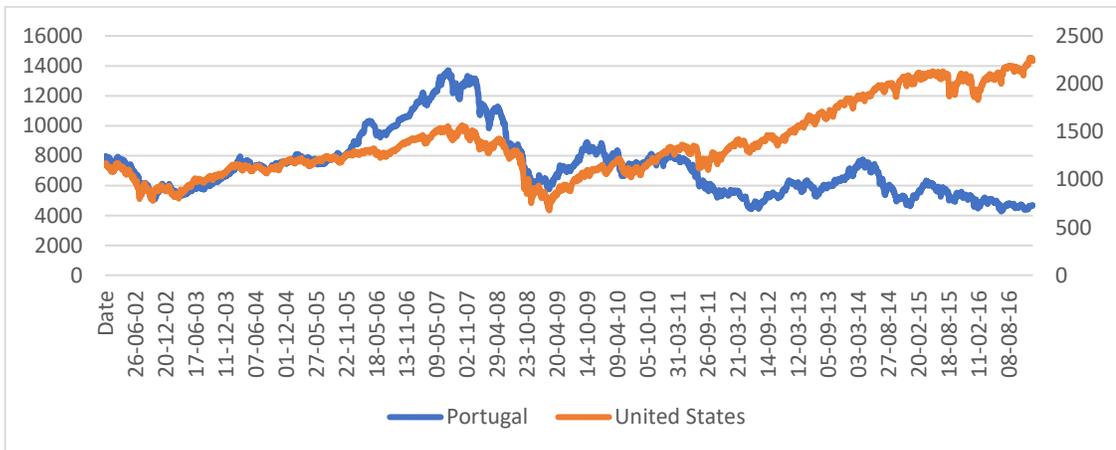
**Figure 5.4 : Stock Indices of Greece vs. US Market**



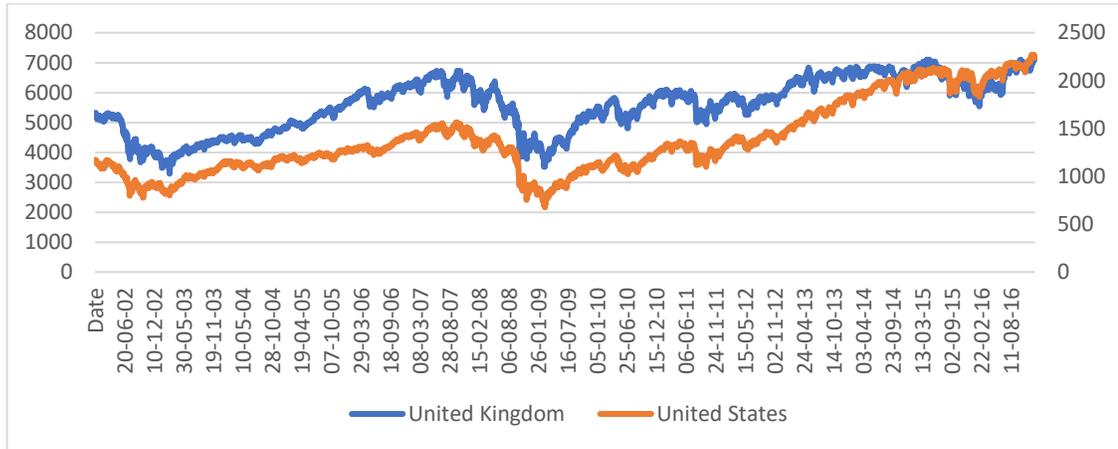
**Figure 5.5 : Stock Indices of Italy vs. US Market**



**Figure 5.6 : Stock Indices of Spain vs. US Market**



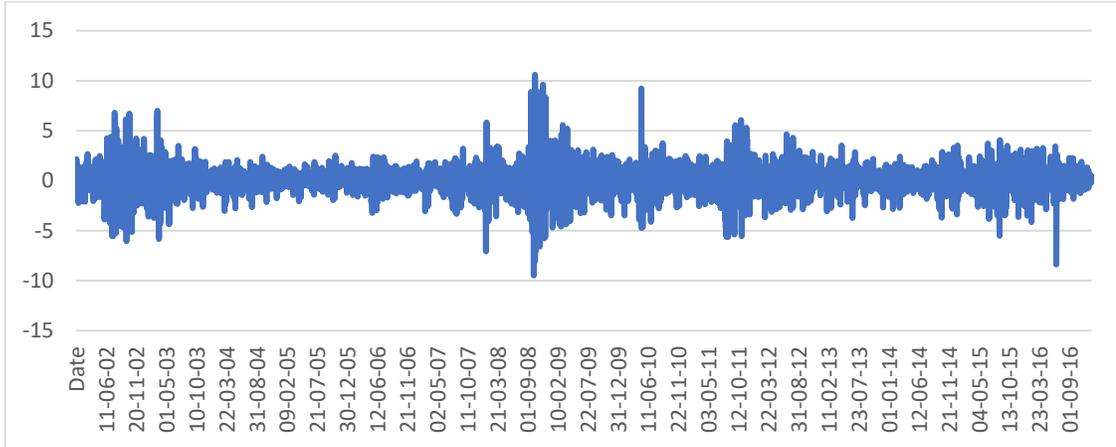
**Figure 5.7 : Stock Indices of Portugal vs. US Market**



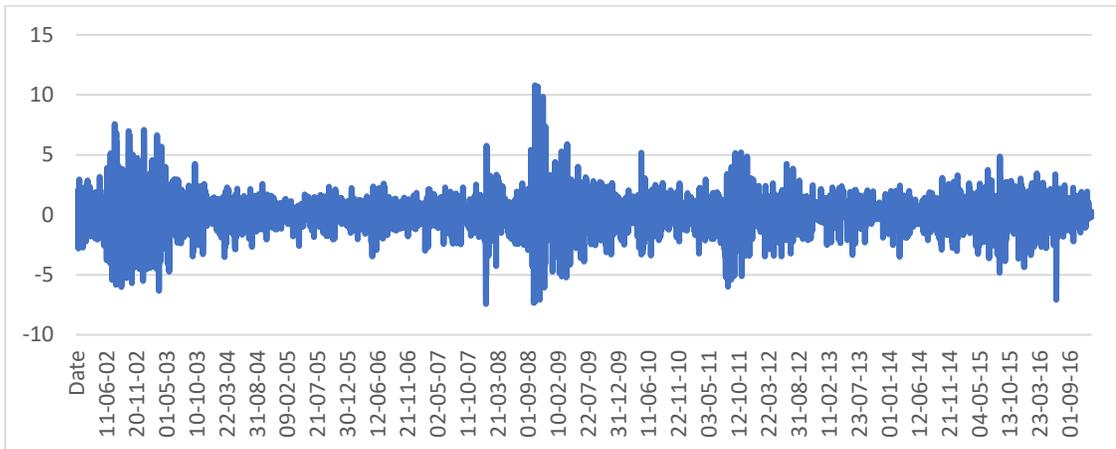
**Figure 5.8 : Stock Indices of UK vs. US Market**

(Arghyrou & Kontonikas, 2012). It is followed up by Portugal and Spain which asked for international support (Bernal, Gnabo, & Guilmin, 2016). Among all countries under observation, only Germany has fully recovered by exceeding its pre-crisis point of stock indices.

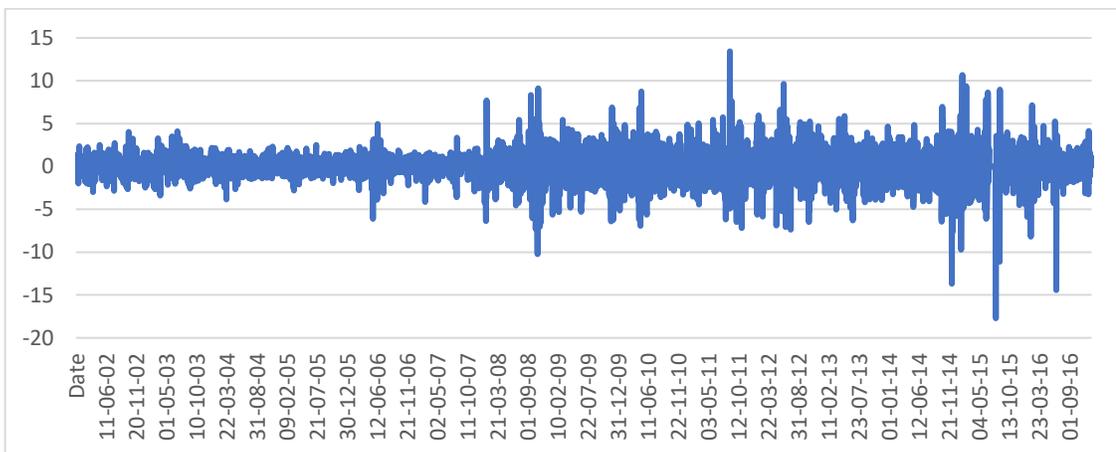
Figure 5.9 – 5.15 plots the daily stock returns for each observed country to picture the situation easily. Daily returns, which are calculated by taking the first difference of the natural logarithm of each index, show high volatility in times of financial crisis. The volatility of all stock markets increased significantly by the crisis period. Greek stock market shows the highest volatility with a standard deviation of 1.8767 while United Kingdom stock market shows the lowest volatility with a standard deviation of 1.1916 within the whole period. Furthermore, it can be depicted from the figures that, while some economies became more stable after 2008 financial crisis (such as UK); some are still struggling with high volatilities for a prolonged period of time (like Greece).



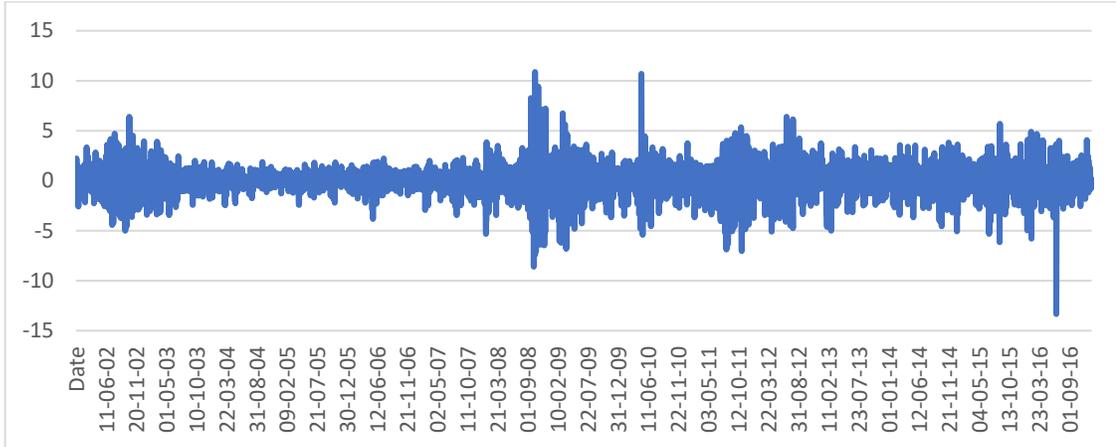
**Figure 5.9 : Daily Stock Returns – Stock Market of France**



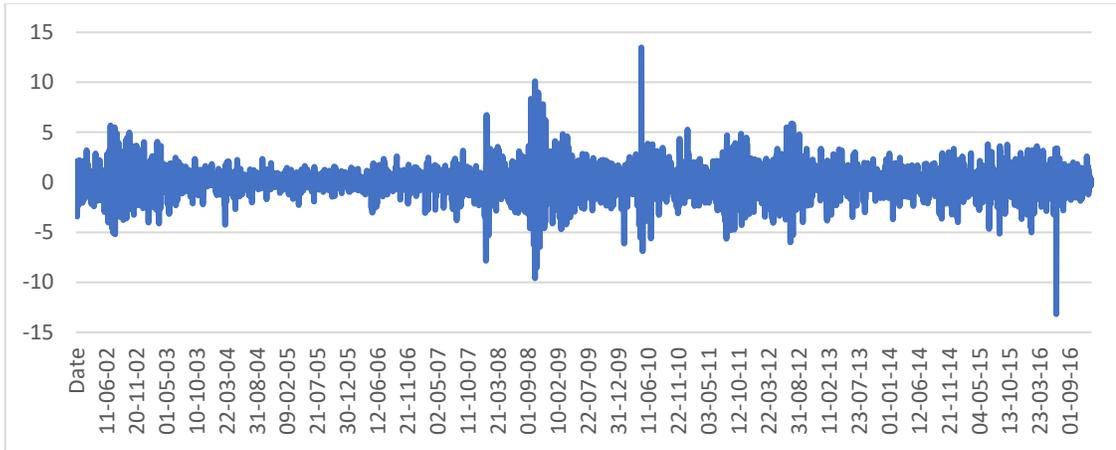
**Figure 5.10 : Daily Stock Returns – Stock Market of Germany**



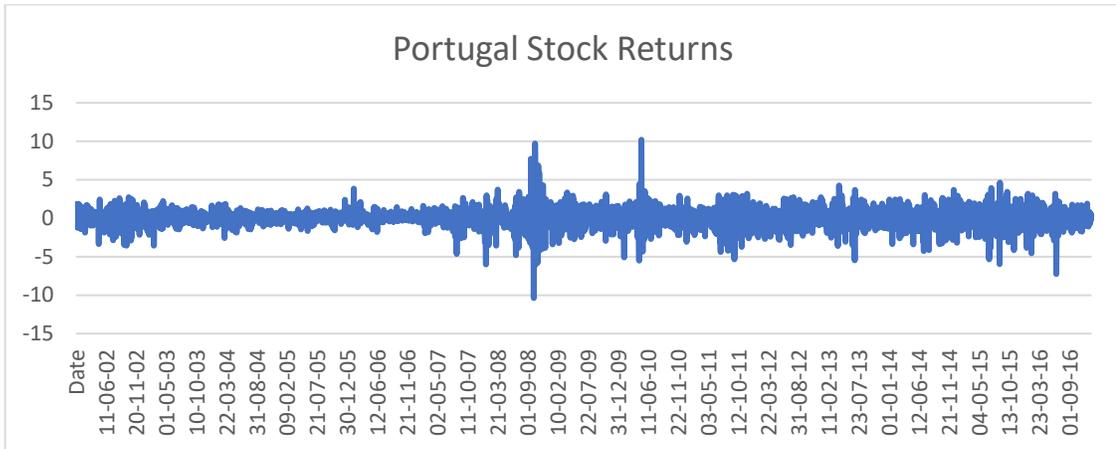
**Figure 5.11 : Daily Stock Returns – Stock Market of Greece**



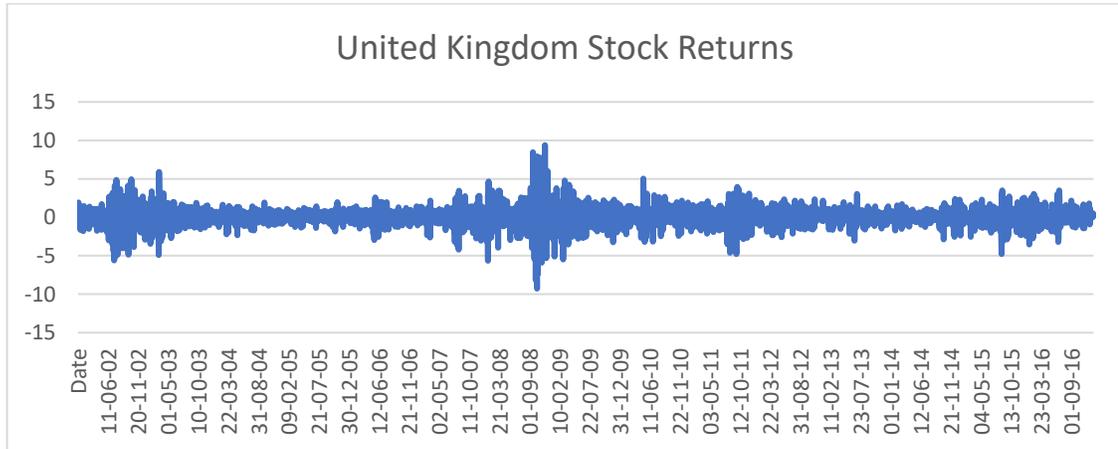
**Figure 5.12 : Daily Stock Returns – Stock Market of Italy**



**Figure 5.13 : Daily Stock Returns – Stock Market of Spain**

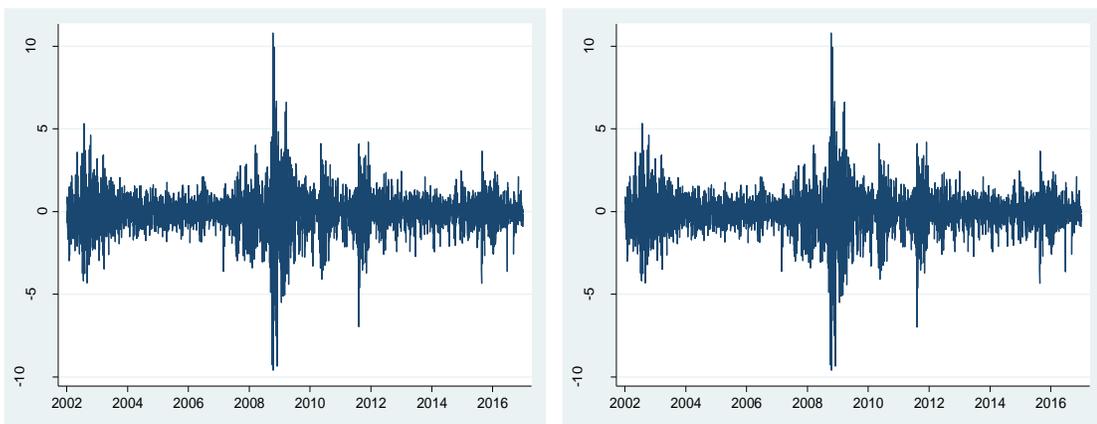


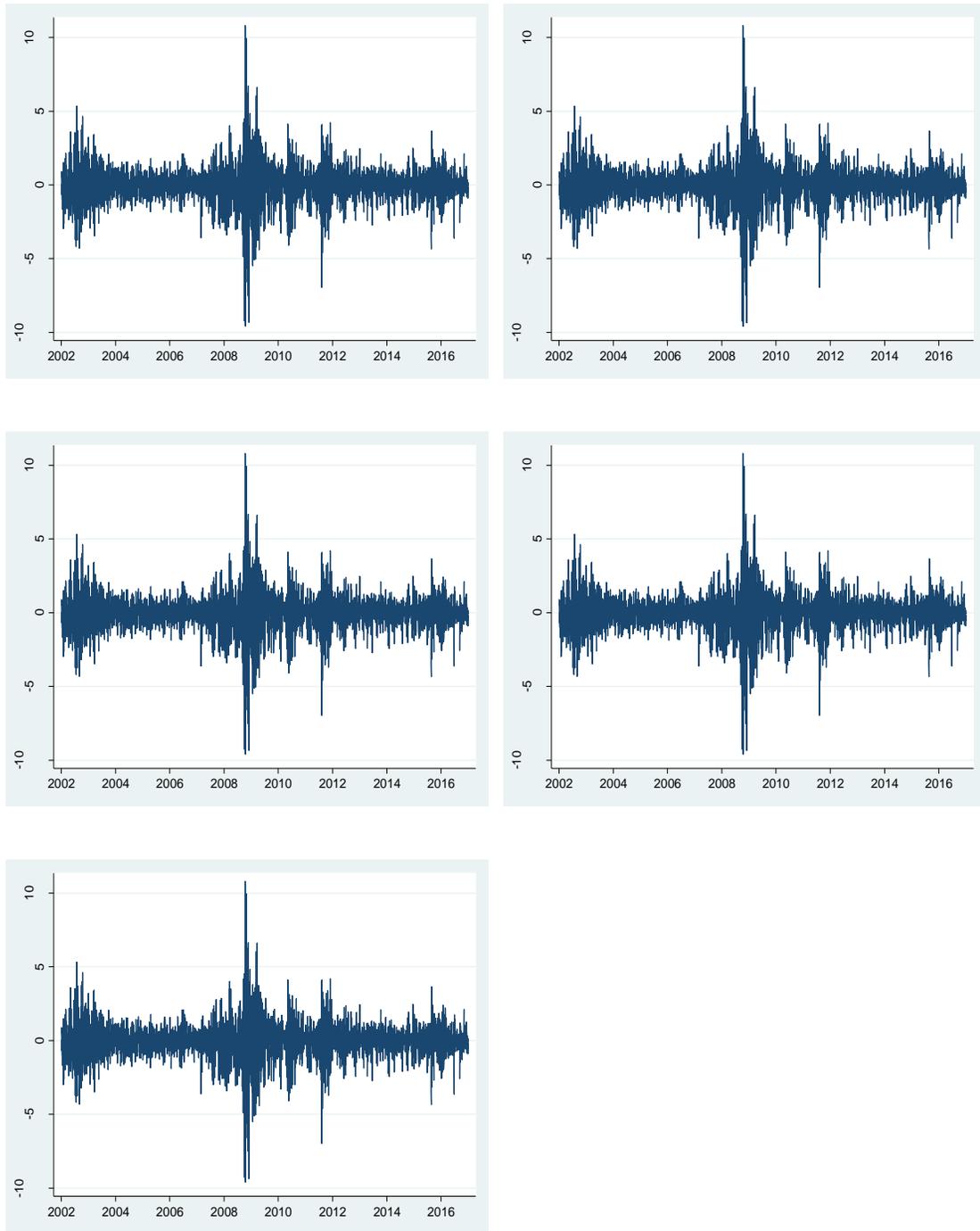
**Figure 5.14 : Daily Stock Returns – Stock Market of Portugal**



**Figure 5.15 : Daily Stock Returns of Selected European Markets**

Clustering volatility is one of the pre-conditions for estimating ARCH and GARCH models with the other pre-condition of the existence of ARCH effect. Volatility clustering means that large volatilities are followed by large volatilities while small volatilities are followed by small volatilities for a prolonged time. This shows that the errors arise in clusters. The countries under observation have shown an example of this situation while there was a clustering of large volatility around the global financial crisis year without exception. This condition submits that the residuals are conditionally heteroscedastic and ARCH and GARCH methods are suitable to estimate this kind of model.





**Figure 5.16 : Residuals for Volatility Clustering Check**

Second pre-condition for ARCH and GARCH modelling is the existence of ARCH effect. ARCH-LM test has been applied to the data of the residuals in the mean equation.

The null hypothesis of ARCH-LM test indicates that there is no ARCH effect while the alternative hypothesis indicates that there is ARCH effect. The LM test results for ARCH is presented in the Table 5.5. According to the test results, null hypothesis is strongly rejected and rather, alternative hypothesis is accepted. This indicates that there exists ARCH effect in the residuals of the mean equation. Second condition of ARCH/GARCH modelling has also been satisfied.

<b>Country</b>	$\chi^2$	<b>Df</b>	<b>Prob &gt; <math>\chi^2</math></b>
<b>France</b>	69.742	1	0.0000
<b>Germany</b>	61.895	1	0.0000
<b>Greece</b>	30.665	1	0.0000
<b>Italy</b>	59.778	1	0.0000
<b>Portugal</b>	75.698	1	0.0000
<b>Spain</b>	39.378	1	0.0000
<b>United Kingdom</b>	137.758	1	0.0000

**Table 5.6 : LM Test for ARCH**

### **5.3.3. Implication of DCC-GARCH Methodology**

Subsequent to the confirmation of the ARCH/GARCH models to be applied, DCC GARCH (1,1) model has been constructed by the following steps:

- 1) Setting a mean equation for the stock market returns,
- 2) Setting the conditional variance equation,
- 3) Estimating the dynamic conditional correlations.

$$\text{Mean equation: } R_{i,t} = \alpha_0 + \alpha_1 R_{i,t-1} + \alpha_2 R_{US,t-1} + \varepsilon_t, i = 1, \dots, 7 \quad (1)$$

$$\text{Variance equation: } H_{i,t} = \omega + \gamma_i \varepsilon_{i,t-1}^2 + \delta_i H_{i,t-1}, i = 1, \dots, 7 \quad (2)$$

$$\text{Dynamic Conditional Correlation: } \rho_{ij,t} = \frac{q_{ij,t}}{\sqrt{q_{ii,t} q_{jj,t}}} \text{ where } i, j = 1, 2, \dots, 7 \text{ and } i \neq j \quad (3)$$

Equation 1 exhibits the mean equation where  $R_{i,t}$  is the return series for country  $i$  and time  $t$ ,  $\alpha_0$  is the constant term,  $R_{i,t-1}$  is the AR(1) of stock return for country  $i$ ,  $R_{US,t-1}$  is the one-day lagged stock return for United States and finally  $\varepsilon_t$  is the residual. The AR (1) is used to check for the autocorrelation of stock returns and to consider the investor behavior of relying on the previous returns in order to make future investment decisions. Additionally, it is aimed to examine the effect of the US stock markets on selected economies stock returns. For this purpose, one-day lagged US stock return is included in the equation. The rationale of using the lagged US stock return is based on the existing findings in the literature that the US stock returns play an important role on determining stock returns in Europe.

Equation 2 exhibits the variance equation where  $\omega$  is the constant,  $\varepsilon_{i,t-1}^2$  is the ARCH (autoregressive conditional heteroscedasticity) term with  $\gamma_i$  parameter as the ARCH effect. It measures the effect of previous period's volatility on the current period's volatility. This parameter is expected to be a positive value.  $H_{i,t-1}$  is the GARCH term with  $\delta_i$  parameter as a measure for persistence. Persistence lasts longer as  $\delta_i$  parameter is larger. A positive GARCH term coefficient ( $\delta_i$ ) stands for the clustering volatility. According to clustering volatility, small variances are followed by small variances for a long time, vice versa. ARCH and GARCH terms can be called as the family or internal

shocks on the volatility of the European stock markets. Lastly, equation 3 shows dynamic conditional correlation ( $\rho_{ij,t}$ ) of stock returns of country i and j for time t.

Additionally, three dummy variables have been used in order to evaluate the effect of financial crisis on conditional variances. Dummy variables have been decided according to following dates:  $DM_{pre}$  is constructed for the pre-crisis period that covers from January 2002, through September 6, 2008.  $DM_{crisis}$  is constructed for the crisis period which is from the failure of Fannie Mae and Freddie Mac (September 7, 2008) through the end of March, 2009 - the first repayment of Troubled Asset Relief Program (J. K. Hwang, 2014). Lastly,  $DM_{post}$  is the dummy that is constructed for the post-crisis period from April 2009 through December 2015.

The modified variance equation has been created as:

$$\text{Variance equation: } H_{i,t} = \omega + \gamma_i \varepsilon_{i,t-1}^2 + \delta_i H_{i,t-1} + \Gamma_1 DM_{pre} + \Gamma_2 DM_{crisis} + \Gamma_3 DM_{post}, i = 1, \dots, 7$$

Equation 3 exhibits the modified variance equation with three crisis dummies where  $\omega$  is the constant,  $\varepsilon_{i,t-1}^2$  is the ARCH (autoregressive conditional heteroscedasticity) term with  $\gamma_i$  parameter as the ARCH effect.  $H_{i,t-1}$  is the GARCH term with  $\delta_i$  parameter. Lastly,  $\Gamma_1, \Gamma_2$  and  $\Gamma_3$  are the parameters for the dummies for pre-crisis, crisis and post-crisis respectively. Those parameters reflect the structural fluctuations because of an external event -which is the US financial crisis in this case, during three different periods of the shock.

### 5.3.3.1. Estimates of DCC-GARCH Model

The estimated parameters of co-movements between selected European countries and US stock markets are shown in Table 5.7. All the parameters (except AR (1) term for Greece and Portugal) and the constant terms show statistically significant results in mean equation and variance equation except the coefficients for the crisis dummy variables. This can be accepted as a justification for the use of DCC-GARCH model.

	France	Germany	Greece	Italy	Portugal	Spain	United Kingdom
<b>Mean Equations</b>							
$\alpha_0$	0.0607*** (3.78)	0.0930*** (6.00)	0.04522** (2.47)	0.0498*** (3.04)	0.0502*** (3.78)	0.0737*** (4.46)	0.0478*** (4.01)
$\alpha_1$	-0.2456*** (-16.31)	-0.2055*** (-13.79)	0.0011 (0.07)	-0.1786*** (-11.36)	0.0084 (0.52)	-0.1262*** (-7.90)	-0.2320*** (-15.42)
$\alpha_2$	0.4341*** (19.47)	0.3638*** (16.81)	0.3148*** (15.04)	0.3177*** (14.23)	0.1894*** (11.83)	0.3065*** (13.98)	0.3384*** (19.78)
<b>Variance Equations</b>							
$\omega$	-3.3932*** (-9.67)	-4.0186*** (-7.15)	-1.7454*** (-6.04)	-2.2931*** (-8.14)	-2.8921*** (-9.63)	-2.5341*** (-8.85)	-3.9280*** (-9.12)
$\gamma$	0.0856*** (10.88)	0.0702*** (9.15)	0.0888*** (7.82)	0.0845*** (10.06)	0.1125*** (10.11)	0.1028*** (10.59)	0.0863*** (8.82)
$\delta$	0.8936*** (91.19)	0.9161*** (106.55)	0.8461*** (38.12)	0.8895*** (83.46)	0.8502*** (55.89)	0.8728*** (75.81)	0.8978*** (78.79)
$\Gamma_1$	-0.2419 (-0.78)	0.1579 (0.31)	-0.9539* (-4.73)	-1.3790*** (-5.37)	-0.8025*** (-3.09)	-0.9422*** (-3.61)	-0.1782 (-0.46)
$\Gamma_2$	1.8370*** (4.17)	2.3524*** (3.74)	0.9469*** (3.23)	1.0542*** (2.81)	0.9103** (2.35)	0.8917** (2.06)	2.1698*** (3.95)
$\Gamma_3$	0.1731 (0.57)	0.2787 (0.54)	0.8049*** (3.97)	-0.3339 (-1.30)	0.2591 (1.00)	-0.2100 (-0.81)	-0.1068 (-0.27)
<b>Persistence</b>	0.9792	0.9863	0.9349	0.9740	0.9627	0.9756	0.9841

Notes: (\*), (\*\*) and (\*\*\*) indicates 90%, 95% and 99% confidence level, respectively. The numbers in brackets are z-values.

**Table 5.7 : Estimated Parameters of Mean, Variance and Correlation Models against US Stock Market**

The AR (1) term,  $\alpha_1$ , is statistically significant and positive for most of the countries in the analysis. Only insignificant results for  $\alpha_1$  are for Greece and Portugal. This term represents the effect of the countries' own lagged returns on current period's returns. The coefficient of the lagged stock return of the US market,  $\alpha_2$ , is again statistically significant confirming the effect of the US stock returns on European countries' stock returns. The results derived from the mean equation indicates both the effect of the US stock market's and the countries' own past stock market returns on their present returns. In our case, investments are affected from the US but also the past

behavior of the other investors. Greece and Portugal are found exceptional in our model indicating that their present returns are only affected by the US stock market's returns.

Additionally, the lagged conditional volatility and the persistence values in the variance equation show highly significant results. Volatility from the previous periods may have influence on the current volatilities of the stock market returns. Similarly, high persistence levels, which are very close to one in all cases, indicates that a large positive or a large negative return will lead future forecasts of the variance to be high for a prolonged period. In other words, the duration of the effect is very long. Long periods of clustering volatilities which have been visualized in Figure 5.16, are consistent with the persistence results.

However, the effect of crisis dummies has shown different results for different sub-periods and countries. The impact of global financial crisis on the dynamic conditional correlations' volatility is crucial because as the volatility increases, reliability decreases in terms of its guidance on investor decisions. In the pre-crisis years,  $DM_{pre}$  has shown insignificant results for more developed stock markets such as Germany, United Kingdom and France while the pre-crisis dummy was significant for other countries, namely Greece, Italy, Portugal and Spain. Insignificant results for pre-crisis dummy indicate that there was no evidence of volatility contagion from the US to those European countries before 2008. Even if the results were significant for four aforementioned countries, the signs were negative for the pre-crisis dummy. Pre-crisis conditions had diminishing effects on the stock market volatilities of these European countries by 0.9539 for Greece, 1.379 for Italy, 0.8025 for Portugal and 0.9422 for Spain.

On the other hand,  $DM_{crisis}$ , dummy variable for the crisis period has positive and significant coefficients in the model for all the stock markets. This situation shows that volatility in the correlation coefficients have been more severe in the crisis period. All the European countries in the analysis seems to be contaminated by the US in this period. Negative coefficients of crisis are replaced with positive effects of crisis on the countries' stock market volatilities which is an expected result. More specifically, the most dramatic

increase in the effects of crisis on volatilities belongs to Germany whose variance has been increased by 2.3524. Additionally, United Kingdom, France and Italy stock market variance has been increased by 2.1698, 1.8370 and 1.0542, consecutively. The countries which have relatively small and less developed stock markets such as Greece, Portugal and Spain stock market volatilities has shown increasing variance pattern because of crisis with increases of 0.9469, 0.9103 and 0.8917 respectively. Increasing dynamic conditional correlations among the US and European economies have been supported with these results.

Lastly, the coefficients of  $DM_{post}$  are mostly insignificant with one exception, Greece. The severe changes on the volatilities related to crisis period have not been extended to the post crisis period. Only for Greece, the situation was different. In fact, Greece was the source country of European debt crisis which has arisen after global financial crisis. The prolonged effect of US financial crisis on Greece was the most expected result for the post crisis period. Positive post crisis coefficient is leading to the conclusion that Greek stock market volatility has continued to increase by 0.8049 even after the crisis. Significant crisis dummy is followed by the significant post crisis dummy which then lead to more serious financial problems for Greece.

### **5.3.3.2. Estimates of DCC for Stock Return Data**

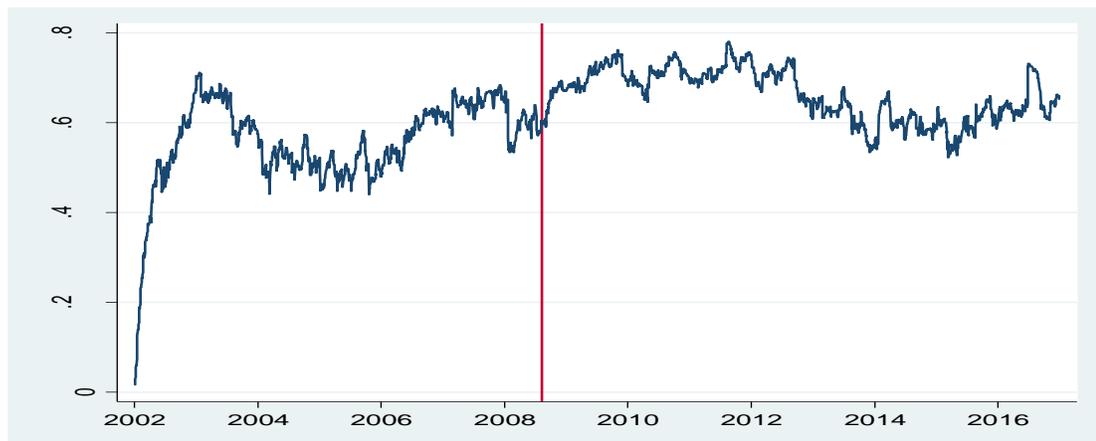
The movements of dynamic conditional correlations for European countries against the US which are found in DCC-GARCH model, are illustrated in Figures 5.17 – 5.23. Additionally, dynamic conditional correlation statistics are given in Table 5.8. Red lines in the figures show the breakpoint date selected as the beginning of the crisis period for this analysis. All countries show unique characteristics about the correlations. In the overall sample, Germany and France has the highest dynamic correlations with the US stock market with mean values of 0.6234 and 0.6163 respectively. These countries are followed by United Kingdom, Italy and Spain while Greece and Portugal have the lowest correlations in overall sample with average correlations of 0.2794 and 0.4174 respectively. The rankings stay nearly the same in all sample periods, but in crisis period, mean

correlations tend to increase for all the selected European economies' stock markets compared to the pre-crisis period.

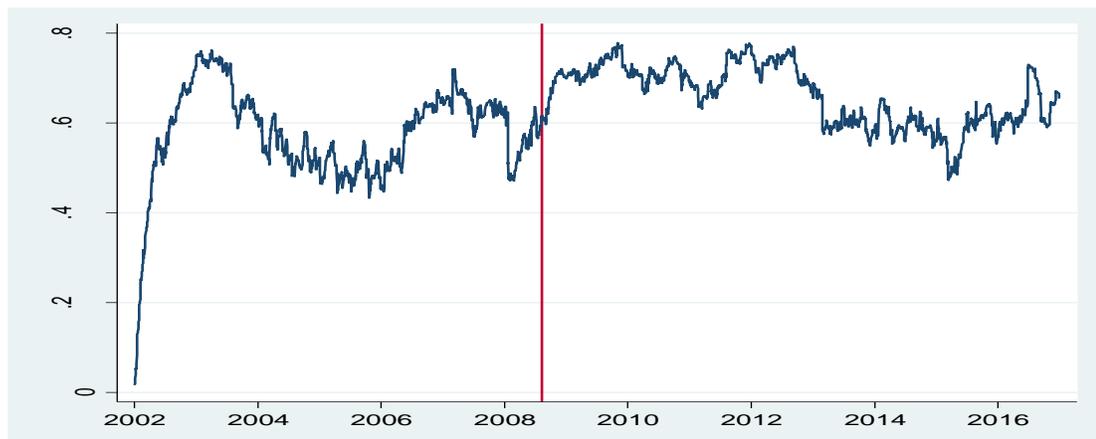
	France	Germany	Greece	Italy	Portugal	Spain	United Kingdom
<b>MODEL A – Entire Sample Period (Jan. 01, 2002 – Dec. 31, 2016)</b>							
<b>Mean</b>	0.6163	0.6234	0.2794	0.5718	0.4174	0.5601	0.5896
<b>St. Deviation</b>	0.0913	0.0954	0.0706	0.0626	0.1158	0.0666	0.0912
<b>Maximum</b>	0.7813	0.7789	0.5559	0.7420	0.6521	0.7057	0.7523
<b>Minimum</b>	0.0152	0.0157	0.0182	0.0296	0.0083	0.0156	0.0108
<b>Observations</b>	3913	3913	3913	3913	3913	3913	3913
<b>MODEL B – Pre-Crisis Sample Period (Jan. 01, 2002 – Sept. 06, 2008)</b>							
<b>Mean</b>	0.5594	0.5761	0.2712	0.5481	0.3216	0.5259	0.5215
<b>St. Deviation</b>	0.0936	0.1037	0.0776	0.0681	0.0861	0.0748	0.0855
<b>Maximum</b>	0.7122	0.7630	0.5559	0.7233	0.5034	0.6548	0.6596
<b>Minimum</b>	0.0152	0.0157	0.0182	0.0296	0.0083	0.0156	0.0108
<b>Observations</b>	1743	1743	1743	1743	1743	1743	1743
<b>MODEL C – Crisis Sample Period (Sept. 07, 2008 – Mar. 31, 2009)</b>							
<b>Mean</b>	0.6735	0.6961	0.3625	0.6068	0.4873	0.6202	0.6337
<b>St. Deviation</b>	0.0156	0.0234	0.0419	0.0183	0.0238	0.0118	0.0172
<b>Maximum</b>	0.7007	0.7218	0.4633	0.6484	0.5269	0.6415	0.6658
<b>Minimum</b>	0.6196	0.6199	0.2665	0.5728	0.3901	0.5759	0.5785
<b>Observations</b>	147	147	147	147	147	147	147
<b>MODEL D – Post Crisis Sample Period (Apr. 01, 2009 – Dec. 31, 2016)</b>							
<b>Mean</b>	0.6629	0.6623	0.2771	0.5903	0.4916	0.5846	0.6485
<b>St. Deviation</b>	0.0619	0.0712	0.0557	0.0512	0.0755	0.0425	0.0510
<b>Maximum</b>	0.7813	0.7789	0.4688	0.7088	0.6521	0.6811	0.7523
<b>Minimum</b>	0.5222	0.4721	0.1026	0.4581	0.2596	0.4886	0.5209
<b>Observations</b>	1762	1762	1762	1762	1762	1762	1762

**Table 5.8 : Dynamic Conditional Correlations Statistics**

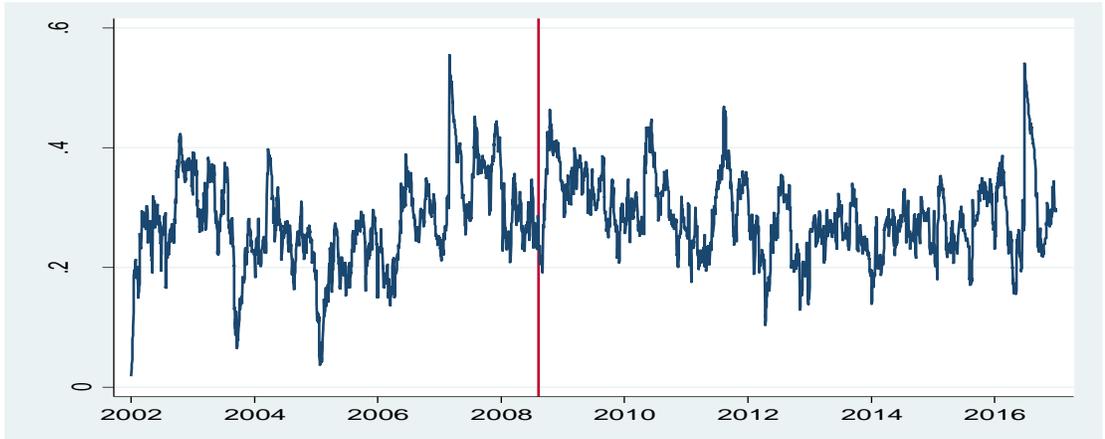
According to the figures, dynamic conditional correlations are relatively high except for Greece and Portugal. Additionally, there are sudden increases in the correlations after the selected crisis date. Those findings are also similar to the unconditional correlations reported in Table 5.3. Greece has the lowest correlation with the US, but it faced the sharpest increase in the correlation after the breakpoint date.



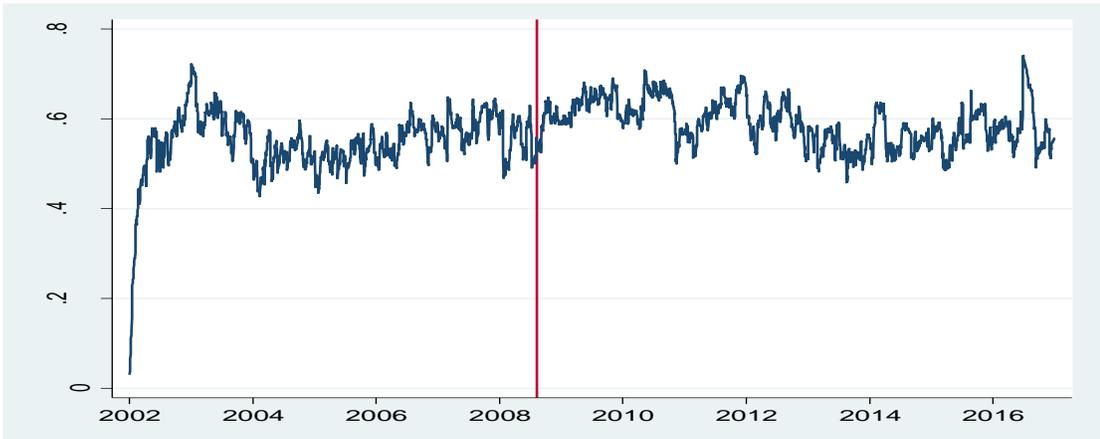
**Figure 5.17 : Dynamic Conditional Correlations Graph of France against US**



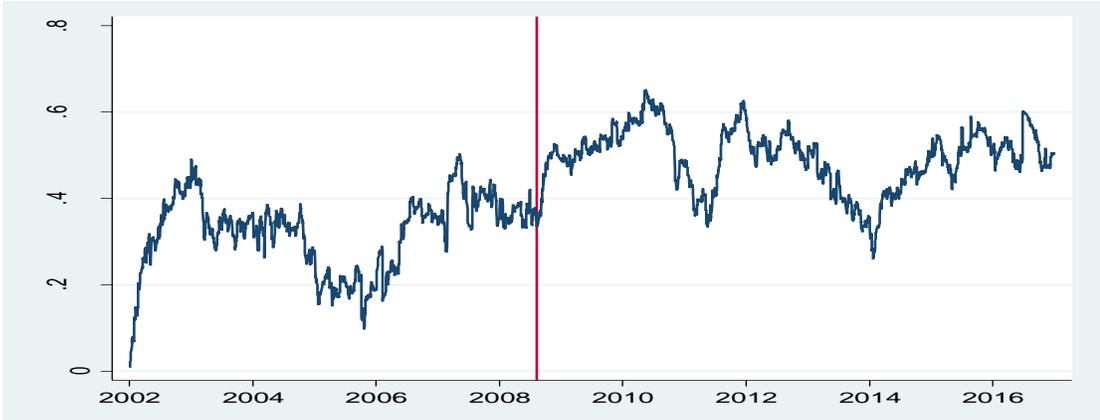
**Figure 5.18 : Dynamic Conditional Correlations Graph of Germany against US**



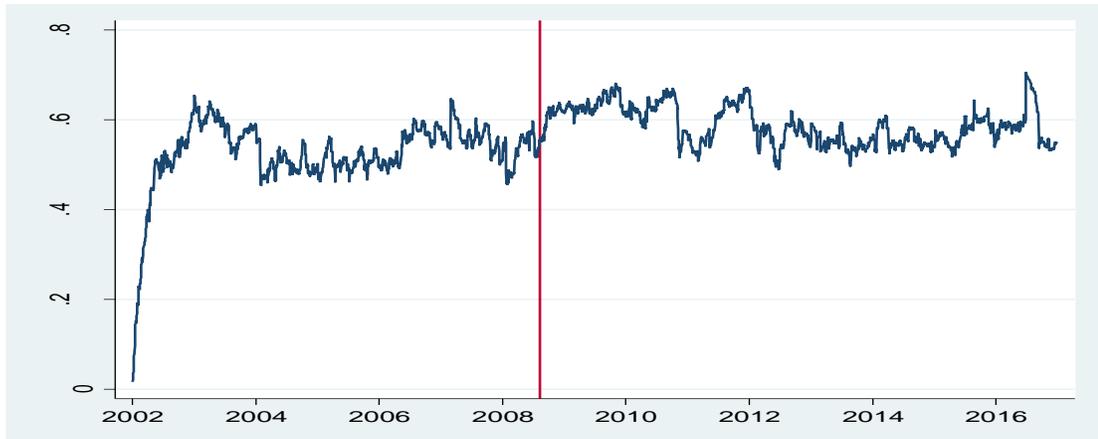
**Figure 5.19 : Dynamic Conditional Correlations Graph of Greece against US**



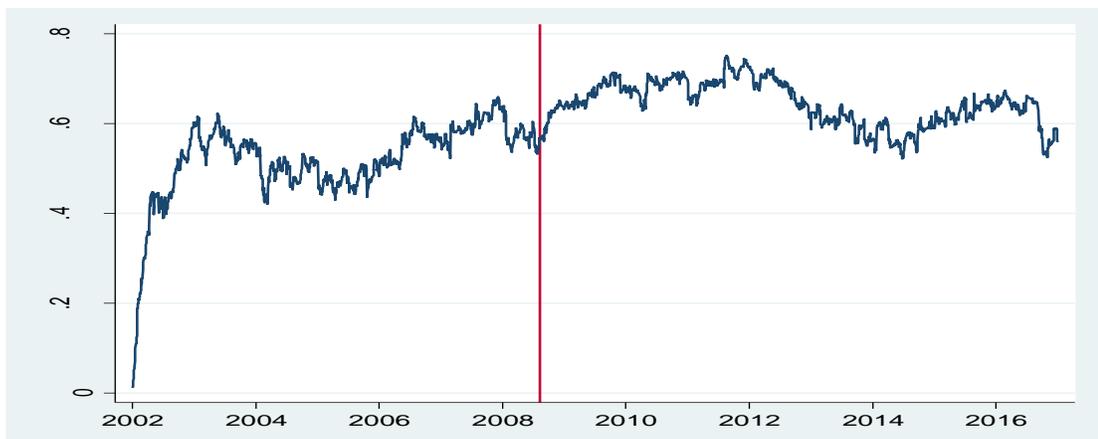
**Figure 5.20 : Dynamic Conditional Correlations Graph of Italy against US**



**Figure 5.21 : Dynamic Conditional Correlations Graph of Portugal against US**



**Figure 5.22 : Dynamic Conditional Correlations Graph of Spain against US**



**Figure 5.23 : Dynamic Conditional Correlations Graph of UK against US**

### 5.3.3.3. Goodness of Fit Test of the DCC-GARCH Model

Diagnostic test to check whether the model is good to explain the data is crucial as the last step for the analysis. Residuals of the model have been obtained and analyzed for testing purposes. The residuals are expected to follow a normal distribution and to be almost symmetric. For this purpose, Shapiro-Wilk test of normality has been applied to the residuals in which the null hypothesis claims the data to be normally distributed. The tests for all the stock markets' analysis failed to reject the null hypothesis.

Additionally, autocorrelation and partial autocorrelation functions have to be estimated for the residuals. The residuals should not have a problem of serial correlation. Both autocorrelation and partial autocorrelation functions gave confirmative information that the residuals do not have serial correlation problem.

Goodness of fit tests give information whether the fitted model can be used for forecasting or not. Our model has given satisfactory results in the goodness of fit tests.

Lastly, ARCH effect has to be tested again and the ARCH effect that has been present in the data as a pre-requisite condition for ARCH/GARCH modelling, has to be removed in the end of the analysis. For this purpose, ARCH-LM test has been applied to residuals again and it has been observed that ARCH effect has been removed with a significance of 95%.

#### **5.4. CONCLUSION**

It is aimed to examine the contagion of 2008 global financial crisis on selected European economies by assessing the conditional variances of daily stock returns using DCC-GARCH model.

According to the stock indices figures, all stock markets show dramatically decrease in financial crisis period. Greece, Portugal, Spain and Italy show lower growth in the recovery period which can be associated to the European sovereign debt crisis. Only Germany has fully recovered by exceeding its pre-crisis point. Focusing on the daily returns, it can be concluded that countries such as UK and the US reached stable points after the crisis while countries like Greece and Portugal are still trying to cope with the high volatilities.

During crisis period, mean returns of all selected countries are negative and all the standard deviations increase. Daily average stock returns in post-crisis period are higher than the returns in pre-crisis and full sample periods for most of the economies except for

Greece, Portugal and Spain. These countries were some of the most affected economies after the crisis.

After analyzing the dynamic conditional correlations with GARCH methodology, all the parameters showed significant results as a justification for the DCC modelling. The results from the mean equation indicates both the effect of US stock market's and the countries' own past stock market returns on their present returns. Investments are affected from both the US and the past behavior of the other investors. Greece and Portugal are found exceptional that their present returns have been only affected by the US stock market's returns.

Additionally, the lagged conditional volatility and the persistence values in the variance equation show highly significant results. Volatility from the previous periods may have influence on the current volatilities of the stock market returns. High persistence levels indicate that the duration of the effect is very long.

Dynamic conditional correlations show an increasing pattern in the crisis period which lead us to a conclusion of contagion for all the countries. DCC-GARCH model allows us to examine possible herding behavior of the investors in times of financial turmoil. This can easily be detected by looking at the correlation's movement after crisis period. For most of the countries, correlations continue to increase except for Spain and Greece.

As the crisis dummies are investigated, different results have been discovered. More developed European countries such as Germany, United Kingdom and France have given insignificant pre-crisis results and thus, showed no evidence of volatility transferred from the US to those European countries before the period of financial crisis. However, countries like Greece, Spain, Italy and Portugal have seem to be contaminated by the US by the analysis of significant results for pre-crisis dummies.

When the overall model is concerned, dynamic conditional correlation coefficients which have been depicted from the DCC-GARCH model, show an increasing pattern in

the crisis period which lead us to a conclusion of contagion. DCC-GARCH model allows us to examine possible herding behavior of the investors in times of financial turmoil. The movements in correlations after the financial crisis period can confirm this situation. For most of the countries, correlations continue to increase with two exceptions as Spain and Greece.

Following the analysis of volatility contagion from the US to the selected European stock markets, it is crucial to detect the channels of the volatility transmission. Finding the possible transmission channels of volatility is a very crucial subject for researchers as well as policy makers to implement the correct policies to correct measures in order to prevent an upcoming crisis to happen and more importantly, spread globally. Next chapter is organized as a study that aims to highlight the factors effecting dynamic conditional correlations depicted from the DCC-GARCH model of this chapter.

## **CHAPTER SIX**

### **6. QUANTILE REGRESSION APPROACH IN THE ANALYSIS THE POSSIBLE CONTAGION CHANNELS OF GFC**

The global financial crisis is an extreme negative risk event that led to an increase in the sovereign credit risk in the Eurozone. As a recall, global financial crisis was triggered by the 2007 subprime mortgage crisis in the United States and spread widely to global real economies. Those crises are proofs for strong market linkages and the tendency of adverse situations to spread rapidly. Since the barriers for international trade and transaction costs have reduced, traders and investors (both experienced and inexperienced) choose to invest in multiple markets. This situation results with easy spread of bad news in one market into another national market. The ultimate result becomes reduction in liquidity and increase in risk premiums.

The global crises experiences of the world in the last decades have resulted in defaults of investment banks and governments. The sovereign defaults have significant effects on sovereign riskiness. As the sovereign credit risk of a country increase, its access to global capital becomes harder and borrowing cost would increase.

European sovereign debt crisis arose after similar conditions in the Eurozone area. As the sovereign indebtedness of Eurozone economies increased, the contagion possibility came into light and attracted the researchers as well as market participants and policymakers. Transmission mechanism of the financial crisis into the Eurozone is a significant topic in taking cautious actions and preventing a potential crisis.

In fact, many Eurozone countries faced public deficit difficulties after the global financial crisis, and they have tried to solve this problem with sovereign debts. Since it is a known fact that sovereign credit default swaps are indicators of risk perception of the market regarding indebtedness, CDSs of eurozone countries have been in the center of attention since the middle of 2007. The credit default swap market has grown rapidly since the International Swaps and Derivatives Association (ISDA) produced its first version of

a standardized contract in 1998. According to the ISDA, the global notional outstanding volume of credit derivatives transactions was \$31.2 trillion in 2009, up from \$631.5 billion in 2001 (Hassan, Ngene, & Yu, 2015).

Existing literature focus on the effects of globalization as driving force for the increase in the country risk correlations. When the global markets get correlated, international diversification benefits decrease, since the conditions of the economies converge each other. Turmoil periods are the times when the connections among the markets deepen. Wake-up call hypothesis which indicates that a crisis in one region is a wake-up call to investors in another region, is verified in the latest crisis. With increasing globalization and linkages among the markets, wake-up calls have been one of the reasons for contagions.

Moreover, most of the studies in the European literature, focus on the central and eastern European economies which have lately completed their financial and economic transition and differs from the other developed European economies. However, the developed markets may be more vulnerable to a shock from the US since their developed financial markets are more correlated to each other. After a contagion, the realized effects of the shock on the economy differs according to the country's strengths and weaknesses.

In the previous chapter, the existence of financial contagion from the core country, the United States, to the selected European countries has been observed from the increasing pattern of dynamic conditional correlations in the crisis period. Global financial crisis has a powerful effect on correlation dynamics among the selected markets. After this result, it is crucial to question the reasons for these dynamic correlations and the forces those drive them to move in an increasing pattern.

In this chapter, it is aimed to analyze the effects of global macroeconomic factors on the conditional correlations among the selected markets. While financial and commodity markets have been chosen to investigate for their impact on the correlations, oil price, gold price, TED interest spread, and volatility index have been utilized as the

independent variables. For this aim, quantile regression analysis is useful for its ability to project the changes in the effects of explanatory variables for different correlation levels.

## **6.1. DATA SELECTION**

As a follow up to the literature and the accompaniment to our country basket, four exogenous variables are selected to determine the dynamic conditional correlations as the TED spreads, stock market volatility index, gold prices and oil prices as a proxy for the global markets.

In the search of the data, the guiding source has been Thomson Reuters' Datastream for all countries and all periods. Daily data have been chosen to fully analyze a high frequency data such as oil prices, gold prices and stock indices.

Sample period is chosen in tandem with the previous analysis of dynamic conditional correlations which starts from 2002 and goes till the end of 2016. The effects of conditional variables on dynamic correlations will be analyzed by dividing the whole sample period as pre-crisis and post-crisis with the breakpoint date of the failure of Fannie Mae and Freddie Mac (September 7, 2008).

### **6.1.1. The Volatility Index:**

One of the four conditional variables that affect the conditional variances is chosen as the volatility index (VIX). The transmission of big shocks in international markets is a crucial subject about market integration and financial crises literature. Implied volatility measures help to analyze the risk expectations in different equity markets by the usage of the volatility indices which let researchers to analyze the relationships between different index markets.

Chicago Board Options Exchange Volatility Index (VIX) is one example of the proxies for market uncertainty. It is the volatility index issued by the Chicago Board Options Exchange and measures the implied volatility of the S&P 500 index options over the next 30 days. So, it is a key measure of market expectations of short-term volatility

conveyed by the S&P 500 stock index option prices. When it is introduced in 1993, it was a weighted average of implied volatility of eight at-the-money put and calls options on S&P 100 index. But after ten years, in 2003, it was expanded to S&P 500 to estimate the implied volatility of at-the-money index option with 30 days to expiration.

Since it is a proxy for market uncertainty, it can be included in the analysis as a measure of market risk. In fact, the index is referred as the investor fear gauge. When there is an increase in the VIX index, the expectation is on the side of an increase in the market volatility. Investors lose confidence to the market when it becomes more volatile. As the ratio becomes higher, the investors' confidence becomes lower, which indicates a negative relationship.

Skiadopoulos (2004) analyzed the relationship between Greek volatility index (GVIX) and the US volatility indices of VIX and VXN. Applying regression models, the author concluded with a spillover between GVIX and the US indices. Similarly; Wagner and Szimayer (2004) investigated the dynamic behavior of daily implied volatility indices of the US and Germany as measured by the VIX and VDAX during the years 1992-2002 with mean reversion model that allows for Poisson jumps. However, they have found weak evidence of spillover from one market to the other. The effects were mostly country specific.

Nikkinen and Sahlström (2004) utilized from implied market volatilities of the US, UK, Germany and Finland in order to examine international equity market integration of uncertainty. According to results, the US, UK and German markets were highly integrated in terms of uncertainty with the US being the source of that uncertainty. While the analysis among the European markets, Germany was coming as a leading source of uncertainty.

Äijö (2008) analyzed the linkages among VDAX, VSMI, VSTOXX volatility indices in order to find an evidence of stock market integration. The results showed that the estimated volatility term structures were highly correlated. Peng and Ng (2012) studied the cross-market dependence between the World's most popular equity indices of the US,

Europe and Japan. The authors claimed that the cross-market volatilities reflect the dynamics of market dependence better than the returns. As a result of their study, findings support the financial contagion and the volatility index returns show that the turbulent markets have higher risks. López (2014) is another researcher that focus on the existence of implied volatility contagion for the global financial crisis period by utilizing the VAR approach. The findings support that volatility contagion is robust over the financial crisis period and post crisis period.

To explain the transmission channels of global financial crisis of 2008, volatility index is selected as one of the conditional variables. Following the work of Giot (2005) in the literature, the relationship between the VIX volatility index and stock returns is expected to be significant and negatively correlated. Additionally, Cai, Chou, and Li (2009) analyzed the dynamic correlations among six stock market indices and their relationship to market volatility. The findings support that higher correlations emerge between countries when both countries experience a contractionary phase or higher volatilities in their stock markets.

Another important variable while analyzing the factors of financial contagion is the financial stress of the US stock markets. To capture its effects on the conditional correlations, Financial Stress Index (FSI) has been implemented. FSI considers capital market measures of stress to capture higher frequency dynamics in six main financial markets (securitization, equity, credit, real estate, foreign exchange and funding). However, FSI is not a widely used index like VIX market volatility index. Thus, following the literature, VIX has been chosen to be included in the analysis.

### **6.1.2. Oil and Gold Prices**

Gold and oil markets are two global and large commodity markets which may have influence on almost all the economies and most of the sectors. However, the movements of these two large markets have diverged from supply and demand mechanisms in the latest turbulent times. When the dollar depreciated and OPEC manipulated the oil price in

2002, both markets have been affected and entered into an increasing trend. The oil prices climbed from 20\$ till 145\$, while gold prices increased from 275\$ till nearly 1000\$ between 2002 and 2008. This trend has come to an end in 2008 (see Figure 6.1 for the evolution of oil and gold prices after 2002). Due to the challenging conditions of global financial crisis, those commodity markets have faced with sharp decline. Oil price was nearly at its initial levels as in 2002 (Zhang & Wei, 2010).



**Figure 6.1 : Oil and Gold Prices between 2002-2016**

Even if the European economies have faced a debt crisis after the GFC, the effect of this crisis on these global variables has not been so deep. The prices were volatile as usual, but they have not experienced such sharp declines and increases until 2014.

The large volatility of oil and gold prices are associated with events such as financial crashes or wars. These volatilities concern both governments as well as traders, producers and consumers. Many scholars have studied the shock transmission between the stock market and oil and gold markets.

For the analysis of Gulf equity markets Malik and Hammoudeh (2007) analyzed the transmission among equity and crude oil markets of the US and three Gulf countries. They have found that all equity markets received volatility from the oil market while for the case of Saudi Arabia, the transmission is just from the opposite side, from equity to oil market. Park and Ratti (2008) studied the effect of oil price shocks on real stock returns for both the US and 13 European countries and concluded the variance decomposition analysis that the increased volatility on oil prices depressed the real stock returns for the case of many European countries. Conducting a VAR-GARCH approach for the European markets; Arouri, Jouini, and Nguyen (2012) analyzed the volatility transmission from oil market to stock market. Seven different sectors are included in the analysis since the effects of oil price on different sector volatilities vary. A more apparent volatility transmission is justified from oil to stock markets.

Mensi, Beljid, Boubaker, and Managi (2013) concentrated on the crisis period from 2000 to 2011 in their analysis of volatility transmission between equity market and commodity price indices. Their study was more comprehensive in terms of the commodity markets included such as gold, energy, food and beverages. The results were not contradictory to the general acceptance of transmission between volatilities.

Oil and gold markets are two alternative markets in times of a crisis. When the conditions start to worsen, the investors search for an alternative area to switch their investments. So, in crisis times, hedging becomes crucial which then affects the correlation dynamics among the markets. Alternative markets also become critical because when the conditions worsen in stock markets, for instance, the global investors watch the alternative markets' conditions closely to find an escape position. The safe haven characteristics of gold market and leading dynamic characteristics of oil market have put them in an important position to take into account while analyzing the alternative markets.

Gold has been always in the center of attention especially for its duty as a store of value in crisis times. With the developed stock markets facing various crises all around

the world, means of investment which may be considered as a hedge or safe haven raised as an important concern.

In order to distinguish between safe haven and hedge characteristics of an asset, Baur and McDermott (2010) provided definitions for the two concepts. According to these definitions, a strong hedge is defined as “*an asset that is negatively correlated with another asset or portfolio on average*”; while a strong safe haven is defined as “*an asset that is negatively correlated with another asset or portfolio in certain period only*”. Weak characteristics of a hedge or safe haven display an uncorrelated movement. This distinction is crucial for the investors since in case of negative correlation, investors enjoy the positive returns of an alternative portfolio when the other portfolio shows negative returns. They cannot enjoy this benefit when the assets are not correlated as in the case of weak hedge or safe haven. As it can be understood from the definitions, the financial condition of the time period is what distinguishes the two characteristics from each other.

When the stock market volatility increases in times of crisis, gold has been a strong candidate as a safe haven by a negative correlation with downward stock market movements in extreme turbulent times, and a hedge by a negative correlation with stock prices.

Approving the causality between gold prices and stock market returns, an empirical study has been conducted by Bhunia and Das (2012) for the Indian market, utilizing from Granger causality analysis and vector error correction modelling. Positive causality is found between gold prices and stock markets. Analysis results lead investors to consider gold as an investment tool in case of a decline in stock markets.

Mollick and Assefa (2013) concentrated on the US stock markets, as S&P 500, Dow Jones, NASDAQ and Russell 2000; and studied the effects of wide variety of variables on the US stock returns. Some of these variables included in the analysis were VIX volatility, interest rates, gold prices and exchange rates. Findings indicated that stock markets reacted negatively to the gold price increases.

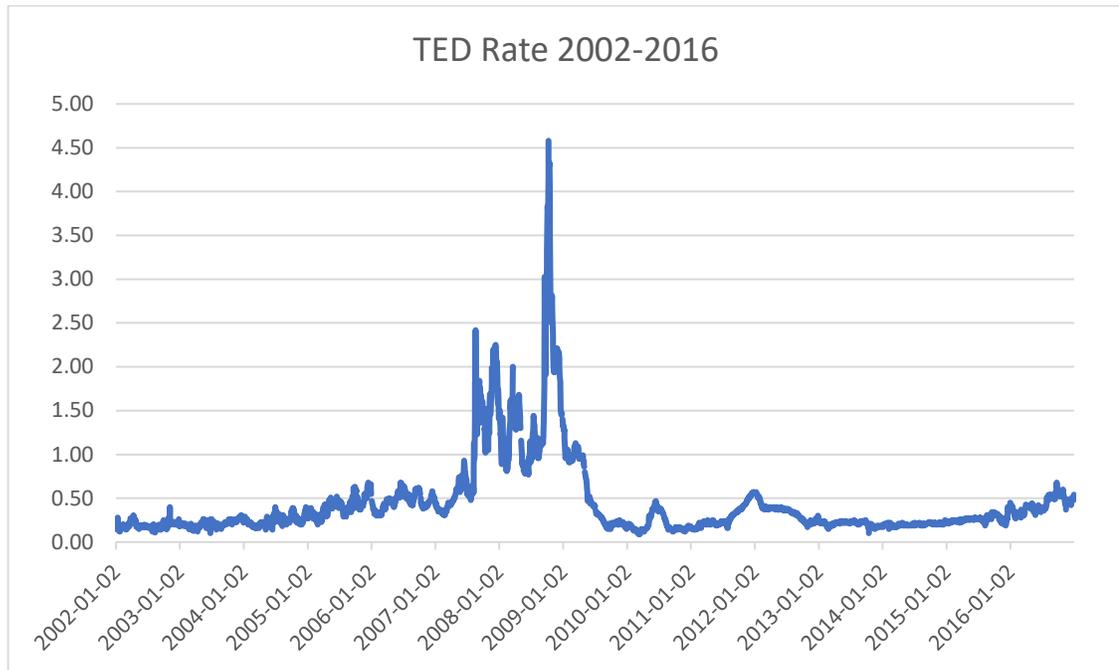
Another confirmatory study about the volatility transmission from global gold market to Chinese stock market is constructed by Arouri, Lahiani, and Nguyen (2015). The scholars have analyzed the extent of the effect and portfolio diversification of Chinese investors. According to the results Chinese stock market is decoupled from the global gold markets. Additionally, the ability of gold to be safe haven in times of financial crisis has been tested and verified by the scholars. For that reason, in order to feel safe in case of turbulent times, it is assumed to be better to hold more gold than stocks in the portfolios.

In the empirical analysis of the conditional variables those have effects on dynamic conditional correlations of the US and European stock markets, gold and oil prices are chosen as global macroeconomic indicators to capture the effect of those very important markets.

### **6.1.3. TED Spread**

TED spread which is calculated as the difference between three-month LIBOR and three-month treasury bill rate, is accepted as an indicator for the perceived credit risk and taken as a reliable predictor of financial crisis. The starting point for the global financial crisis was US housing and credit market. Therefore, TED spread is included in the analysis to detect the severity of the effect of liquidity and credit risk on the conditional correlations. It also measures the stress in the interbank market since the spread is calculated with the inclusion of the LIBOR rates. (Cheung, Fung, & Tsai, 2010; Min & Hwang, 2012).

As it is shown in Figure 6.2, TED spread increased sharply in July 2007 with the effect of global financial crisis originated from the US. Till September 2008, it kept its volatile situation which then jumped again with the events such as the collapse of Lehman Brothers. It can easily be detected from the figure that TED spread is very sensitive to new information and adjusts itself accordingly. This property shows that the rate can also serve as a leading fear indicator (Cheung et al., 2010).



**Figure 6.2 : TED spread for the US between 2002-2016**

Source: FRED Federal Reserve Bank of St. Louis

Despite the fact that there are number of empirical studies which included TED spread as an indicator that affects conditional correlations of equity markets, its effect on the European stock markets is still questionable.

## **6.2. QUANTILE REGRESSION METHODOLOGY**

The effects of financial and global macroeconomic factors on dynamic conditional correlations are examined by applying quantile regression (QR). QR methodology helps a researcher to study the effects of chosen independent variables on the conditional quantiles. By examining different quantiles, the changes in the effects of selected independent variables are determined. In the analysis, Stata statistical package is utilized.

QR methodology is frequently being compared to OLS methodology. One advantage of QR analysis is that the effects of different quantiles of an independent variable can be estimated, not just the mean picture can be examined. That leads to more

precise results in impact analysis. Secondly, QR analysis relaxes normality and homoscedasticity assumptions, which are necessary and sufficient conditions that should be satisfied in the OLS method (Kocaarslan, Soytaş, Sari, & Ugurlu, 2018).

In this sub-section, it is aimed to analyze which variables have effect on dynamic correlations between European countries and the US stock markets. In the traditional linear regression, the dependency is constructed by using standard OLS with the equation such as;

$$DCC = c + b_1 * VIX + b_2 * TED + b_3 * GP + b_4 * OP$$

where DCC is the dynamic conditional correlations between selected stock markets and the US stock market which has been estimated in the previous analysis of DCC-GARCH, C is the constant term, VIX is the volatility index, TED is the TED spread, GP is the gold price and OP is the oil price.  $b_1$ ,  $b_2$ ,  $b_3$  and  $b_4$  are the coefficients to be estimated.

In order to analyze if VIX, TED, OP and GP affect the dynamic conditional correlations between the stock markets differently when the correlations are low and when the correlations are high, QR analysis is needed. Simple regression equation cannot answer this question. Quantiles are used to describe the distribution of the dependent variable. A QR models the relationship between x and the conditional quantiles of y rather than just the conditional mean of y as in the standard OLS models. For this reason, it gives a more comprehensive picture of the effect of the independent variables on the dependent variable.

The hypothesis is that in the times of crisis, the correlations are getting higher. So, when the correlations are getting higher and the effects of the independent variables change. Accordingly, the independent variables role in a crisis can be determined. For this kind of relation, QR methodology is needed. In extreme times like the financial crisis, extreme points like high correlations are more interested by the researchers than the mean correlations. For these purposes, the data is going to be analyzed accordingly.

### 6.3. QR MODEL ESTIMATION

The QR function for the analysis is modeled with two dummy variables considering related sub periods as pre-crisis and post-crisis. The analysis results are expected to demonstrate the effect of conditional variables on the dependent variable, DCC, across different quantiles.

In 2008, during the global financial crisis, oil prices have faced a significant decrease while gold prices have increased. Decreasing world oil prices after global financial crisis, created the need for a change in the allocations of portfolios which in turn might be effective on the dynamic conditional correlations among the markets. Similarly, increasing gold prices after the turmoil caused investors to reevaluate their investments in the markets which became risky in the end and to buy gold instead. As expected, financial stress index has increased significantly in that period. Likewise, TED spread has shown a spike after 2007. All those mechanisms might have an impact on the behavior of the stock market correlations – negative or positive-. The importance of this empirical study is the quantiles' ability to detect the impact of mentioned global variables on conditional correlations on different levels of uncertainty and risk environments.

The QR model is constructed as;

$$Q_y(\tau|X) = \omega(\tau) + \sum_k \beta_k(\tau)X_k + D[\mu(\tau) + \sum_k \gamma_k(\tau)X_k]$$

where  $X_k$  denotes to VIX, TED, OP and GP. The dependent variable which is  $Q_y(\tau|X)$ , stands for the different quantiles of DCCs from the previous empirical study.  $\beta_k$  is the coefficient that measure the effects of VIX, TED, OP and GP on stock market correlations in pre-crisis period while  $\gamma_k$  is the coefficient that measure the effects of VIX, OP and GP in post-crisis period for different quantiles.  $\mu(\tau)$  stands for the crisis dummy and lastly,  $\omega(\tau)$  is for the constant term.

In line with the previous empirical chapter, time period has been cut from the date which has been selected as the beginning of the crisis. D refers to the dummy variable which divide the period into two. That's to say, D takes the value of zero if the variable belongs to pre-crisis period and value of one if the variable belongs to post-crisis period. When D takes the value of zero in the pre-crisis period, the expression inside the parenthesis becomes zero. It means that,  $\omega(\tau)$  and  $\beta_k$  are the coefficients left in order to explain the effects of conditional variables (VIX, OP and GP) on the stock market correlations in pre-crisis period. Similarly;  $\mu(\tau)$  and  $\gamma_k$  are the coefficients which explain the effects of conditional variables on the correlations for the post-crisis period comparatively. As a recall, crisis period has been decided as from the failure of Fannie Mae and Freddie Mac (September 7, 2008).

In order to take more accurate analysis results, different quantiles of 0.05, 0.10, 0.25, 0.50, 0.75, 0.90 and 0.95 have been used. Lower quantiles (such as 0.05 and 0.10) represent the effects on correlations in tranquil times, intermediate quantiles represent the moderate correlations and upper quantiles (such as 0.90 and 0.95) represent the high correlations which are associated with turmoil times.

### **6.3.1. Summary Statistics**

Prior to the QR analysis, data are examined according to their appropriateness to use in a further study. Table 6.1 shows the descriptive statistics for the conditional variables, namely VIX volatility index, TED spread, oil price and gold price. The results are given separately for the whole period, pre-crisis period, crisis period and post-crisis period in order to be able to make a comparison among the time series.

Volatility index has shown a sharp increase in the mean values after crisis. Likewise, the standard deviations have also increased with high volatility in the turmoil period. Mean and standard deviations were similar for the TED spread. Oil prices has increased but the percentage increase was not high among the periods of pre-crisis and crisis. However, the standard deviation has shown a decrease in the crisis period which

	<b>VIX</b>	<b>TED Spread</b>	<b>Oil Price</b>	<b>Gold Price</b>
<b>Entire Period</b>				
<b>Mean</b>	19.153	0.407	67.073	947.923
<b>St. Deviation</b>	9.559	0.446	26.818	447.087
<b>Skewness</b>	1.747	3.596	0.1634	0.072
<b>Kurtosis</b>	9.017	20.879	2.054	1.758
<b>Jarque-Bera</b>	7896.268	60573.92	163.2	255.015
<b>Probability</b>	0.0000	0.0000	0.0000	0.0000
<b>Observations</b>	3914	3914	3914	3914
<b>Pre-Crisis Period</b>				
<b>Mean</b>	17.867	0.459	55.587	515.615
<b>St. Deviation</b>	7.416	0.421	26.977	186.761
<b>Skewness</b>	0.497	1.934	1.049	0.830
<b>Kurtosis</b>	3.955	6.607	3.793	2.625
<b>Jarque-Bera</b>	138.142	2032.504	365.947	210.599
<b>Probability</b>	0.0000	0.0000	0.0000	0.0000
<b>Observations</b>	1744	1744	1744	1744
<b>Crisis Period</b>				
<b>Mean</b>	47.889	1.698	56.767	850.306
<b>St. Deviation</b>	14.684	0.981	21.947	72.540
<b>Skewness</b>	-0.780	0.797	1.177	-0.161
<b>Kurtosis</b>	5.251	3.332	3.249	1.996
<b>Jarque-Bera</b>	45.942	16.235	34.304	6.809
<b>Probability</b>	0.0000	0.0000	0.0000	0.0000
<b>Observations</b>	147	147	147	147
<b>Post-Crisis Period</b>				
<b>Mean</b>	18.174	0.269	77.718	1327.703
<b>St. Deviation</b>	7.173	0.146	22.247	224.019
<b>Skewness</b>	0.613	1.281	-0.499	0.411
<b>Kurtosis</b>	4.770	7.102	1.939	2.405
<b>Jarque-Bera</b>	390.787	1971.887	178.963	86.664
<b>Probability</b>	0.0000	0.0000	0.0000	0.0000
<b>Observations</b>	2023	2023	2023	2023

**Table 6.1 : Descriptive Statistics for the Conditional Variables**

put oil prices in a safer place in times of crisis with high uncertainty.<sup>8</sup> Gold price situation was the safest in crisis period in which the mean gold price increased more than 50% while the standard deviation for the gold price has declined like a proof for a safe haven. The mean and standard deviation values have turned back to the pre-crisis levels for volatility index of VIX as expected. Gold prices had an increasing trend even after the crisis period with the oil prices. Normality of the series are rejected for all the periods and for all the time series with the approval of Jarque-Bera test for normality.

Variables	Augmented Dickey Fuller Test for Unit Root	
	Test Statistics	P-Value
Gold Price	-1.681	0.4408
Oil Price	-2.234	0.1943
Volatility Index (VIX)	-19.067	0.0000
TED Spread	-10.124	0.0000
Gold Price (Diff.)	-57.221	0.0000
Oil Price (Diff.)	-58.291	0.0000

Note: Critical values for unit root test are -3.43 and -2.86 respectively at 1% and 5% levels. (Diff) denote for the differenced series.

**Table 6.2 : Augmented Dickey Fuller Unit Root Test for the Stationarity of Conditional Variables**

Table 6.2 presents the unit root test results for all the conditional variables. Augmented Dickey Fuller test has been applied in line with the previous empirical study of the previous chapter. According to the findings VIX and TED spread have demonstrated stationarity while oil price and gold price were not stationary. First differences of the oil price and gold price series have been implemented to the data for the QR analysis. As it can be depicted from the table, taking the first differences was enough to derive stationary data for further analysis.

<sup>8</sup> As a response to financial crisis, oil prices decreased significantly from 145\$ in July 2008 30\$ in December 2008 as it is given in Figure 6.1. However, the results in Table 6.1 are the averages of a longer time period which cover the severity of the loss.

### 6.3.2. Estimates of the Model

Quantile Regression estimations for the US and European economies dynamic conditional correlation series are presented in the Tables 6.3-9 and Tables 6.10-13. According to the results, VIX index had highly significant pre-crisis effect on the dynamic conditional correlations of the European economies with the US. In the lower quantiles the effect was negative while in the intermediate and upper quantiles, the effect was positive for all the countries except Greece and Portugal. Those two economies had pre-crisis effect which is positive for all the quantiles. For Portugal, the situation became reversed after the GFC and the effect of VIX on DCCs had been negative among the quantiles. Post-crisis effect of VIX for the remaining countries became as the opposite of the pre-crisis. VIX had negative effect in the upper quantiles that represents the turmoil.

Quantiles	$\omega$	$\mu$	$\beta_{vix}$	$\Upsilon_{vix}$	$\beta_{ted}$	$\Upsilon_{ted}$
<b>Q (0.05)</b>	0.37787***	-0.08221***	-0.00626***	0.01014***	0.08252***	-0.09126***
<b>Q (0.10)</b>	0.37782***	-0.02503	-0.00196***	0.00565***	0.00801	-0.01944
<b>Q (0.25)</b>	0.37296***	0.03993***	0.00108***	0.00273***	-0.00941	-0.01021
<b>Q (0.50)</b>	0.35915***	0.12893***	0.00253***	0.00138***	0.00412	-0.04465***
<b>Q (0.75)</b>	0.42809***	0.13801***	0.00388***	-0.00087***	-0.00417	-0.03804***
<b>Q (0.90)</b>	0.5205***	0.14458***	0.00361***	-0.00183***	-0.00074	-0.03137***
<b>Q (0.95)</b>	0.56913***	0.10741***	0.0026***	-0.00114***	-0.00202	-0.02808***
Quantiles	$\beta_{gp}$	$\Upsilon_{gp}$	$\beta_{op}$	$\Upsilon_{op}$		
<b>Q (0.05)</b>	0.00013**	0.00003	0.00097**	-0.00094**		
<b>Q (0.10)</b>	0.00016***	-1.59E-05	0.00069*	-0.00086**		
<b>Q (0.25)</b>	0.00041***	-0.00029***	-0.00131***	0.00125***		
<b>Q (0.50)</b>	0.00061***	-0.00055***	-0.00281***	0.00326***		
<b>Q (0.75)</b>	0.00049***	-0.00047***	-0.00257***	0.00338***		
<b>Q (0.90)</b>	0.00035***	-0.00032***	-0.00224***	0.00216***		
<b>Q (0.95)</b>	0.00028***	-0.00025***	-0.00186***	0.00202***		

**Table 6.3. QR Estimations for USA-FRANCE Dynamic Correlation Series**

Quantiles	$\omega$	$\mu$	$\beta_{vix}$	$\Upsilon_{vix}$	$\beta_{ted}$	$\Upsilon_{ted}$
Q (0.05)	0.39901***	-0.13594***	-0.00491***	0.00993***	0.06331***	-0.08659***
Q (0.10)	0.42611***	-0.10454***	-0.00135**	0.00597***	0.00537	-0.02504
Q (0.25)	0.37389***	-0.03101*	0.00335***	0.00078**	-0.02738***	0.02064**
Q (0.50)	0.37671***	0.04774***	0.00429***	0.00034	-0.02943***	0.00123
Q (0.75)	0.43151***	0.13541***	0.00584***	-0.00304***	-0.04566***	0.01366
Q (0.90)	0.58901***	0.08206***	0.00496***	-0.00383***	-0.03799***	0.01339
Q (0.95)	0.6788***	0.00069	0.00323***	-0.00233***	-0.02921***	0.00561
Quantiles	$\beta_{gp}$	$\Upsilon_{gp}$	$\beta_{op}$	$\Upsilon_{op}$		
Q (0.05)	-0.0000459	0.00016**	0.00176***	-0.00092*		
Q (0.10)	-1.44E-05	0.00013*	0.00119***	-0.00077		
Q (0.25)	0.00044***	-0.00029***	-0.00204***	0.00213***		
Q (0.50)	0.00072***	-0.00062***	-0.00406***	0.00432***		
Q (0.75)	0.00061***	-0.00058***	-0.00361***	0.00429***		
Q (0.90)	0.00031***	-0.00029***	-0.00255***	0.00293***		
Q (0.95)	0.00012***	-0.00011***	-0.00167***	0.00225***		

**Table 6.4. QR Estimations for USA-GERMANY Dynamic Correlation Series**

Quantiles	$\omega$	$\mu$	$\beta_{vix}$	$\Upsilon_{vix}$	$\beta_{ted}$	$\Upsilon_{ted}$
Q (0.05)	0.03799**	0.1936***	0.00174***	0.00122*	-0.00301	0.00263
Q (0.10)	0.09943***	0.18588***	0.00212***	2.51E-05	0.05124***	-0.04407***
Q (0.25)	0.16842***	0.13064***	0.00157***	0.00048*	0.06925***	-0.06277***
Q (0.50)	0.19377***	0.09232***	0.00185***	0.00023	0.06063***	-0.05319***
Q (0.75)	0.16894***	0.1091***	0.00355***	-0.00121***	0.02242**	-0.01021
Q (0.90)	0.1845***	0.14652***	0.00344***	-0.00172***	-0.00246	0.02317
Q (0.95)	0.18328***	0.18621***	0.00271***	-0.00079	-0.02104	0.04097**
Quantiles	$\beta_{gp}$	$\Upsilon_{gp}$	$\beta_{op}$	$\Upsilon_{op}$		
Q (0.05)	0.00016***	-0.00025***	4.95E-05	0.00034		
Q (0.10)	0.00011**	-0.00019***	-0.00057*	0.00068**		
Q (0.25)	0.00013***	-0.00021***	-0.00125***	0.00132***		
Q (0.50)	0.00021***	-0.00023***	-0.00168***	0.00147***		
Q (0.75)	0.00043***	-0.00041***	-0.00273***	0.00203***		
Q (0.90)	0.00058***	-0.00052***	-0.00332***	0.00205***		
Q (0.95)	0.00073***	-0.00065***	-0.00403***	0.00221***		

**Table 6.5. QR Estimations for USA-GREECE Dynamic Correlation Series**

Quantiles	$\omega$	$\mu$	$\beta_{vix}$	$\Upsilon_{vix}$	$\beta_{ted}$	$\Upsilon_{ted}$
Q (0.05)	0.46685***	0.00676	-0.00476***	0.00688***	0.06573***	-0.07226***
Q (0.10)	0.47691***	0.01644	-0.00233***	0.00471***	0.04391***	-0.06114***
Q (0.25)	0.46451***	0.00809	0.00091***	0.00193***	0.02404***	-0.05359***
Q (0.50)	0.48146***	0.04004***	0.00173***	0.00153***	0.01947***	-0.05591***
Q (0.75)	0.50201***	0.05821***	0.00219***	0.00075**	0.011	-0.04313***
Q (0.90)	0.51182***	0.11778***	0.00294***	-0.00123***	-0.00211	-0.00978
Q (0.95)	0.53018***	0.11873***	0.00371***	-0.00227***	-0.01322	0.00583
Quantiles	$\beta_{gp}$	$\Upsilon_{gp}$	$\beta_{op}$	$\Upsilon_{op}$		
Q (0.05)	0.0000831*	-6.75E-05	-2.87E-05	-0.00014		
Q (0.10)	4.16E-05	-2.14E-05	5.69E-05	-0.00041*		
Q (0.25)	0.00013***	-0.0000807***	-0.00065***	0.00034*		
Q (0.50)	0.00021***	-0.00021***	-0.00142***	0.001511***		
Q (0.75)	0.00021***	-0.00022***	-0.00132***	0.00159***		
Q (0.90)	0.00026***	-0.00022***	-0.00159***	0.00099***		
Q (0.95)	0.00023***	-0.00017***	-0.00147***	0.00049		

**Table 6.6. QR Estimations for USA-ITALY Dynamic Correlation Series**

Quantiles	$\omega$	$\mu$	$\beta_{vix}$	$\Upsilon_{vix}$	$\beta_{ted}$	$\Upsilon_{ted}$
Q (0.05)	0.00125	0.29173***	0.00138***	-0.00022	-0.00121	0.03294**
Q (0.10)	0.02302	0.27182***	0.00557***	-0.00431***	-0.03547***	0.06316***
Q (0.25)	0.04931***	0.31451***	0.00627***	-0.00482***	-0.01644*	0.02652**
Q (0.50)	0.06482***	0.38127***	0.00561***	-0.00375***	-0.02582***	0.01089
Q (0.75)	0.12687***	0.34476***	0.00525***	-0.00263***	-0.03703***	0.00207
Q (0.90)	0.19191***	0.36303***	0.00409***	-0.00098**	-0.03939***	-0.00896
Q (0.95)	0.22101***	0.32086***	0.00378***	-0.00093**	-0.04401***	-0.00069
Quantiles	$\beta_{gp}$	$\Upsilon_{gp}$	$\beta_{op}$	$\Upsilon_{op}$		
Q (0.05)	0.00033***	-0.00011**	-0.00011	-0.00259***		
Q (0.10)	0.00028***	-7.13E-05	-0.00047	-0.00201***		
Q (0.25)	0.00052***	-0.00036***	-0.00254***	0.00056**		
Q (0.50)	0.00076***	-0.00066***	-0.00392***	0.00232***		
Q (0.75)	0.00067***	-0.00061***	-0.00331***	0.00247***		
Q (0.90)	0.00065***	-0.00063***	-0.00331***	0.00257***		
Q (0.95)	0.00065***	-0.00061***	-0.00339***	0.0028***		

**Table 6.7. QR Estimations for USA-PORTUGAL Dynamic Correlation Series**

Quantiles	$\omega$	$\mu$	$\beta_{vix}$	$\Upsilon_{vix}$	$\beta_{ted}$	$\Upsilon_{ted}$
Q (0.05)	0.40301***	0.21456***	-0.00661***	0.0075***	0.05048***	-0.05252**
Q (0.10)	0.46174***	0.08666***	-0.00194***	0.00338***	0.00579	-0.00892
Q (0.25)	0.44435***	0.08989***	0.00069***	0.00213***	-0.01492***	-0.01541**
Q (0.50)	0.44405***	0.10689***	0.00105***	0.00186***	-0.01679***	-0.01652***
Q (0.75)	0.47436***	0.11662***	0.00208***	0.00065***	-0.03294***	-0.00089
Q (0.90)	0.48586***	0.17945***	0.00275***	-0.00109***	-0.03937***	0.02912***
Q (0.95)	0.50698***	0.15672***	0.00261***	-0.00128***	-0.04186***	0.03095***
Quantiles	$\beta_{gp}$	$\Upsilon_{gp}$	$\beta_{op}$	$\Upsilon_{op}$		
Q (0.05)	-1.81E-05	-6.04E-05	0.00182***	-0.00182		
Q (0.10)	-4.16E-05	2.27E-05	0.00113***	-0.00124		
Q (0.25)	0.000079***	-0.0000806***	0.00018	-0.00041		
Q (0.50)	0.00025***	-0.00025***	-0.00094***	0.00078***		
Q (0.75)	0.00028***	-0.00031***	-0.00136***	0.00138***		
Q (0.90)	0.00032***	-0.00031***	-0.00166***	0.00079***		
Q (0.95)	0.00031***	-0.00029***	-0.00168***	0.00094***		

**Table 6.8. QR Estimations for USA-SPAIN Dynamic Correlation Series**

Quantiles	$\omega$	$\mu$	$\beta_{vix}$	$\Upsilon_{vix}$	$\beta_{ted}$	$\Upsilon_{ted}$
Q (0.05)	0.34304***	0.04823	-0.00757***	0.01134***	0.07618***	-0.12348***
Q (0.10)	0.37795***	0.03958*	-0.00289***	0.00663***	0.02795**	-0.07547***
Q (0.25)	0.37568***	0.09179***	-0.00113***	0.00437***	0.02149***	-0.05791***
Q (0.50)	0.37941***	0.12156***	0.00111***	0.00224***	0.02819***	-0.07641***
Q (0.75)	0.40226***	0.14869***	0.0019***	0.00025	0.01503***	-0.05172***
Q (0.90)	0.44293***	0.13643***	0.00211***	-0.00046*	0.00313	-0.03775***
Q (0.95)	0.46723***	0.11551***	0.00188***	-0.00041*	0.00227	-0.03588***
Quantiles	$\beta_{gp}$	$\Upsilon_{gp}$	$\beta_{op}$	$\Upsilon_{op}$		
Q (0.05)	0.00027***	-0.00014*	0.00028	-0.00084		
Q (0.10)	0.00028***	-0.00015***	-0.00039	-0.00023		
Q (0.25)	0.00038***	-0.00026***	-0.00121***	0.00049***		
Q (0.50)	0.00046***	-0.00037***	-0.00212***	0.00196***		
Q (0.75)	0.00046***	-0.00041***	-0.00218***	0.00251***		
Q (0.90)	0.00043***	-0.00041***	-0.00221***	0.00288***		
Q (0.95)	0.00042***	-0.00038***	-0.00215***	0.00291***		

**Table 6.9. QR Estimations for USA-UK Dynamic Correlation Series**

The effect of TED spread on the DCCs have demonstrated an insignificant result in most of the quantiles. For France the effect became significant and negative for upper quantiles. The correlation between UK and the US had been affected significantly in general. Pre-crisis effect was positive while it turned out to be negative after GFC. Germany and Portugal have shown similar results in terms of TED spread effects on their DCCs. Negative and significant effects of TED spread became insignificant after the crisis. Only significant results were for the lower quantiles for these two countries. In the Italian case, the results were highly significant for the tranquil periods (positive and significant for pre-crisis and negative and significant for the post-crisis) while turmoil quantiles have not displayed significant results both before and after the crisis.

Gold prices and oil prices as global indicators in the analysis had highly significant results for the overall cases. Gold prices had positive effects on the conditional correlations before crisis especially in the intermediate and upper quantiles. After the

Quantiles	<u>USA-France</u>		<u>USA-Germany</u>		<u>USA-Greece</u>		<u>USA-Italy</u>	
	Pre-Crisis	Post-Crisis	Pre-Crisis	Post-Crisis	Pre-Crisis	Post-Crisis	Pre-Crisis	Post-Crisis
Q (0.05)	-	+	-	+	+	+	-	+
Q (0.10)	-	+	-	+	+	NS	-	+
Q (0.25)	+	+	+	+	+	+	+	+
Q (0.50)	+	+	+	NS	+	NS	+	+
Q (0.75)	+	-	+	-	+	-	+	+
Q (0.90)	+	-	+	-	+	-	+	-
Q (0.95)	+	-	+	-	+	NS	+	-
Quantiles	<u>USA-Portugal</u>		<u>USA-Spain</u>		<u>USA-UK</u>			
	Pre-Crisis	Post-Crisis	Pre-Crisis	Post-Crisis	Pre-Crisis	Post-Crisis		
Q (0.05)	+	NS	-	+	-	+		
Q (0.10)	+	-	-	+	-	+		
Q (0.25)	+	-	+	+	-	+		
Q (0.50)	+	-	+	+	+	+		
Q (0.75)	+	-	+	+	+	NS		
Q (0.90)	+	-	+	-	+	-		
Q (0.95)	+	-	+	-	+	-		

**Table 6.10. Summarized Findings for the Impact of VIX on DCC among markets**

Quantiles	<u>USA-France</u>		<u>USA-Germany</u>		<u>USA-Greece</u>		<u>USA-Italy</u>	
	Pre-Crisis	Post-Crisis	Pre-Crisis	Post-Crisis	Pre-Crisis	Post-Crisis	Pre-Crisis	Post-Crisis
Q (0.05)	+	-	+	-	NS	NS	+	-
Q (0.10)	NS	NS	NS	NS	+	-	+	-
Q (0.25)	NS	NS	-	+	+	-	+	-
Q (0.50)	NS	-	-	NS	+	-	+	-
Q (0.75)	NS	-	-	NS	+	NS	NS	-
Q (0.90)	NS	-	-	NS	NS	NS	NS	NS
Q (0.95)	NS	-	-	NS	NS	+	NS	NS
Quantiles	<u>USA-Portugal</u>		<u>USA-Spain</u>		<u>USA-UK</u>			
	Pre-Crisis	Post-Crisis	Pre-Crisis	Post-Crisis	Pre-Crisis	Post-Crisis		
Q (0.05)	NS	+	+	-	+	-		
Q (0.10)	-	+	NS	NS	+	-		
Q (0.25)	-	+	-	-	+	-		
Q (0.50)	-	NS	-	-	+	-		
Q (0.75)	-	NS	-	NS	+	-		
Q (0.90)	-	NS	-	+	NS	-		
Q (0.95)	-	NS	-	+	NS	-		

**Table 6.11. Summarized Findings for the Impact of TED on DCC among markets**

Quantiles	<u>USA-France</u>		<u>USA-Germany</u>		<u>USA-Greece</u>		<u>USA-Italy</u>	
	Pre-Crisis	Post-Crisis	Pre-Crisis	Post-Crisis	Pre-Crisis	Post-Crisis	Pre-Crisis	Post-Crisis
Q (0.05)	+	NS	NS	+	+	-	+	NS
Q (0.10)	+	NS	NS	+	+	-	NS	NS
Q (0.25)	+	-	+	-	+	-	+	-
Q (0.50)	+	-	+	-	+	-	+	-
Q (0.75)	+	-	+	-	+	-	+	-
Q (0.90)	+	-	+	-	+	-	+	-
Q (0.95)	+	-	+	-	+	-	+	-
Quantiles	<u>USA-Portugal</u>		<u>USA-Spain</u>		<u>USA-UK</u>			
	Pre-Crisis	Post-Crisis	Pre-Crisis	Post-Crisis	Pre-Crisis	Post-Crisis		
Q (0.05)	+	-	NS	NS	+	-		
Q (0.10)	+	NS	NS	NS	+	-		
Q (0.25)	+	-	+	-	+	-		
Q (0.50)	+	-	+	-	+	-		
Q (0.75)	+	-	+	-	+	-		
Q (0.90)	+	-	+	-	+	-		
Q (0.95)	+	-	+	-	+	-		

**Table 6.12. Summarized Findings for the Impact of GP on DCC among markets**

Quantiles	<u>USA-France</u>		<u>USA-Germany</u>		<u>USA-Greece</u>		<u>USA-Italy</u>	
	Pre-Crisis	Post-Crisis	Pre-Crisis	Post-Crisis	Pre-Crisis	Post-Crisis	Pre-Crisis	Post-Crisis
Q (0.05)	+	-	+	-	NS	NS	NS	NS
Q (0.10)	+	-	+	NS	-	+	NS	-
Q (0.25)	-	+	-	+	-	+	-	+
Q (0.50)	-	+	-	+	-	+	-	+
Q (0.75)	-	+	-	+	-	+	-	+
Q (0.90)	-	+	-	+	-	+	-	+
Q (0.95)	-	+	-	+	-	+	-	+
Quantiles	<u>USA-Portugal</u>		<u>USA-Spain</u>		<u>USA-UK</u>			
	Pre-Crisis	Post-Crisis	Pre-Crisis	Post-Crisis	Pre-Crisis	Post-Crisis		
Q (0.05)	NS	-	+	-	NS	NS		
Q (0.10)	NS	-	+	-	NS	NS		
Q (0.25)	-	+	NS	-	-	+		
Q (0.50)	-	+	-	+	-	+		
Q (0.75)	-	+	-	+	-	+		
Q (0.90)	-	+	-	+	-	+		
Q (0.95)	-	+	-	+	-	+		

**Table 6.13. Summarized Findings for the Impact of OP on DCC among market financial crisis, the effect became significantly negative among the quantiles for all the analyzed countries. Correspondingly, oil prices had significantly negative effects on the conditional correlations before crisis in the intermediate and upper quantiles while the effects of oil price became significantly positive after the crisis.**

## 6.4. CONCLUSION

In this chapter, it is analyzed whether the constructed model has the potential to relate contagion to underlying global risk factors. These factors may have effect on equity returns in various markets. According to the QR results, significant effects of VIX, gold price and oil price on dynamic correlations among the European countries and the US have been detected, while TED spread has been mostly insignificant in explaining the correlations between the markets. The factors have been chosen according to their ability to control international stock markets' asset values and to adjust the demand of those asset classes on the degree of contagion.

The impact of volatility index on conditional correlations between the US and European economies is generally positive in the pre-crisis period. Negative effect of VIX is dominant only in the lower quantiles. Post-crisis effect of VIX does not give a comprehensive picture for the conditions of the European markets. The US has recovered faster after the global financial crisis with the immediate policy actions taken by the FED. These reactions lead the stock market returns to increase and VIX index to decrease in post-crisis period. However, due to Europe's belief in their economies' resilience, the reaction of ECB has been later than the US FED's. Accordingly, the negative coefficients of VIX in explaining the dynamic correlations for the turmoil quantiles reflect this policy gap in European regulative body. The expected post-crisis sign of VIX was positive, however the extension of recovery reflects the negative sign of the coefficients especially for Portugal and Greece. Fluctuations in these markets reflect their own fundamental risks in the presence of high financial stress in the post-crisis period. Accordingly, the results do not support the co-movement with the US anymore, in terms of VIX index values.

As a recall, gold prices tend to influence the correlations positively in pre-crisis, while the influence was negative in the post-crisis period. The upward movement in gold prices attract the investors to diverge from stocks to gold in their portfolios, i.e. investors are observing the countries' situations, risks and strengths, and evaluate the gold price increases along with that information. If the evaluated country is perceived to be risky,

then the investors liquidate their assets in order to decrease the risk in high quantile periods. Instead, they invest in gold markets. That's to say, investors make their portfolio decisions according to both the dynamic conditional correlations among the markets and their perception of risk factors in liquidation of their portfolio assets in high correlation and increased contagion periods. Since the relationship between the gold prices and correlations is affected negatively after the crisis, increases in gold prices cause the markets to deviate from each other.

Oil price has drawn a picture which is opposite to gold prices in terms of its effect on dynamic conditional correlations. Oil prices positively affect the correlations with the US market in the post-crisis environment. The economies in the observation are mostly developed European economies. They produce and sell the finished product which makes them finished-product-export oriented markets. Countries, whose economies depend on industrial sector, watch oil prices closely since oil is an essential input in those countries' production processes. The macroeconomic risks seem to be shared by these economies, since it is depicted from trade and financial features of these markets after the crisis. Generally sharp oil price declines are associated with crisis conditions. The negative movement of oil prices in pre-crisis period reflects the expected case. However, after the crisis, oil price and correlations move together which demonstrates selected economies' dependency to oil because of their economic characteristics.

## **CHAPTER SEVEN**

### **7. THE IMPACT OF FED'S UNCONVENTIONAL MONETARY POLICY TOOLS ON THE SELECTED EUROPEAN ECONOMIES**

In this final empirical chapter, it is attempted to understand the effects of unconventional monetary policies on the financial markets as well as on the fundamentals of the economy. In order to study the effects of unconventional monetary policies, most common method used in the literature is vector autoregression (VAR) models which will also be the method of this empirical study.

Applying VAR models for the effects of unconventional policies has some advantages. Its compatibility to the literature is one of the advantages. Also, VAR models can predict the effects on output, inflation and unemployment directly. Additionally, with this method it is possible to estimate the effectiveness of unconventional policy tools relative to its volume since the estimated impact is related to the volume of a measure (e.g. the change in the balance sheet) (Fiedler et al., 2016).

To analyze the effect and transmission of monetary policy, money demand function comes as one of the most important variables in the analysis. Money demand function builds a link between real sector and monetary sector while it consists of a money stock variable which depends on the transactions volume and opportunity cost for holding money. However, since the focus of this empirical study is on the balance sheet policies, the proxy for the balance sheet expansions is chosen as the value of the total assets of FED. As a financial variable, interest rate is chosen which denotes the opportunity cost. Following a parsimonious approach for the data selection, small number of variables included in the system since larger number of variables would harm the model by making it harder to catch the dynamic relations between the variables.

## **7.1. INTRODUCTION TO THE ROLE OF CENTRAL BANKS AND THEIR POLICIES**

Under normal economical and financial conditions, central banks' main conventional instruments to reach their goals are the interest rates where their main goals are either low inflation or stimulating economic growth. In fact, different central banks may have different goals stated, such as FED who targets maximum employment (which leads to economic growth), stable prices (that means low inflation) and moderate interest rates while European Central Bank (ECB) targets low inflation at first which then ensures economic growth (which is their expectation). Actually, the objective of killing two birds with one stone cannot be reached always. Central banks try to reach their goals mainly with one tool, interest rate. This situation cannot be possible most of the times in practice.

In theory, economic cycle which consists of booms and busts, includes both the case that the economy has strong growth that leads to high inflation with too much liquidity because of high money supply, and the case that the economy slows down with the central bank's intervention of raising interest rates. For instance; economic growth enhances from a previous decline in interest rates (boom cycle). The enhancement in growth causes higher demand, employment and demand for raw materials, etc. In the end, the situation leads to supply problems which then causes wages to go up and relates to inflationary pressure. In brief, economic growth produces higher inflation (cost-push inflation). At this point central bank intervenes and raises the interest rates which reduces demand and slows the economy down (bust cycle). The cycle goes on as the central bank enters again to reduce interest rates to stimulate economy. All in all, interest rate is the main tool that central banks' conventional policies focus.

For central banks, it is easier to cool an overheating economy with high growth and high credit demand. With low inflation targeting, central banks raise interest rates to whatever level is needed. Consequently, demand will decrease, and inflation will be lowered. The other scenario is challenging because there is a limit for interest rates in the lower bound. In fact, after the global financial crisis of 2008, all central banks aimed to

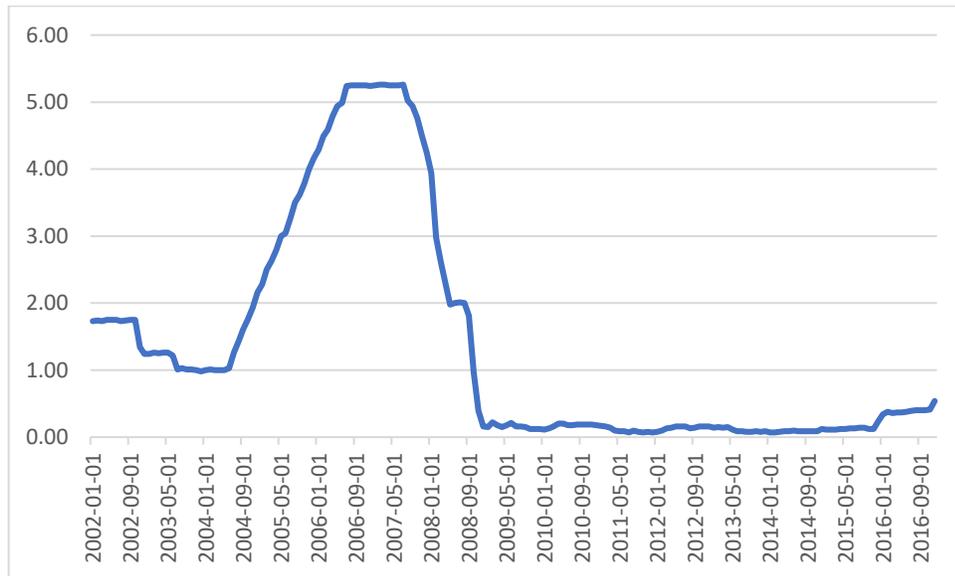
promote economic growth, inflation has not been in the center of concern. But the interest rates have been near the zero lower bound which make lowering the rates impossible (except some cases). This is where the conventional policies have been insufficient to rescue the economies and the unconventional policy tools have been in action for further stimulus.

Quantitative easing, targeted asset purchases and forward guidance are three ways of these unconventional policies. Both quantitative easing (QE) and targeted asset purchases (TAP) are related to central banks' balance sheets. In order to highlight the difference between the two; QE is related to the expansion in the balance sheet while TAP is related to the change in the balance sheet composition. In QE, balance sheet scale and supply of reserves are affected as opposed to TAP. Forward guidance changes neither the composition of the balance sheet nor the scale. It is an announcement by the central bank about the route and expectations about the future policy rate. It is actually an assurance from a central bank to the public to influence the financial decisions by giving clues about the route of the interest rates in order to prevent surprises which may cause harm for the overall economy. All in all, the aim is to keep interest rates low enough not to have credit shortage and to stimulate the economy.

Concerning the European countries' survival from the global financial crisis, the European Central Bank (ECB) has adopted different nontraditional monetary policies ranging from forward guidance through balance sheet measures since the onset of the crisis. Besides; asset purchases in specific market segments (direct credit-easing), large-scale asset purchases (LSAPs are direct quantitative easing) and indirect credit and quantitative easing are included in balance sheet measures to improve the central banks' balance sheets. With the unconventional monetary policies taken, central banks' balance sheet compositions have faced pronounced changes.

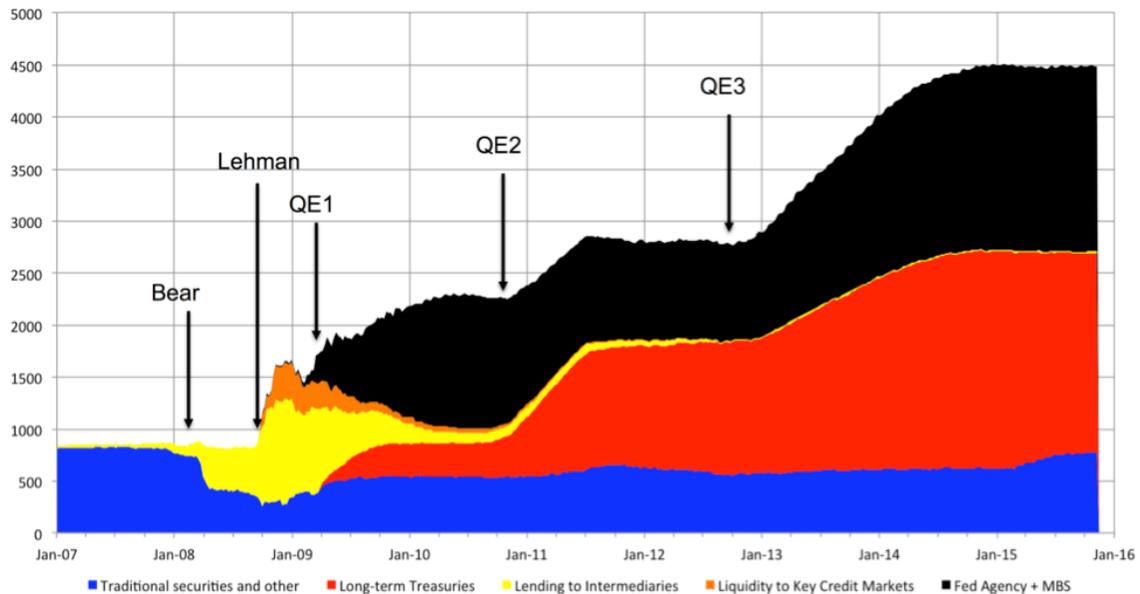
In the beginning phase of the global financial crisis, ECB has adopted indirect credit and quantitative easing policies which then evolved to direct credit and quantitative easing measures. This differs from other central banks such as US FED which has used

direct measures much earlier and recovered much faster after the crisis. The aim was clear and common for all the central banks: to ease the stress and then stimulate economy.



**Figure 7.1 : Monthly Evolution of Federal Fund Rates (2002-2016)**

US FED had cut the federal funds rate sharply after the global crisis. Figure 7.1 shows the dynamics of FED rate between the years 2002 and 2016. Federal funds rate, as a conventional policy tool, hit the zero-lower bound at the end of 2008. FED decided to start large-scale asset purchases as a quantitative easing action which then affected the size and composition of the FED balance sheet. FED was targeting to lower the long-term interest rates and in that way, enhance the economic activity (Bhattarai, Chatterjee, & Park, 2015).

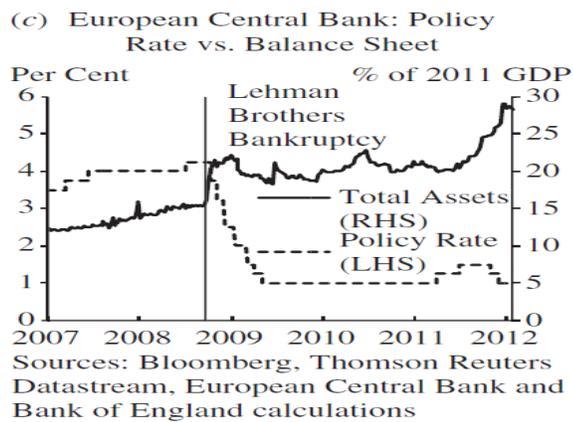
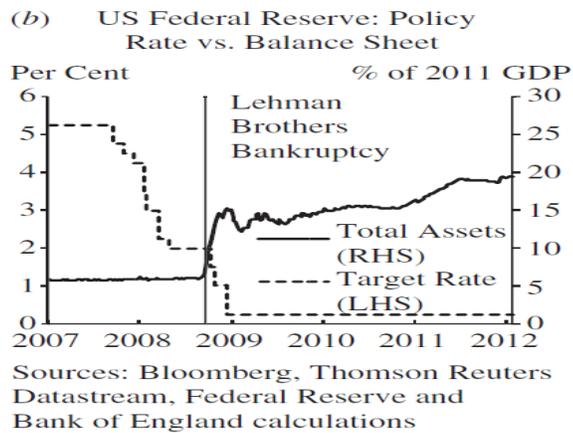
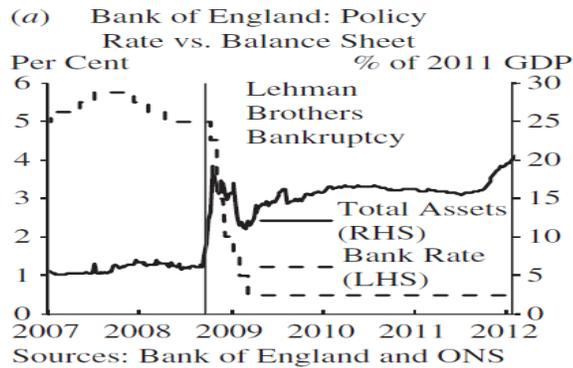


**Figure 7.2 : FED Assets (Billions of Dollars)**

Source: website [www.moneyandbanking.com](http://www.moneyandbanking.com) (taken from Federal Reserve Bank of Cleveland)

In the Figure 7.2, the mix of the FED assets has been shown for the period between January 2007 and January 2016. After the run on Bear Stearns, the composition of FED balance sheet has changed while the size has not been affected. Thus, there has been a TAP implication as an unconventional policy without the use of quantitative easing. Following Bear Stearns, Lehman Brothers collapsed and after that incidence, FED immediately took action and both QE and TAP have been implemented together by providing credit and also expanding balance sheet. It can be depicted from the figure that both QE1, QE2 and QE3 episodes are mixtures of QE and TAP decisions.

In the Figure 7.3, the progress of balance sheet expansions of both ECB, FED and Bank of England with respect to policy rate is shown between the years 2007 and 2012. With the implications of balance sheet expansion policies after the Lehman Brothers collapse, all three central banks performed unconventional monetary policy actions and expanded their balance sheets and ultimately reduced their policy rates.



**Figure 7.3 : Major Central Banks' Balance Sheets and Policy Rates Movements During the Crisis**

Source: The figure is retrieved from the work by M. Joyce, Miles, Scott, and Vayanos (2012)

Thus, the literature for the effects of unconventional policies consists of the effectiveness of balance sheet measures or the effectiveness of forward guidance either on

financial markets or on economic activity. Event studies are constructed for the analysis of the effects on financial markets and VAR models are constructed for the analysis of the effects on the economic activity.

One of the limitations for studies that focus on the effects of unconventional policies is the time period that has been used in the literature which is inevitable. Since these policies have been used for relatively shorter period of time by the central banks, the samples must have been small. Also the frequency of the data used in the VAR studies is generally monthly or quarterly which makes the model to have difficulty in doing correct estimations relative to high frequency data, such as daily or intra-daily (Fiedler, Hanisch, Jannsen, & Wolters, 2016).

Since the QE policies have been used by the US in the first place, most of the studies which focus on the effect of those policies on the financial markets used the FED and US data to understand the impacts. However, with the announcement of new policies by also the ECB, researchers also tried to understand the impacts of the policies on euro area.

## **7.2. LITERATURE REVIEW**

In the literature, the researchers are divided as the ones who try to understand the effects of balance sheet policies and on the other side, the ones who try to understand the effects of forward guidance. In fact, effectiveness of forward guidance is questionable in the literature. In other words, it is difficult to estimate. The success depends on the communication way of central banks and also the understanding of the counterparties; how the guidance is understood and perceived to be credible. For these limitations, the focus of this chapter is not forward guidance but instead the effects of balance sheet policies.

This empirical study intends to contribute to the literature on the global effects of nontraditional policies of US with a special focus on the Europe. Again, the following sub-sections will be looking for the effects of the policies on both financial markets and

macro-economic activity, such as bond yields and GDP, inflation and unemployment levels, respectively.

### **7.2.1. Balance Sheet Policies**

Balance sheet policies are inspected in two categories as QE and TAP. For the mixture of QE and TAP actions, FED has used the term large-scale asset purchases (LSAP) which affect both the size and composition of the balance sheet. The literature on the balance sheet policies are mostly trying to investigate the effectiveness of LSAP actions of FED.

Expected and agreed results for the effects of balance sheet policies which are expansionary, are a decrease in the long-term profits and finally an increase in the asset prices, while they have positive effects on GDP and inflation on the macroeconomic side. The majority of the studies agreed on the positive effects of balance sheet measures on the financials. In this regard, event studies are used by the researchers to understand the effects on the financial markets.

The size of the effects changes across the studies held by the researchers. For example, the peak effects of QE programs scaled to \$1 trillion on GDP range from 0.2 to 4 percent (Fiedler et al., 2016). Furthermore, the studies are mostly concentrated on the US data while newly euro area is also seen to worth for examining, especially after the European sovereign debt crisis which came after the global financial crisis. Our focus will be in these two markets though there are empirical studies on other countries such as Japan and United Kingdom which are struggling with the zero lower-bound of interest rates.

#### **7.2.1.1. Studies Related to Financial Effects of Balance Sheet Policies**

Gambacorta, Hofmann, and Peersman (2014) applied SVAR methodology in order to analyze the effects of unconventional policy tools on economic activity. The focus group of the study was the euro area. The results indicated a similar effect of unconventional policies on economic activity as conventional policies which are working

through changes in the interest rates. They expanded their analysis with fellow researchers by using panel for eight European countries. Again, the effect of non-standard measures on economic activity is proven but the sizes of the effects have been different for each country (Boeckx, Dossche, & Peersman, 2014).

Krishnamurthy and Vissing-Jorgensen (2011) evaluated the effect of FED purchase of long-term bonds (QE1 and QE2) on the interest rates and completed the analysis with the channels of the impact by utilizing the event studies. The findings suggest that the purchases significantly lowered nominal interest rates.

Concentrating on the Bank of England, M. Joyce, Lasosa, Stevens, and Tong (2011) analyzed the effect of QE policies on UK asset prices. Three channels are considered in the paper which might have effect on asset prices, namely, macro news, portfolio balance and liquidity premia. The researchers have used overnight index swap contracts for quantifying the role of channels. The results have concluded that the purchase policies had significant effect on financial markets.

D'Amico, English, López-Salido, and Nelson (2012) approved the negative effect of LSAP policies on long-term bond yield. The authors have analyzed each LSAP program separately and compared the results. According to their analysis, second program which is larger in amount but smaller in its impacts of duration, reduced the yields by about 45 basis points while the first one reduced the long-term yields by about 35 basis points. The direction of the effect is as expected from the implemented policy.

By applying dynamic term structure models, M. Joyce et al. (2012) studied the decrease in government bond yields after FED and Bank of England's nonstandard policy announcements. For the US, they have found that FED's LSAP policies had lowering impact on policy expectations. On the other hand, government bond yields decreased after QE announcement with the effect of reductions in term premiums.

Gilchrist and Zakrajšek (2013) have searched for the effects of FED's LSAP actions on corporate credit risk with the method of heteroskedasticity-based approach. The

findings indicated that nonstandard measures of FED, have lowering impact on the overall level of credit risk but no effect on credit risk in the financial intermediary sector.

Fawley and Neely (2013) adopted a more comprehensive view by analyzing four central banks' QE programs, namely FED, Bank of England, ECB and Bank of Japan. The aim of those programs was to ease the economic conditions of the related countries after the financial crisis. The authors have given a very broad and detailed timeline for the quantitative analysis of four central banks.

In their work, Falagiarda and Reitz (2013) analyzed more than fifty events of non-standard tools in order to study the effects of ECB policies on the sovereign risk of Italy. Both event study and GARCH methodology were utilized. The findings have shown a decrease in the Italian long-term government bond yield spread which was compared with the Germany. They have also compared different non-standard programs and their effects. According to this research, the most effective measure has been found as Securities Markets Programs and Outright Monetary Transactions for the sovereign risk of Italy. The same topic has been studied with the same authors for the euro area. Results were indeed similar and complementary. ECB program announcements have significantly affected the sovereign yield spread of euro area countries. Only exception was Greece (Falagiarda & Reitz, 2015).

Gibson, Hall, and Tavlas (2016) studied the effects of Securities Market Program and Covered Bond Purchase Program of ECB on selected euro area countries' sovereign bond spreads and covered bond prices. Monthly data from 2004 to 2014 has been utilized and findings indicated that mentioned asset purchase policies caused a reduction in sovereign spreads which then ease the stress and raised covered bond prices.

The spillover effects of US QE program have been discussed also by Bhattarai et al. (2015) for the emerging market economies using Bayesian VAR on monthly data. Expansionary US QE shocks have significantly affected the financial variables of emerging economies. The results have been concluded as an appreciation in the exchange

rate, a decrease in the long-term bond yields, stock market boom and an increase in capital inflows to the countries in the analysis. However macro-economic variables, such as consumer prices and output, did not show significant results.

Fratzscher, Duca, and Straub (2016) analyzed the impact of the ECB's unconventional monetary policy on asset prices and exchange rates in the euro area and globally with event study methodology. They have used panel model for the period of 2007-2012, utilizing the daily data. Their study has proved the positive impact of policies on the financial markets in the euro area but more importantly, proved the spillovers to global markets by increasing equity prices and lowering credit risk and risk aversion. Briciu and Lisi (2015) have used broader data with the inclusion of several more years into the time span of Fratzscher et al. (2016) and confirmed their results.

Andrade, Breckenfelder, De Fiore, Karadi, and Tristani (2016) have focused on the asset purchase program of ECB on yields and on macroeconomy. They have found a decrease in sovereign yields on long-term bonds and increase in the share prices of banks those holding more sovereign bonds because of the asset purchase program announcement.

Fratzscher, Lo Duca, and Straub (2017) analyzed daily data of the US, advanced economies and emerging economies in order to examine the effects of FED's QE on portfolio flows, more specifically the effects on portfolio decisions of investors. The results validated the effect of asset purchases on the flows. Additionally, they have confirmed a spillover from the US to other economies, especially in the periods when uncertainty was lower and the US outlook was positive. Analyzing for all individual QE policies, the authors have found that QE1 policy announcements prompted primarily a portfolio rebalancing into riskier market segments while QE2 and QE3 announcements had the strongest impact on inflows to EMEs.

### **7.2.1.2. Studies Related to Macro-Economic Effects of Balance Sheet Policies**

On the macroeconomic side, Le and Pfau (2009) analyzed the monetary transmission mechanism by using VAR methodology. Money, real output, price level, real interest rate, real exchange rate and credit are variables utilized for the reduced form relationships. The outcomes indicated that the monetary policy may affect output and price level as expected. The effect on output took four periods to be visible, while on price levels, it took even longer to be effective.

The use of asset purchases is investigated by Chung, Laforte, Reifschneider, and Williams (2012) as a non-standard tool when the interest rates are stuck at the zero-lower bound, concentrating on the FED. The policies are found helpful in neutralizing the economic costs of the zero-interest rate. The findings support that if FED increases the security holdings, unemployment rate would be lower than the case without the purchases. Furthermore, the researchers have concluded with the role of asset purchases as a rescue from deflation for US. On the contrary; Chen, Cúrdia, and Ferrero (2012) found smaller effects of asset purchases. They have analyzed the LSAP2 program of FED by DSGE modelling and found persistent positive effect on GDP growth levels while the effects on the inflation stayed in the moderate levels.

For the UK in the center of interest, Kapetanios, Mumtaz, Stevens, and Theodoridis (2012) utilized BVAR methodology to investigate the effects of Bank of England's asset purchases on GDP and CPI levels, specifically for the first round of quantitative easing program which started in March 2009. Bank of England's purchases of £200 billion assets helped GDP and CPI to increase by 2.5% and 1.5%.

Weale and Wieladek (2016) analyzed the effects of asset purchases in the UK and the US on real GDP and CPI by utilizing Bayesian VAR methodology. Monthly data is used ranging from 2009M3 to 2014M5. The results indicated that an asset purchase announcement of 1% of GDP leads to a significant rise of 0.58% and 0.62% in real GDP and CPI for US while it caused 0.25% and 0.32% rise in real GDP and CPI for UK. For

the US, the program had a similar effect on GDP and inflation, while the situation differed for UK, which has shown a much larger effect of policy on inflation than GDP.

Filardo and Nakajima (2018) analyzed the data for the US, UK, euro area and Japan by applying time-varying parameter VAR (TVP-VAR) approach. Both interest rate sensitivity and the effects on the sovereign bond yields have been investigated. The findings have supported that the economy did not become less interest sensitive after the financial crisis. Also, they concluded that the effects of policies on the sovereign bond yields have become weaker over time which cause a need for new policy programs to implement.

### **7.3. DATA SELECTION OF UNCONVENTIONAL POLICY ANALYSIS**

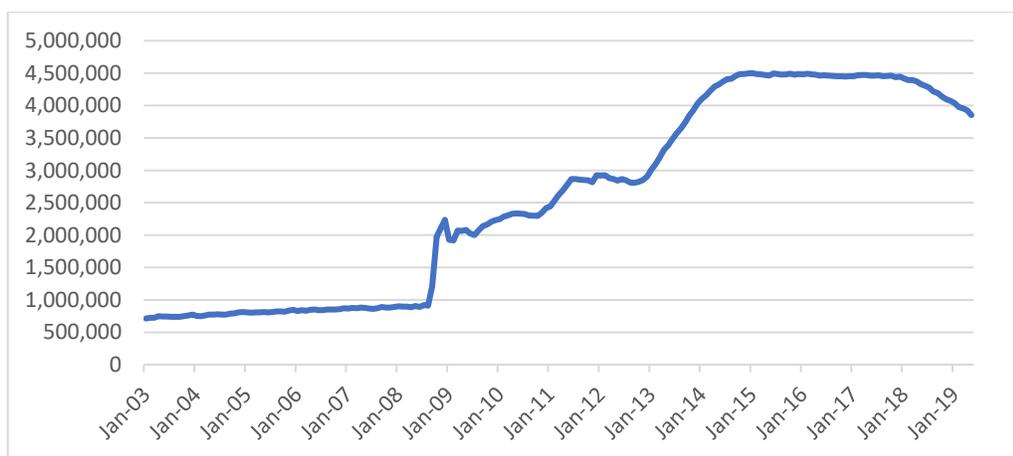
The data for the policy analysis has been determined as parsimonious as possible in order to catch the dynamic relations. For that reason, five variables have been chosen as independent variables, namely real GDP, unemployment, 10-year government bond yield, stock prices and total assets of the central banks.

Time span for the analysis starts from the beginning of 2007 till the end of 2016. Such data interval is selected in order to capture both the dynamics of the period during and after crisis. Time limitation for the unconventional policy analysis restricted the beginning year of the analysis as 2007 but the ending year of the analysis is consistent with the previous empirical chapters.

Even if the first attempt of asset purchases and unconventional policy implications have been started by the FED, ECB and Bank of England have also contributed to the process by their own policy actions soon after. Since the concerning countries are the European countries, the effect of FED is crucial, but it is also important to see the real effects of European central banks in order to be able to make a comparison.

All data is taken from Thomson Reuters DataStream and Federal Reserve Database (FRED) and is calculated on monthly basis. Only exception is the real GDP data which is announced as quarterly basis. For this reason, monthly real GDP data is transformed from quarterly data by utilizing cubic spline interpolation method. After data collection process, data have been transformed into their logarithmic values except the 10-year yield on government bond and unemployment rate.

Firstly; the state of the economy is reflected by real GDP and the unemployment rate variables. Secondly; financial situation is captured by the stock prices. European countries mostly have developed stock markets. Thus, one way for a crisis to spillover to an economy may be stock market channel. That’s why, it is a good proxy to include in the model for the European countries. Thirdly; 10-year government bond yield entered the model as the interest rates which have been widely used as a conventional monetary tool for years by the central banks. Lastly, the total asset of FED and ECB are added into the model as to test for the unconventional behavior of the central banks which have shown a very sharp increase with the asset purchase programs after the global financial crisis. Total asset value has been accepted as a measure for the balance sheet expansion of the central banks.



**Figure 7.4 : Total Assets of FED (mlns \$)**

In the US, asset purchases were implemented in three phases between 2008 and 2014, commonly labelled as QE1, QE2, and QE3. With an attempt to boost the economy, FED has started to buy securities and expand its balance sheet. Before this decision, FED's assets were about \$900 billion. Approximately three months after the collapse of Lehman Brothers, first quantitative easing program has started in November 2008. First QE program was the longest and has been active for 17 months. In those 17 months FED's spending for the purchases reached to \$ 1.7 trillion. The aim was to provide liquidity into the system in order to stop further collapse. After a period of steady balance sheet, QE2 has been decided to be put in action with the FED's decision to lower unemployment which has reached 10%. Second round of QE became active after 7 months from the end of QE1. QE2 has been active for 7 months from November 2010 till June 2011 which has led to a total purchase of \$595 billion. The FED's balance sheet kept growing with other QE programs in this period. As it can be depicted from the Figure 7.4, FED's total assets have been evolved from \$900 billion to \$2.8 trillion. Third announcement came in September 2012 as a purchase when the FED again has been unpleasant with the unemployment rate which has not been lowered enough. Eventually the balance sheet has been evolved to \$4.5 trillion in total after the unconventional monetary policy that the FED has decided to implement in order to support the economy.

The European countries in the analysis are chosen in tandem with the first empirical study of the thesis which analyzes the existence of spillover effect of global financial crisis started in the US. For an attempt to see the divergence from the average effect for the European countries, Eurozone is also added into the analysis.

In the VAR model, asset purchase shocks are identified by using lower triangular scheme with the help of EVIEWS statistical package. Cholesky ordering of variables are decided as real GDP, unemployment, total assets, interest rate and stock prices. So, balance sheet variable is placed after macroeconomic variables but before the remaining variables. The underlying assumption of this decomposition is that real GDP and

unemployment react to total asset changes which is balance sheet expansion variable, but this balance sheet variable does not react to other two variables.

The main steps in the analysis will be as follows:

- 1) Stationarity Test
- 2) VAR model and lag selection
- 3) Impulse Response Functions

### **7.3.1. Stationarity Test**

Most economic time series exhibit non-stationary behavior in their original forms. In order to check for the stationarity of the data, there are several tests to be applied, namely Augmented Dickey Fuller (ADF), Phillips Perron (PP) and Kwiatkowski–Phillips–Schmidt–Shin (KPSS) unit root tests. KPSS test is a stationarity test that check for the null hypothesis that the time series is stationary while ADF and PP tests are unit root tests those check for the null hypothesis that the time series have unit root (therefore, not stationary). In this manner, ADF and PP unit root tests are applied to the data to check for the stationarity and the results have shown that the series are not stationary at levels but become stationary after differencing, as expected. Table 7.1 shows the unit root test results for entire dataset by applying both ADF and PP tests.

There is a debate about the necessity of ensuring the stationarity of the variables while conducting a VAR analysis. One side argues that unit root is a problem that causes the model not to be trustful and causing for the spurious results. On the other side, differencing is a problematic solution which causes researchers to lose long-run relationship between the levels. That is why differencing has practical implications, but it is not a recommended way of solution. While one side argues for the condition of stationarity for running a VAR model, other scholars discuss that it depends on the aim of the study.

If the aim of the analysis is to see the nature of the relationships instead of the coefficients (parameter estimates), then one may be free of ensuring the stationarity. After

Variables	<u>ADF Statistics</u>		<u>PP Statistics</u>	
	ADF in Level	ADF Differenced	PP in Level	PP Differenced
LnTA_FED	-1.725501	-6.725406***	-1.734898	-6.062077***
LnTA_ECB	-1.127398	-10.72268***	-1.173307	-10.72865***
<b>United Kingdom</b>				
LnRGDP	1.267423	-3.184325**	0.428467	-3.542684***
Unemp	-0.687425	-4.374234***	-0.632865	-7.044029***
Yield	-1.446410	-7.393516***	-1.197969	-7.331817***
LnStock	-1.674466	-10.66382***	-1.835402	-10.66695***
<b>Germany</b>				
LnRGDP	-0.155415	-3.452443**	-0.355974	-3.112540**
Unemp	-1.068933	-3.588224***	-1.792089	-7.875073***
Yield	-0.960103	-7.715751***	-0.789835	-7.715751***
LnStock	-0.689663	-8.556647***	-0.839701	-9.296831***
<b>France</b>				
LnRGDP	0.597992	-3.196905**	-0.339491	-3.403870**
Unemp	-1.584936	-4.096378***	-1.118289	-6.986592***
Yield	-0.816271	-7.860573***	-0.545947	-7.662501***
LnStock	-1.986119	-9.443256***	-2.137167	-9.401319***
<b>Italy</b>				
LnRGDP	-3.427819**	-3.246846**	-1.873086	-2.678940*
Unemp	-1.159281	-3.710322***	-1.151496	-13.07587***
Yield	-0.865059	-8.543459***	-0.666290	-8.348559***
LnStock	-2.176429	-9.201028***	-2.215060	-9.180438***
<b>Portugal</b>				
LnRGDP	-1.620225	-2.826634*	-1.210986	-3.208073**
Unemp	-1.177698	-3.670457***	-1.162799	-6.325074***
Yield	-1.773434	-3.708957***	-1.383798	-9.623336***
LnStock	-1.262859	-9.216012***	-1.469657	-9.263459***
<b>Spain</b>				
LnRGDP	-2.525741	-3.812483***	-0.897930	-2.285442**
Unemp	-2.704665*	-14.11472***	-2.200472	-13.97458***
Yield	-0.253675	-8.920187***	-0.387079	-8.778448***
LnStock	-2.047579	-9.938378***	-2.120076	-9.904250***
<b>Greece</b>				
LnRGDP	-2.316262	-5.369373***	-0.876651	-4.263504***
Unemp	-1.889478	-11.45642***	-1.057511	-6.654533***
Yield	-1.588196	-8.970080***	-1.730099	-9.725095***
LnStock	-1.269801	-9.952662***	-1.310273	-9.973444***

**Table 7.1 : Unit Root Test Results of Stationarity**

Note (1) : LNRGDP represents log transformation of real GDP, Unemp represents unemployment rate, Yield represents the yield on 10-year government bond and finally LnStock represents log transformation of stock market prices.

Note (2) : \*, \*\* and \*\*\* shows the significance in %10, %5 and %1, respectively.

estimating a level VAR model with non-stationary variables, the ultimate purpose is to reach the impulse response analysis of variables due to shocks in the policy variables. The shocks can either be identified by Cholesky decomposition or by imposing restrictions on the relationships among the concerned variables which then lead to structural VAR (SVAR) model.

The purpose in this empirical chapter is policy analysis (expansionary monetary policy of the FED and ECB specifically) using impulse response functions and graphs. For that reason, even if the unit root tests proved non-stationarity of the time series data, impulse response analysis will be held with levels under VAR modelling. The shock is identified by Cholesky decomposition and Cholesky ordering of variables are decided as real GDP, unemployment, total assets, interest rate and stock prices. Impulse response function (IRF) graphs which are derived from the VAR analysis will be used to analyze the effects of US asset purchases on selected macroeconomic and financial variables of the selected European countries.

### 7.3.2. Specification of The Empirical Model

The effects of exogenous balance sheet shocks on the economy are analyzed with the use of Vector Auto Regression (VAR) methodology. In order to evaluate the real economy impact of central bank balance sheet expansion, following VAR model is constructed:

$$Y_t = \alpha_c + \sum_{k=1}^L B_k Y_{t-k} + e_t \quad e_t \sim N(0, \Sigma) \quad (1)$$

where  $Y_t$  is a vector of the following endogenous variables:

- a. Total central bank assets (log transformation is applied) used for the size of the balance sheet;
- b. Real gross domestic product (log transformation is applied);
- c. Unemployment Rate;
- d. The yield on the 10-year government bond;
- e. Stock prices in the selected stock markets (log transformation is applied).

$B_k$  is the array of coefficients associated with the corresponding lagged vector of variables for the lag  $k$ .  $\alpha_c$  is a vector for the constants and  $e_t$  is a vector of residuals at time  $t$ . This vector is expected to be normally distributed with variance-covariance matrix  $\Sigma$  as indicated in the Equation 1. The lag length criteria lead us to select the lag length,  $L$ , as four for each individual country's VAR analysis.

Nevertheless, after estimating VAR model, serial correlation LM test is applied to the residuals in order to be sure that the lags are sufficient to explain all the dynamics of the relations among the endogenous variables. Table ??? demonstrates the results of LM test.

Country Analyzed	LM-Stat	Probability
France-US	28.17377	0.2999
Germany-US	30.64355	0.2011
United Kingdom-US	31.74326	0.1656
Italy-US	28.25671	0.2962
Greece-US	33.62634	0.1161
Spain-US	24.75951	0.4759
Portugal-US	27.18644	0.3466

**Table 7.2 : Residual Serial Correlation Test**

Breusch-Godfrey LM test gives information for the serial correlations of the error terms. Null hypothesis for the LM test claims no serial correlation in the residuals.

According to the results, the null hypothesis is failed to be rejected, thus no serial correlation among the error terms is confirmed.

Furthermore, stability analysis for the VAR systems has been applied and no root lied outside the unit circle of the VAR system which satisfied the VAR stability check.

### 7.3.3. Impulse-Response Analysis Results

The results are summarized in Table 7.3 for the entire sample. The peak effect of central bank balance sheet expansion policy on both macroeconomic and financial variables which are real GDP, unemployment, stock prices and bond yield, is presented in the table. Only significant results are shown in the table. Insignificant results have not been reported.

Country/Region	Macroeconomic Regressors		Financial Regressors	
	Real GDP	Unemployment	Stock Prices	Bond Yield
<b>Eurozone</b>	-	-	-0.023	-
<b>United Kingdom</b>	0.0038	-0.121	0.013	-
<b>Germany</b>	-0.0019	0.042	-	-0.060
<b>France</b>	0.0018	0.098	-0.030	-0.081
<b>Italy</b>	-0.0028	-	-0.045	-
<b>Portugal</b>	-	-	-0.039	-
<b>Spain</b>	-	0.07	-0.016	-0.16
<b>Greece</b>	-0.0099	0.58	-0.075	-

**Table 7.3 : Impact of US QE on Selected Countries' Macroeconomic and Financial Variables**

For Portugal, only significant result is achieved for the stock prices similar for the Eurozone as an average. The effects of policies on selected macroeconomic and financial variables of France was significant for the whole groups of variables. For Spain and Greece, real GDP, unemployment and stock prices have been affected significantly for

some periods of the analysis. Bond yields have been affected negatively along with stock prices. However, the direction of the relationship between the macroeconomic variables change across the countries. Stock prices are the variable group which gives the most significant results. This is consistent with the contagion chapter results about the volatility transmission between the US and selected European stock markets.

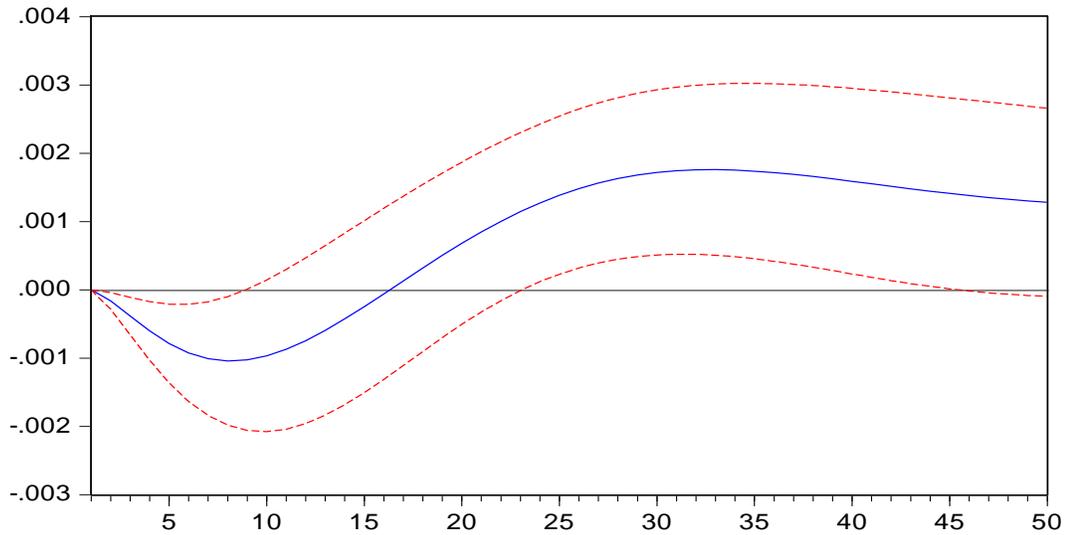
Impulse response function graphs are given for all the countries in the sample and also for the Eurozone. Since the country sample is chosen as six eurozone countries and also the UK which is not in the EMU, it is important to see whether the effect of policies reflect the average responses or each country has experienced according to its own conditions. Thus, the response of the eurozone average has been used in order to make comparison.

#### **7.3.3.1. The Effects on Real GDP**

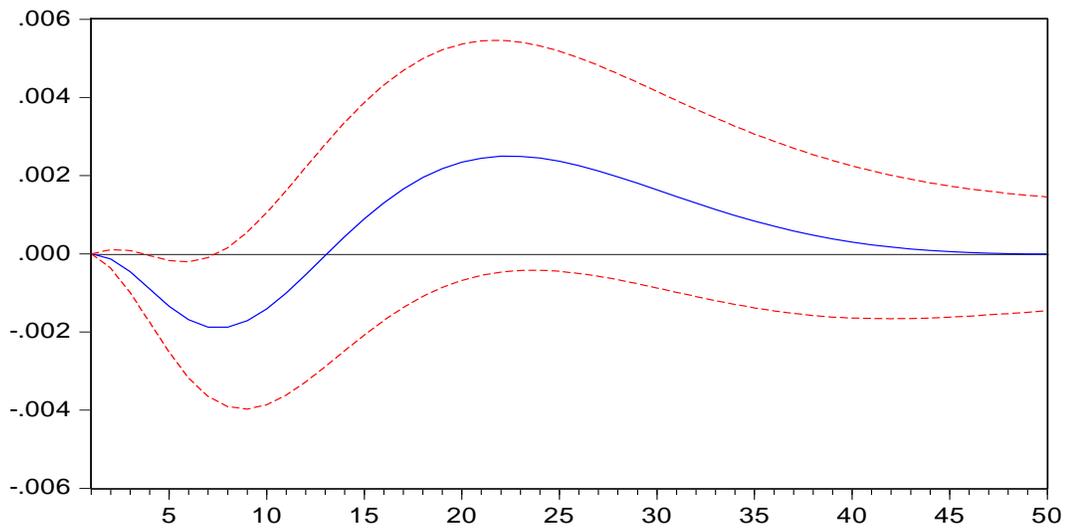
Unconventional expansionary policies have aimed to boost the economies which have halted after the financial crisis in the US. In terms of macroeconomic variables, positive effect on real GDP and negative effect on unemployment levels are expected by the implementation of asset purchase policies. France, Germany and Italy have shown results similar to Eurozone in terms of the movement in the real GDPs. In the shorter period, the effect was significantly negative as real GDP has continued to decline. Only German real GDP among the three individual countries has not responded significantly to the asset shock for a very long time in the shorter period. In fact, real GDP has returned to the beginning level and became positive after 15 months, but significant results could not be reached in the following years. Italian real GDP decline was also statistically significant in the first year of the asset purchase shock, then started to increase but stayed in the negative side of the graph for nearly two years. Portugal and Spain have not shown significant results for the real GDP. The movement of Greek real GDP was negative in the whole period of the analysis. Yet, the effect of the policy was significant for a prolonged period. Lastly UK, as an outsider for the EMU, has shown a positive immediate

response to US asset purchase shocks. After a year, the effects become statistically significant for two years.

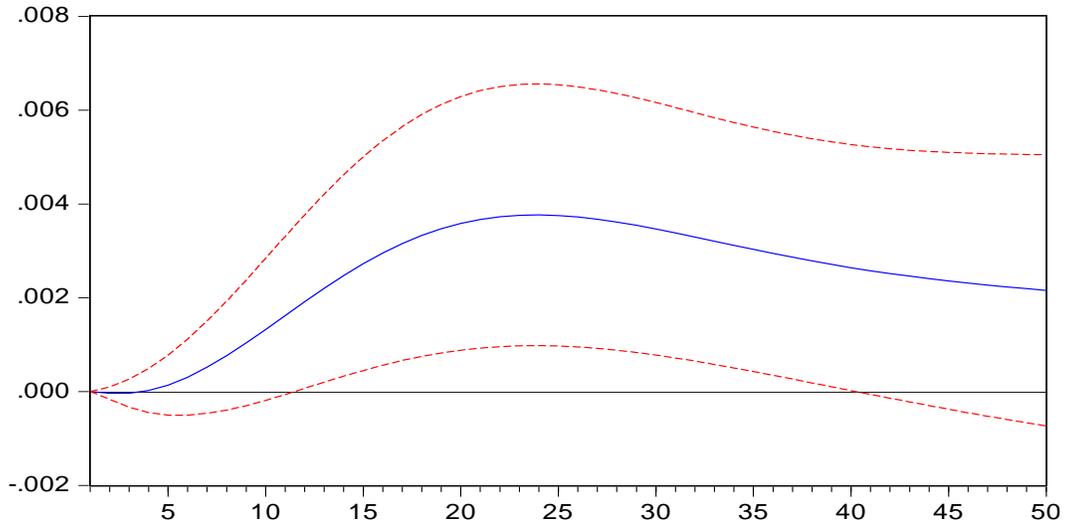
**Response of France Real GDP to FED Asset Purchase Shocks**



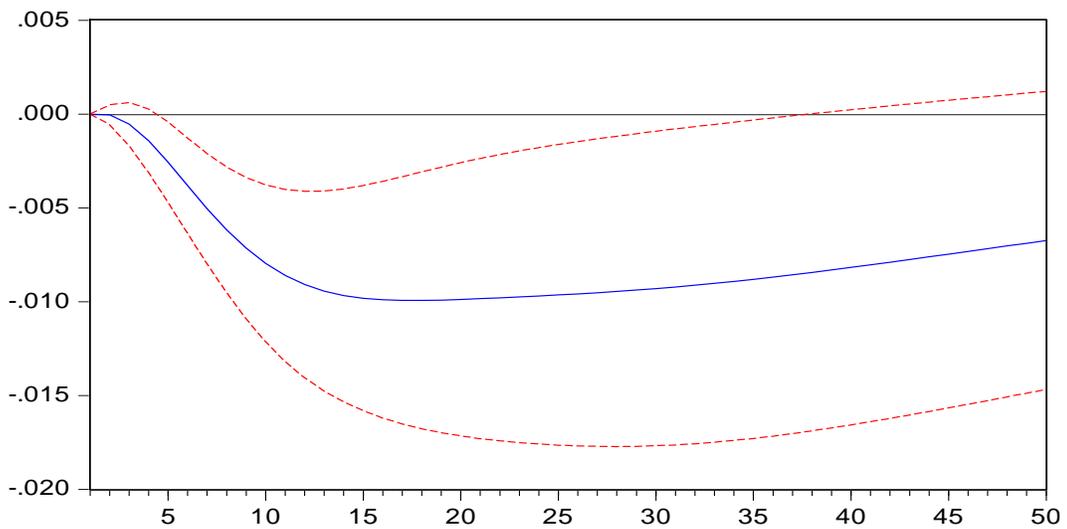
**Response of Germany Real GDP to FED Asset Purchase Shocks**



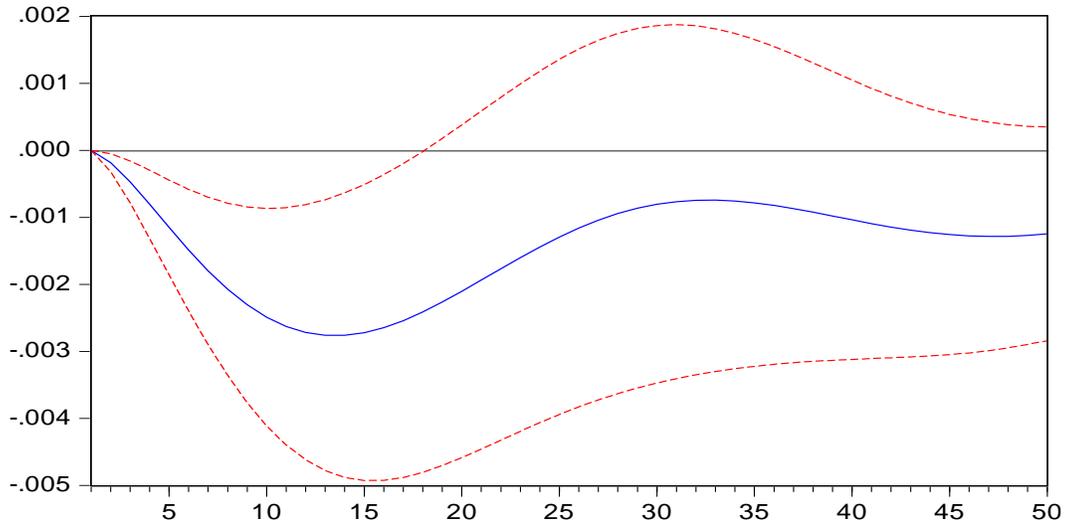
**Response of United Kingdom Real GDP to FED Asset Purchase Shocks**



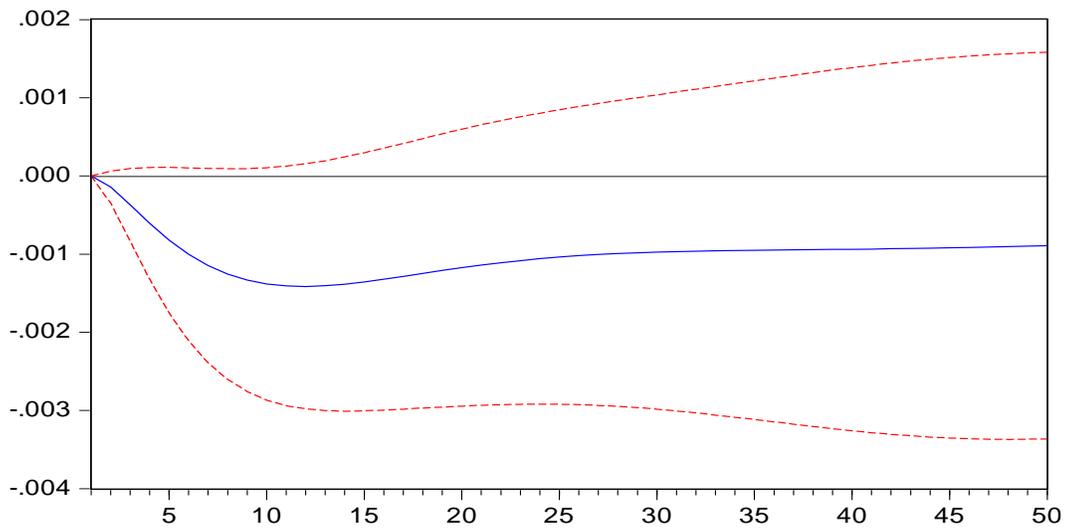
**Response of Greece Real GDP to FED Asset Purchase Shocks**

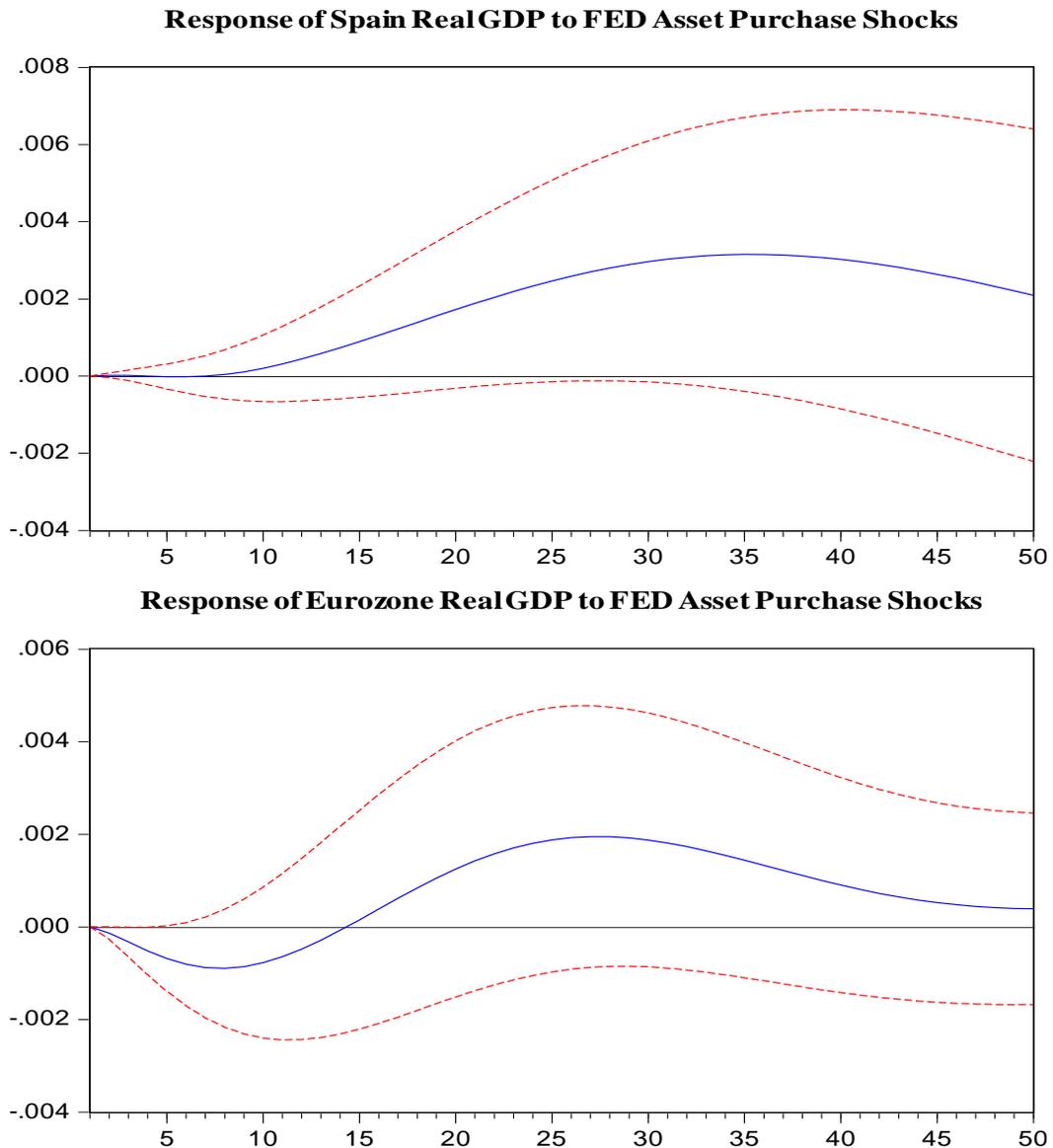


**Response of Italy Real GDP to FED Asset Purchase Shocks**



**Response of Portugal Real GDP to FED Asset Purchase Shocks**





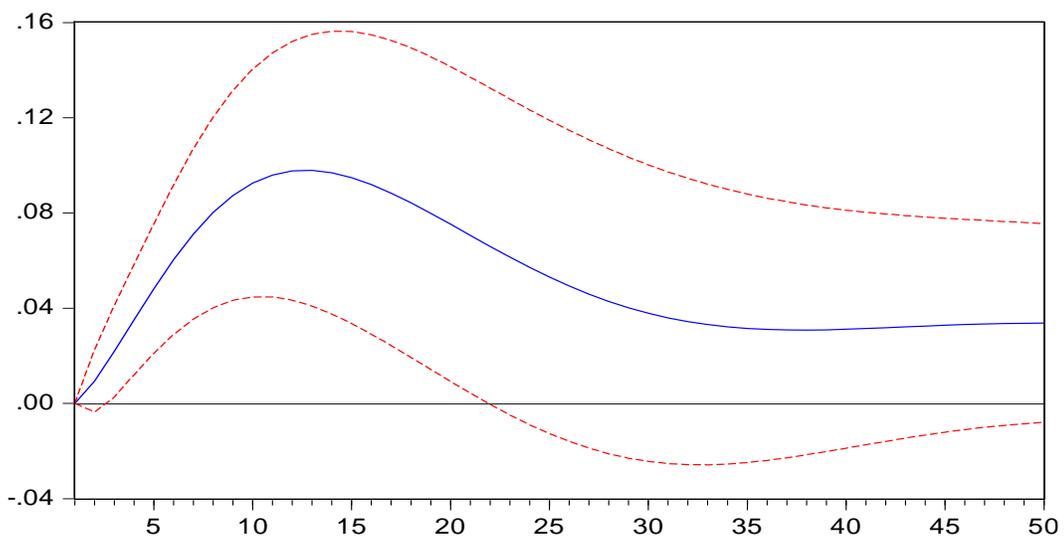
**Figure 7.5 : Response of European Countries' Real GDP Levels to Asset Purchase Shocks of FED**

### 7.3.3.2. The Effects on Unemployment

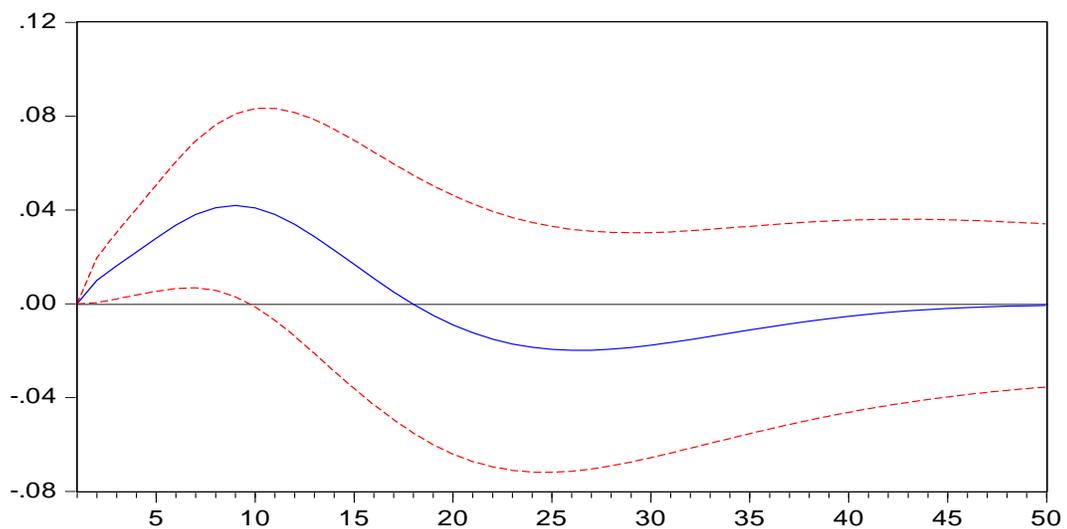
Even if the expectation was on the side of negative effect on the unemployment levels of the economies, the results again differed according to countries. Spain, Italy and Portugal have not shown significant results for the unemployment either. In case of France, unemployment level increased significantly as an immediate response to the shock

and reached its peak at 12<sup>th</sup> period. It started to decline after this point. So, it took one year to see the expected effects in French labor market. German unemployment response was similar to France, but it took shorter for German labor market to react to the policy effects. Greece again showed a reverse effect of shock on the labor market while UK unemployment was in a tendency to decline in the overall period. Eurozone reaction was in tandem with most of the European economies in the sample except for Greece and UK which have shown distinct characteristics in their reactions.

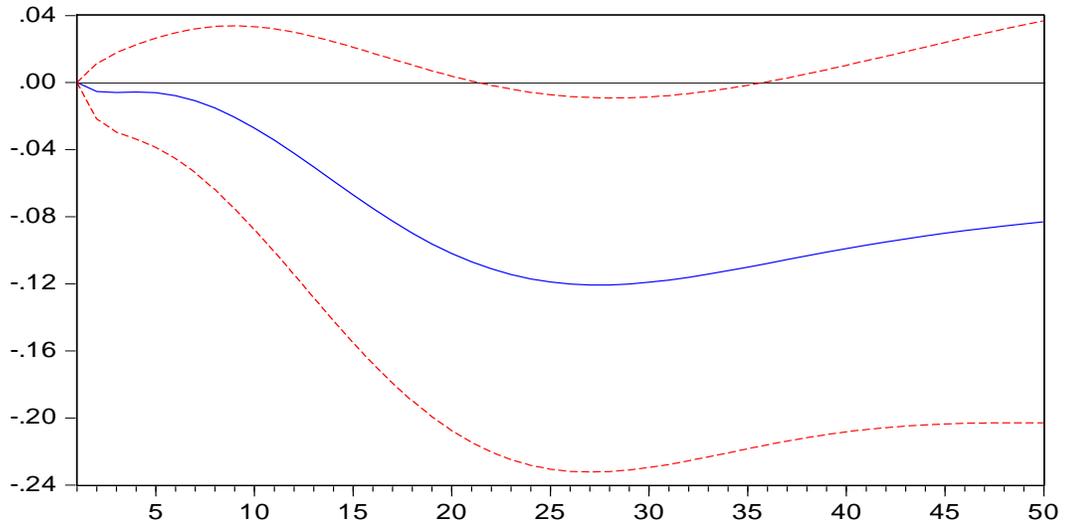
**Response of France Unemployment to FED Asset Purchase Shocks**



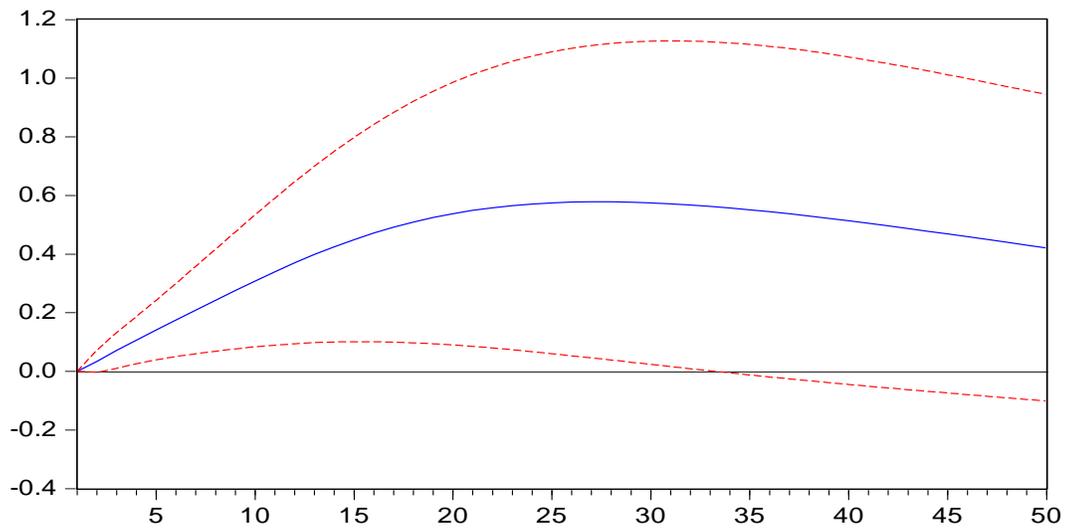
**Response of Germany Unemployment to FED Asset Purchase Shocks**



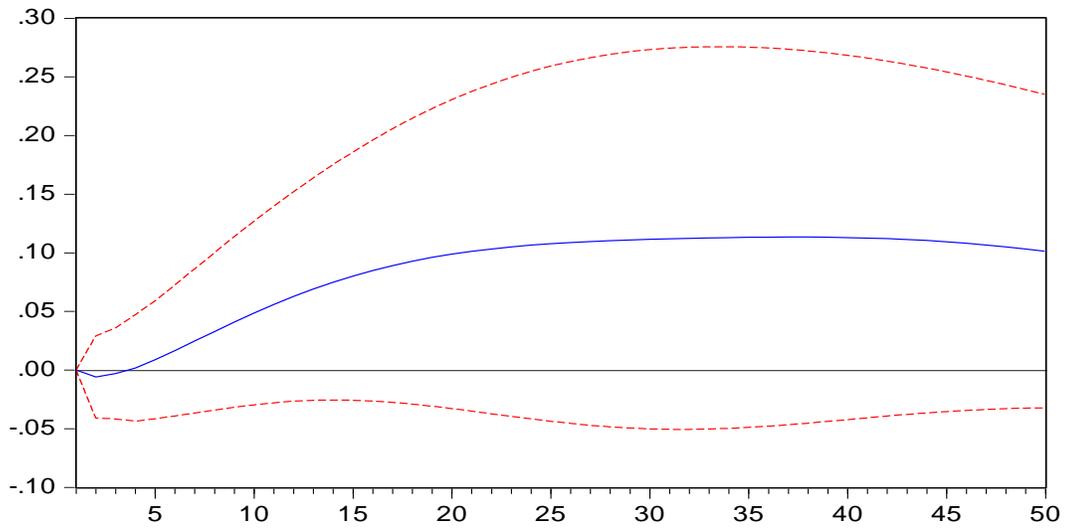
**Response of United Kingdom Unemployment to FED Asset Purchase Shocks**



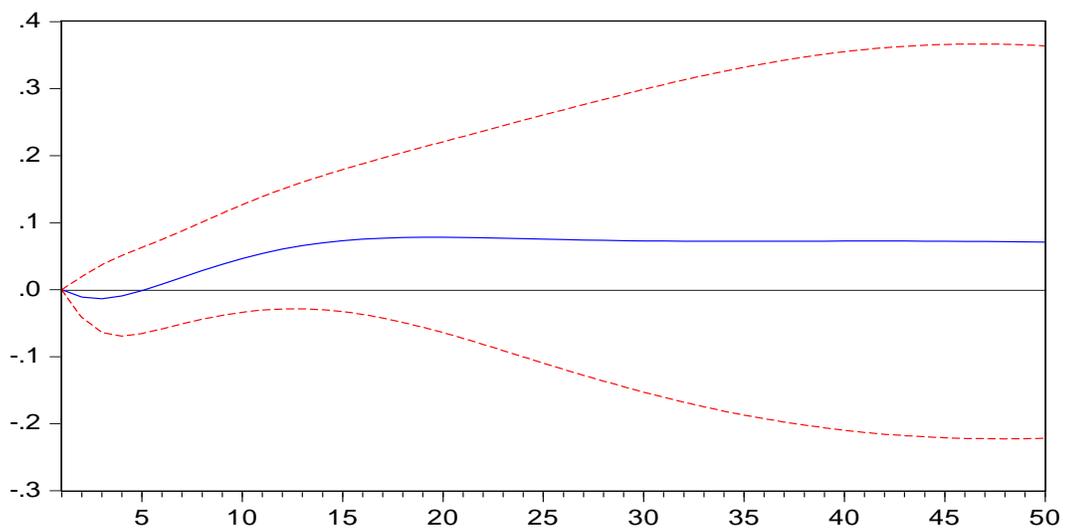
**Response of Greece Unemployment to FED Asset Purchase Shocks**

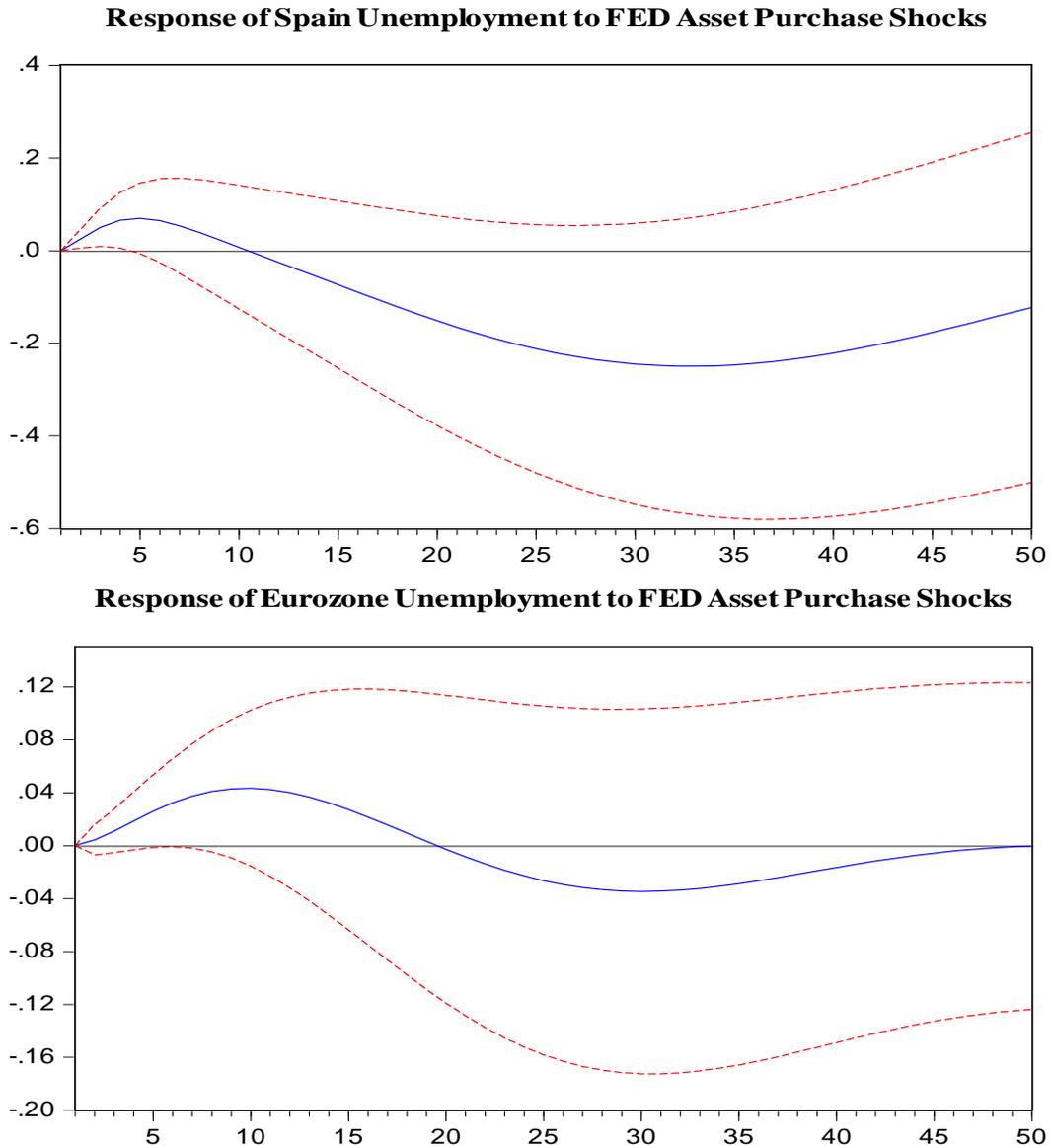


**Response of Italy Unemployment to FED Asset Purchase Shocks**



**Response of Portugal Unemployment to FED Asset Purchase Shocks**





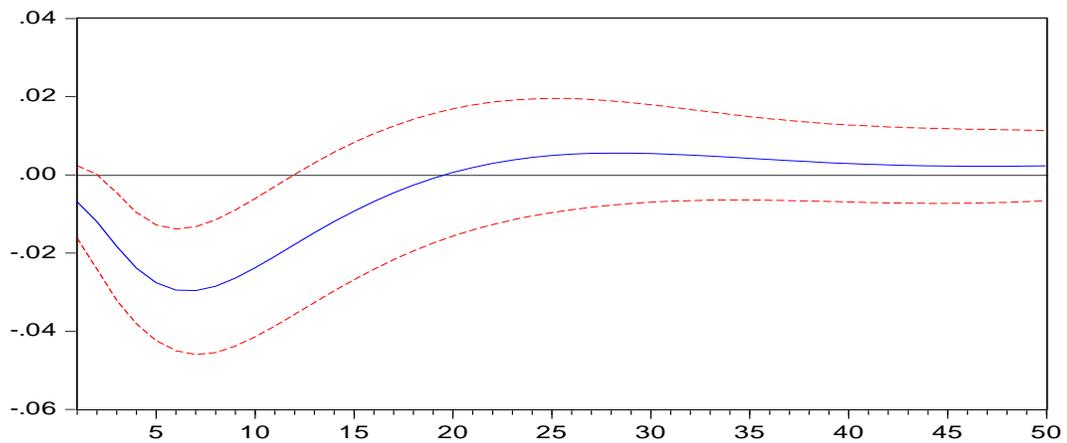
**Figure 7.6 : Response of European Countries' Unemployment Levels to Asset Purchase Shocks of FED**

### 7.3.3.3. The Effects on Stock Prices

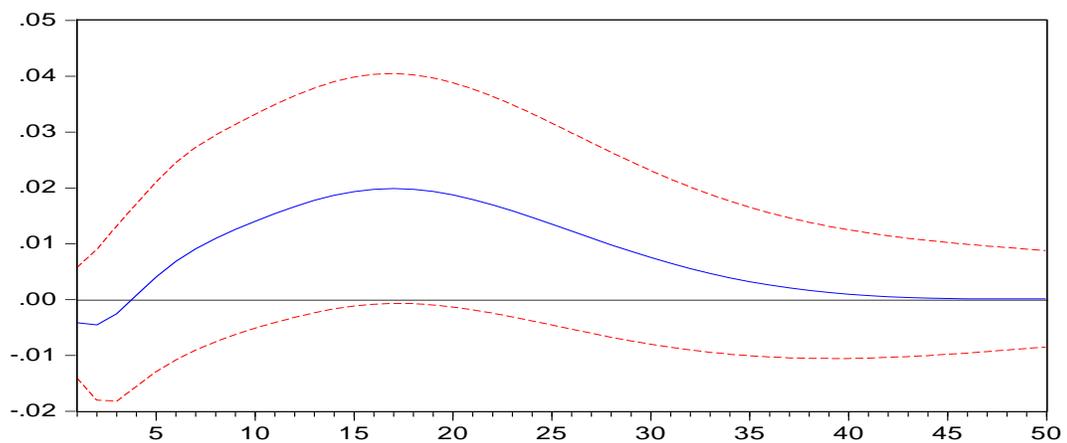
An increase in the asset purchases generally pushes the interest rates (bond yield in our case) down and pushes the equity prices (stock prices in our case) up. This case has occurred for Eurozone Stoxx50 index response to policy shock. However, the results were only significant in the first year. French, Italian and British reaction was similar to

Eurozone. For the stock prices, Greece has also shown significant movement with the policy effects however, the reaction could not manage to be on the positive side. Besides all, the movement turned to be upward after a year. Portugal response was similar to Greece while Spain could not achieve a significant reaction to asset shocks.

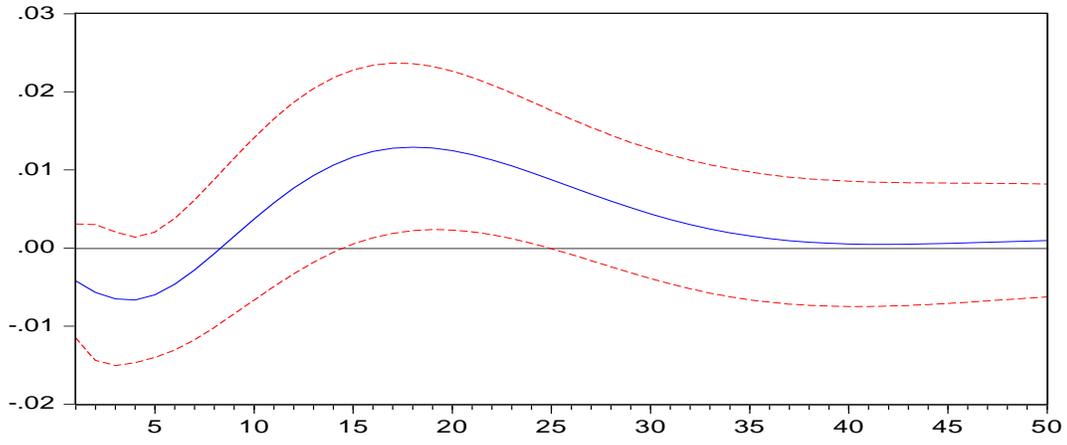
**Response of France Stock Market to FED Asset Purchase Shocks**



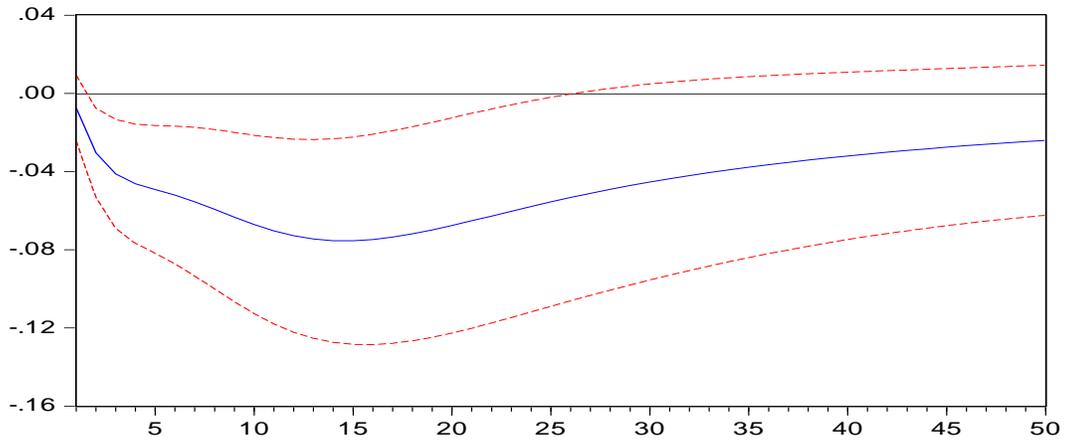
**Response of Germany Stock Market to FED Asset Purchase Shocks**



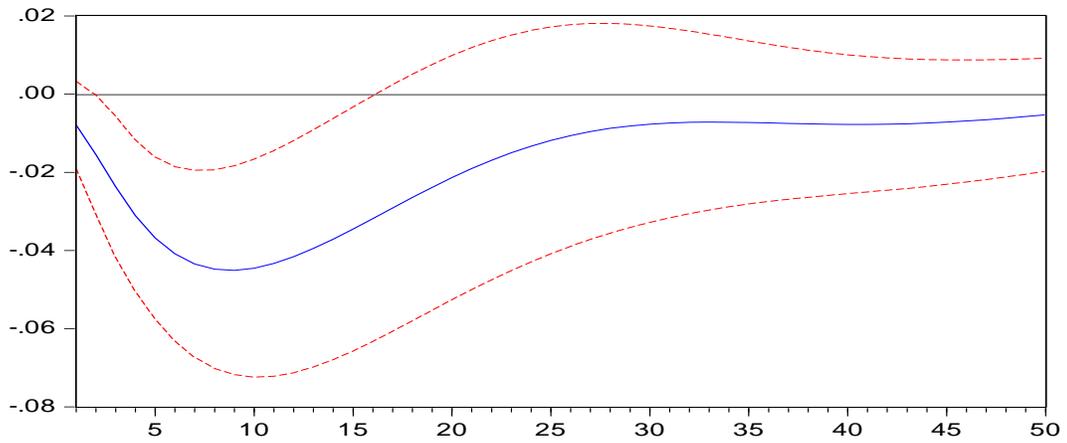
**Response of United Kingdom Stock Market to FED Asset Purchase Shocks**

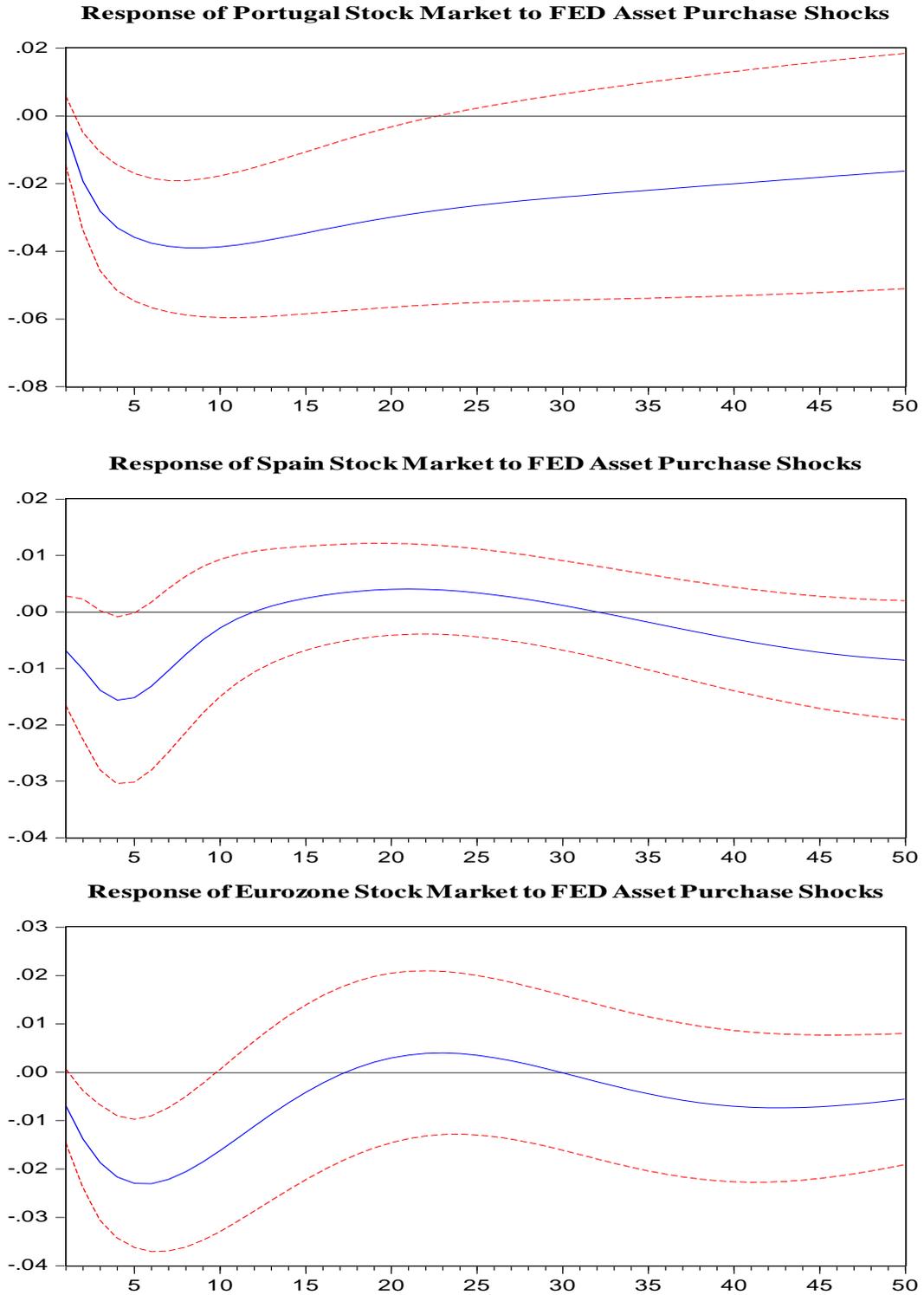


**Response of Greece Stock Market to FED Asset Purchase Shocks**



**Response of Italy Stock Market to FED Asset Purchase Shocks**



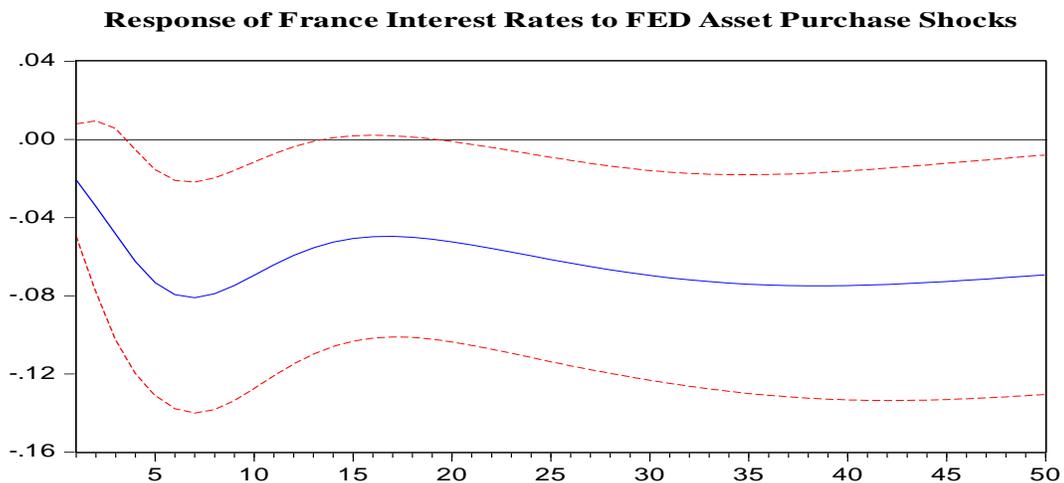


**Figure 7.7 : Response of European Countries' Stock Market to Asset Purchase Shocks of FED**

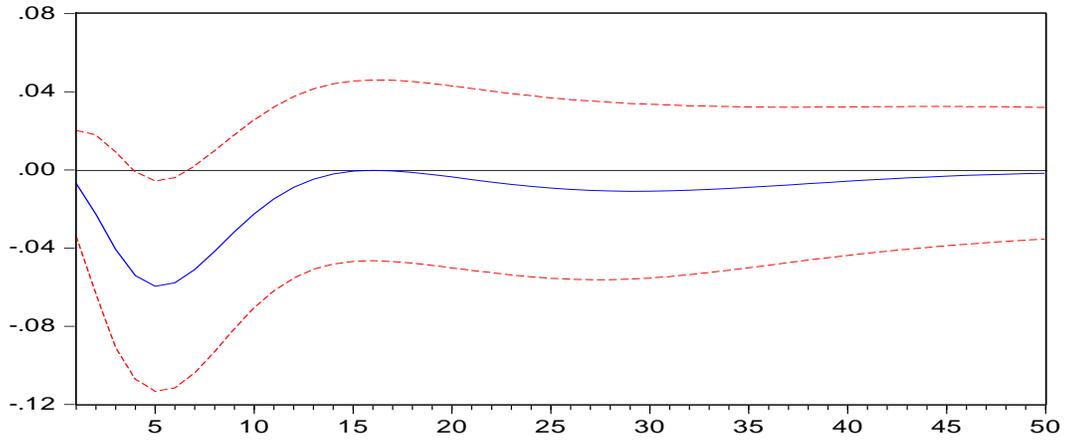
### 7.3.3.4. The Effects on Bond Yield

The expected result for the interest rates to be in downward movement as a response to asset purchases. German and French interest rates showed the generally expected response to asset purchase shocks by downward movement. However, Eurozone bond yield has not been affected from the shock in a statistically significant environment. Italy, Portugal, Greece, Spain and UK have followed that same path.

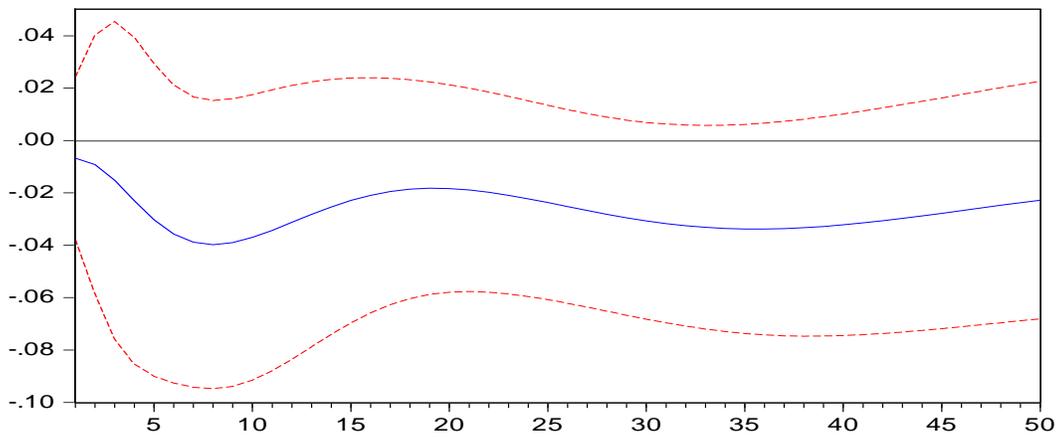
Besides both macro and financial effects of unconventional monetary policy that can be seen from the US to European economies, the magnitude of these effects is limited. ECB policies are more important in European economies. Even if the expectations are on favor of the policy effects of ECB on European countries macro and financial variables, the thesis that is tested is the US FED expansionary monetary policies, namely the asset purchases, have been effective in the European economies. The rationale for this view is that even if the FED reacted to financial crisis immediately, ECB should have also reacted quicker than it did in the global financial crisis. As a matter of fact, additional analysis is held for the expansionary monetary policies of ECB on the same sample of countries. The results were rarely significant and yet, are not presented inside the chapter (Related impulse response graphs are given in the Appendix 12-18). This relatively late reaction of ECB might have been effective in the occurrence of the European debt crisis.



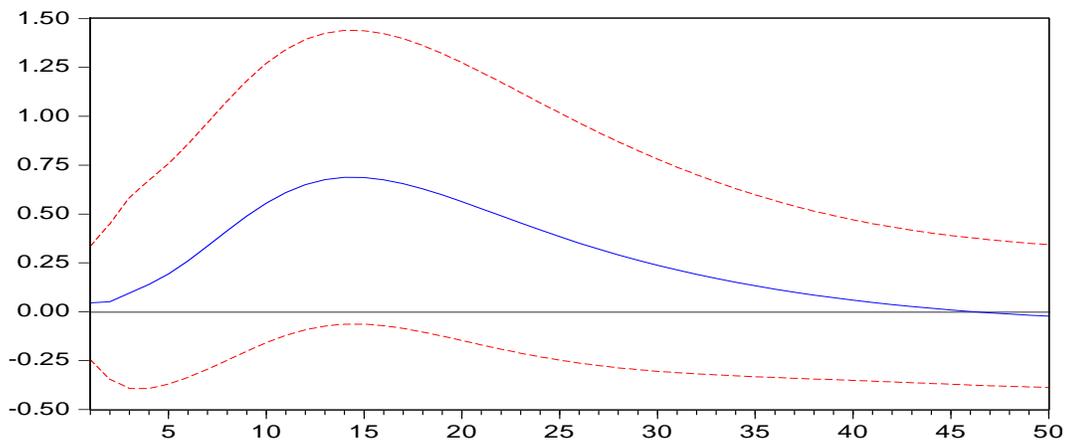
**Response of Germany Interest Rates to FED Asset Purchase Shocks**



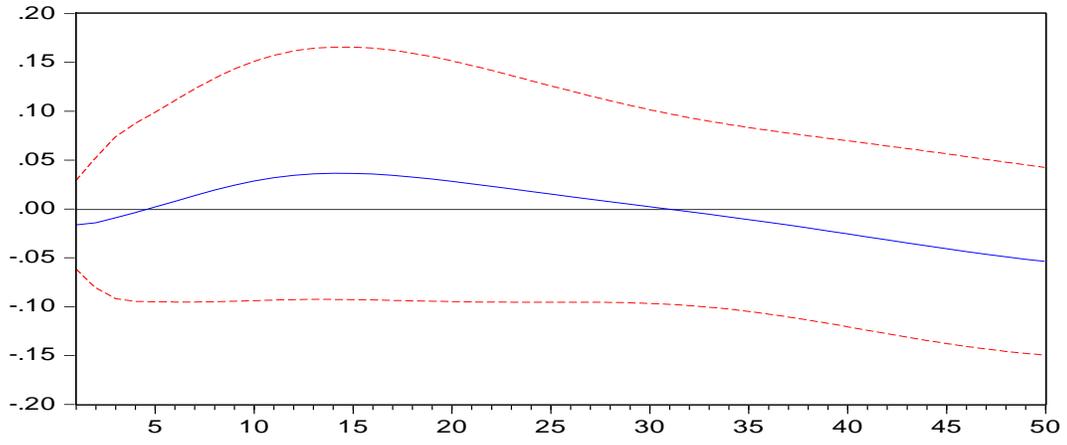
**Response of United Kingdom Interest Rate to FED Asset Purchase Shocks**



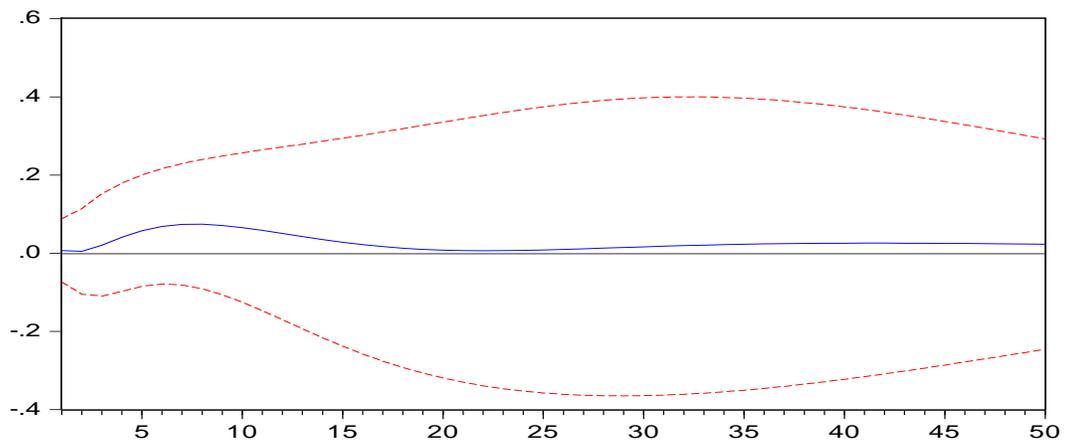
**Response of Greece Interest Rates to FED Asset Purchase Shocks**



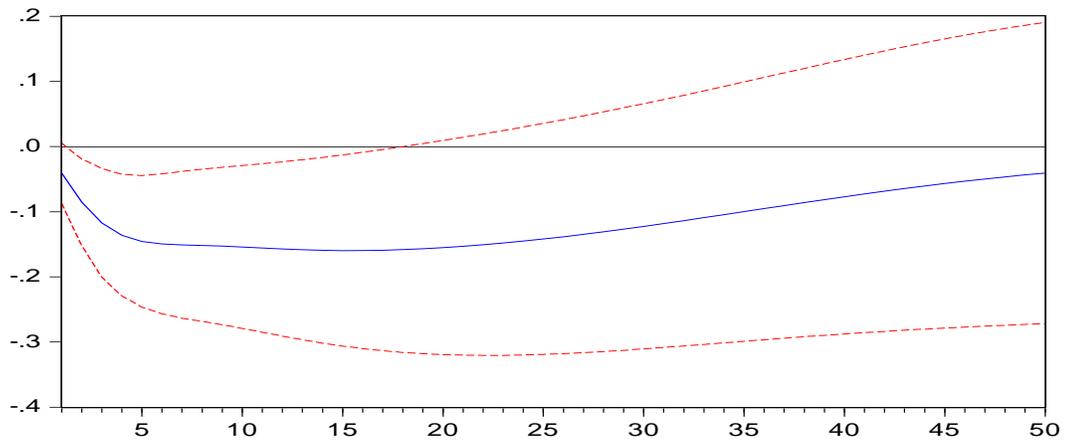
**Response of Italy Interest Rates to FED Asset Purchase Shocks**

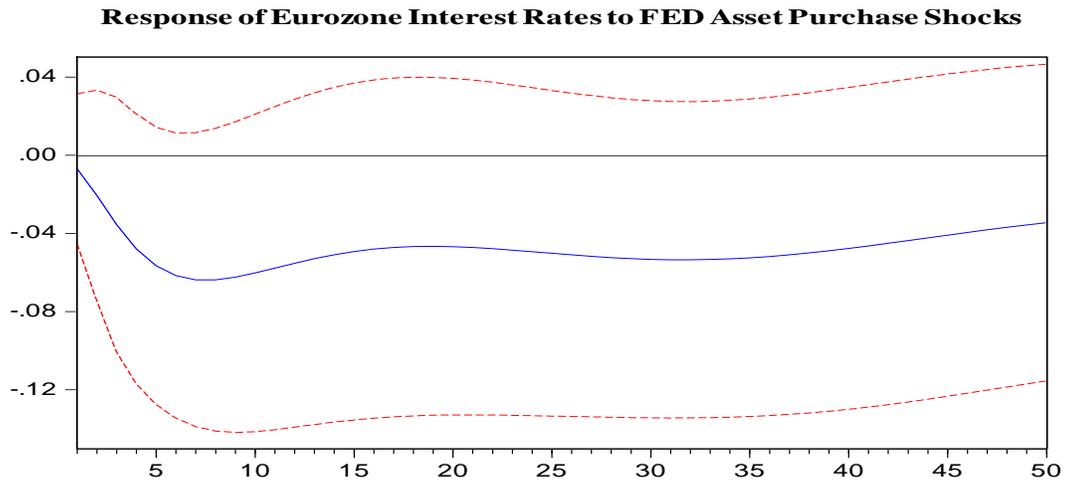


**Response of Portugal Interest Rates to FED Asset Purchase Shocks**



**Response of Spain Interest Rates to FED Asset Purchase Shocks**





**Figure 7.8 : Response of European Countries' Interest Rates to Asset Purchase Shocks of FED**

#### 7.4. CONCLUSION

In the past decades, especially developed economies' central banks have purchased assets as an expansionary monetary policy. Those policies often called as quantitative easing. In crisis conditions, when the interest rate tool became disabled with zero-lower bound, central banks had to apply some unconventional -or nonstandard- measures to boost growth and change the course of economy. In fact, up to the eve of the financial crisis, steady and low inflation target has been achieved with standard monetary tools. However, those policies could not prevent asset bubble to grow. The focus of central banks changed after financial crisis from taking actions about those bubbles after they burst to taking actions to foresee and preventing the bubbles.

The significant effects of those policies on financial markets and the economy has already been studied empirically and proved. However, there is scarce literature about the contagious effects of the policies of one country's central bank on other economies. Especially the European economies in the global financial crisis and right before European debt crisis have not been focused widely. This empirical chapter is an attempt to fill this gap in the literature and give an overview about the effects of US FED asset purchase policies on several European countries' macroeconomic and financial status.

According to the results from the VAR analysis, the reactions of countries' macroeconomic and financial variables to an asset purchase shock originating from the US varied over the sample according to the individual situations and fragilities and strengths of the countries. The most remarkable and significant impact of the US monetary policy was on the side of the equity markets. The upward movement of the stock markets has not been guaranteed as an initial response to policy shock, but the situation turned out to be as expected in 5 to 10 months. Stock markets' response to expansionary policies is realized optimistic which rises the prices. Even if the contagion of financial crisis spilled over to the other economies rapidly, the recovery did not happen that quick. Additionally, countries such as Greece, Portugal and Italy could not recover the stock prices even after FED policies. The case for these economies was different. They had their own fragilities in their economies. The individuals' expectations were on the negative side which discouraged people from consumption and investments. Decreasing demand was worsening the situation and causing deeper recession.

Another expected result was the downward movement of interest rates after asset purchases. With decreasing interest rates, investors do not prefer bonds; instead the demand for the equity market might increase which pushes the stock prices even higher. Even though the immediate response to shock was as expected, no statistically significant result has been reached about the bond yields in response to the asset purchase shock.

Macroeconomic effects of FED monetary policy have been analyzed by using real GDP and unemployment situations of European economies. Policies could not boost growth for the European countries, especially for Greece, Portugal and Italy. They have faced with a prolonged recession with negative rates after 2008. The countries with strong fundamentals such as United Kingdom, showed immediate reaction to the asset purchase policies.

Unemployment levels thought to be saved in the last place in recessions. However, in European case, unemployment became a very significant problem. After global financial crisis, with record low interest rates, it was an opportunity to borrow money and

develop the businesses for the firms. This in return, would expand the job market and decrease the unemployment levels. This situation was achieved in the US, yet discussed and commented that the numbers might be misleading with actual numbers of increasing wage inflation. In Europe, the effects on unemployment was not as expected for most of the countries in the sample. Only Germany, United Kingdom and Spain reactions were as expected with declines in the unemployment rates even if the reaction took place in a year (except immediate response of United Kingdom)

European response to the US asset purchase policies have been positive but it took time to see the effects in an expected way. For some countries such as Greece and Portugal the effects were not as expected. The actions of ECB are thought to matter more for those economies. However, in the analysis of ECB policies on the countries' selected financial and macroeconomic variables, the results found to be mostly insignificant. This might be due to their late actions compared to FED since no one could foresee distortions to happen this rapidly with the effects of contagion and spillover.

## **SUMMARY AND CONCLUSION**

The outbreak of the Global Financial Crisis of 2008, its rapid contagion through the Europe, the possible transmission mechanisms and evaluation of the United States Federal Reserve monetary policies which have been implemented to cool the overheated financial sector, are investigated in this PhD dissertation. Therefore, the causes, stages and consequences of the global financial crisis have been examined both in a theoretical and empirical approach. In this regard, the thesis has tried to offer a comprehensive analysis of the turmoil, starting from the basic definitions of crisis and contagion through analysis of macroeconomic status of selected European economies in the 20<sup>th</sup> century, to empirical verification of contagion and transmission channels. Finally, the policy implications by the monetary authorities are analyzed by focusing on the expansionary unconventional monetary policies of Federal Reserve following the financial crisis term. As a conclusion, some important results have been achieved and will be summarized in the following, chapter by chapter.

The second chapter gives insight about the descriptive side of the financial crisis concept in general. Different explanations of two main economics school of thought have been given in describing the crises. Classical economists think that the monetary aggregates are the sources for a financial crisis to occur and spillover to the other sectors in real economy. With monetary aggregates, the emphasis is on the money supply and growth naturally. When money supply declines, economic activity is interrupted and according to monetarists, banking panics are seen with financial crisis and everything is linked to each other as bank failures, money supply declines and economic activity decreases. However heterodox school of economic thought does not accept this opinion, instead they think that capitalist financial system is prone to crises as an inner dynamic. It is opposed to orthodox economists who assume that the core reason of malfunctioning of financial system is the effects of external interventions such as the central banks' involvement in solving the problems. Efficient market theory with its hypothesis as the financial markets provide all the necessary information and the market prices are always in their fair value, is given against the financial instability theory with its hypothesis as

the boom period of a cycle is always followed by a bust period. Optimism which create the bubbles causes the economy to move from stability to instability and this process ends with market crashes. Government intervention is considered to be inevitable after all. The chapter continues with the events those are effective in creating a crisis and different types of crisis, such as currency crisis, sudden stops, debt crisis and banking crisis.

The third chapter of the thesis is devoted to the analysis of global financial crisis from the perspective of European economies starting with the events which were effective in the rapid contagion of the turmoil. The downturn in the world economies, but in the first place in the US, has been linked to the deregulation in the financial markets and financial innovations. Then the spread of the crisis to the European continent has been analyzed with actual experiences of the selected economies.

Creating a link to the major economic schools which have been discussed, it can be concluded that the financial crisis of 2008 might be evaluated as a proof of the critiques directed to the classicists such as being deaf to the short-term deficiencies and the markets inability to correct itself. Indeed, government intervention has been unavoidable and even European Central Bank has been criticized to be late to act. Heterodox theories were to provide explanations to the problem encountered since orthodox theorists could not provide explanations to the decline in economic activity and growing unemployment, especially in Europe. Minsky moments were started to be discussed as a description of credit supply's dry up. Additionally, Minsky's financial instability theory about the rejection of ever-growing economy and Fisher's approach of debt-deflation which supports the idea that over indebtedness trigger liquidity crises and depression, have been the events those constituting the main body of the global financial crisis. In the end, monetary authorities are called to intervene which again affirms the heterodox point of view in explaining the latest crisis.

The macroeconomic performances of the European countries before the financial crisis is key to explain the severity of the crash. Globalization in the financial system and flat earth allegations make way for the vulnerabilities of countries in such depressive

conditions. The linkages among the economies via trade, neighborhood or finance cause them to be closely affected by a shock in another economy and at another territory. In fact, it has been a long time since the Europe and other continents to be without frontiers. However, the intensity of the damage to one economy after an internal or external shock depends on the economy's strength and weaknesses. It is crucial to have this prior knowledge in order to be able to make a complete analysis of the effects of the shock and find the exit strategies.

A positive trend has been observed in the growth percentages of the European economies till the onset of the crisis. However, the winds have changed after the crisis for the growth data which is a standard for the economies' performances. The most serious problem with Europe was the length of recovery after the crisis in terms of gross domestic product. The great depression evolved into a debt crisis which erupted from Greece. A special emphasis might be appropriate for Greece because the country faced with demand contractions and worsening of import performances. The conditions such as the declines in economic activity were leading up to unemployment increases, salary cuts which in turn have effects on disposable income. Additionally, the indebtedness of the sectors was quite high that made the growth unsustainable. The dependency of economic growth to external debt had a very important role in the spillover mechanism of the crisis to the continent by Greece.

Another spillover mechanism which is worth to mention here is the capital flows. As the financial development of a country increases, its openness to external shocks increases. The current account deficits of developed economies encouraged the current account surpluses for the emerging economies. The global saving glut created by the emerging economies cause the capital to flow from surplus economies to the US. Capital mobilization might be possible with high stock market capitalization ratios and therefore with high financial development. Capital inflows in turn created the risk-taking behavior and credit boom. Financial deregulations triggered the adverse situation of Europe.

Even if the contagion of global financial crisis from the US to Europe is discussed, to verify this claim is only possible with an empirical analysis. Chapter four is designed as an empirical literature review prior to the analysis of contagion in order to fully understand the studies which are captured and find the gap to fill as a contribution to the existing literature. This chapter of the thesis has been structured in this manner again starting from the very basic definitions of contagion, the studies regarding the contagion, spillover and co-movements have been presented. Even if there are many studies for the crisis transmission from the US to Europe, the sample of countries mainly comprised of central and eastern European economies. The empirical analyses of the thesis vary from the others regarding their country basket. The timespan for the analyses is held relatively long and high frequency data have been utilized. Additionally, a study which comprises both the verification of the existence of contagion, -if verified- the channels have been effective in this contagion process and also the success of implied policies by the authorities, can be claimed to be a very comprehensive study held in the financial crisis area.

After mentioning about the importance of the study in the literature, first empirical analysis has been conducted for the stock markets of seven European countries, namely Germany, France, United Kingdom, Italy, Greece, Spain and Portugal. The analysis is held by utilizing the dynamic conditional correlations-generalized autoregressive conditional heteroscedasticity method to test for the thesis that claims, “US financial crisis had contagious effects on European economies with a bound of stock markets.”. Further analysis of dynamic correlation coefficients has shown that the European stock markets have been affected by both their own experiences and also from the US stock market behavior. Investors tend to follow also the latest news coming abroad beside other investors. This result might lead us to a herding behavior in the financial markets. Greece and Portugal as countries with relatively small stock markets do not trust on their past returns but instead follow the American market. Dynamic conditional correlations derived from the analysis prove an existing contagion among the European stock markets and the US. Correlations tend to increase in turbulence times and also continue to increase after

crisis period. These results lead us both contagion from the United States to Europe and also herding behavior of investors after the crisis period.

By the analysis of crisis dummies, different results are achieved for different countries. More developed European countries such as Germany, United Kingdom and France showed no evidence of volatility transferred from the United States in the pre-crisis period. However, they could not resist the effect of global financial turbulence in crisis years. Unsurprisingly, countries such as Greece, Portugal, Spain and Italy have seemed to be contaminated by the crisis long before the other developed economies which can be investigated by the significant pre-crisis dummies.

Following the verification of volatility contagion from the US to the selected European stock markets, it is crucial to spot the channels of the volatility transmission. Finding the possible transmission channels of volatility is a very critical subject for researchers as well as policy makers to implement the correct policies to correct measures in order to prevent an upcoming crisis to happen and more importantly, spread globally. For this purpose, the influence of global macroeconomic factors as well as the selected financial factors on the dynamic conditional correlations depicted from the previous empirical chapter, have been evaluated by the analysis of different quantiles.

According to the results global factors as oil price, gold price and volatility index have been found mostly significant. Volatility index had negative post-crisis relationship with the conditional correlations. As the US stock market recover after crisis, volatility index has started to decrease. However, European belief in the strength of their economies led their regulative body to be late to take immediate action after the crisis as the Federal Reserve did. Negative coefficients of volatility index in explaining the dynamic correlations for the turmoil quantiles, reflect this policy gap in the reactions in majority of the selected economies.

Gold prices and correlations have shown negative relations, i.e. increases in gold prices cause the correlations to decrease which means the markets deviate from each other.

The influence of gold prices on the correlations turned from being positive in the pre-crisis to being negative in the post-crisis. Increases in gold price attract the investors to change their portfolio decisions from stocks to gold. Their risk perceptions of a highly risky profile country had effects on their decisions to liquidate their assets in such country and invest in gold markets. On the contrary, oil price has drawn an opposite picture. Oil prices positively affect the dynamic correlations in the post-crisis period. All the economies under observation are developed European economies which are industrialized. Those economies have high independency to oil and react to oil prices. Generally sharp declines in oil prices are the cases for crisis conditions. For that reason, negative relationship between oil prices and correlations are expected case. However, oil and dynamic correlations move together after the crisis which reflect the oil dependency of those countries.

In brief, the influence of various factors on explaining the increasing correlations depend on the financial and macroeconomic structure of the economies. Risk perception of investors in the territory, countries' industrial capacity and abilities and also their trade characteristics play an important role in the dynamics between the country and the US. The perception of risk for these economies depended on the policy implications of the two central banks, namely ECB and FED. While FED took immediate action in the crisis, ECB has been criticized to be late to intervene. This situation is reflected with the effects of VIX on correlations after the crisis.

With this regard, the efficiency of the central banks' interventions has been investigated by the vector autoregressive approach. FED's asset purchase actions have been effective partly in the European economies while the effect of ECB was insignificant. The most remarkable and significant effect of the United States monetary policy was on equity markets. Stock markets' reaction to expansionary policies rised the prices since it is considered to be optimistic. However, the recovery did not happen rapidly. Also countries such as Greece and Portugal, which have high vulnerabilities, could not recover even after Federal Reserve or European Central Bank policies. This situation partly

reflects the worsening conditions in Europe and the debt crisis that aroused after the global financial crisis. Interest rates tended to decrease after the policy implications but no significant results have been achieved from the analysis on the side of bond yield reactions to the expansionary monetary policy.

Macroeconomic effects have been studied with a special focus on the growth and unemployment levels. In terms of the effects on growth, policies could not be effective on the majority of European economies and the countries have faced with prolonged recession after 2008. Similar results have been achieved for the unemployment levels. Only Germany, United Kingdom and Spain reacted the policies as expected declining unemployment levels.

Shortly, even if some results reflected the expected case, the reactions were not immediate. The actions of European Central Bank are more of a concern for those countries. Nevertheless, additional analysis of the effect of ECB monetary policy on the countries have shown that the results were significant for almost all the cases. This might be a proof for the late actions of European authorities compared to the US authorities since the Europeans could not foresee what was coming and considered themselves strong to the shocks.

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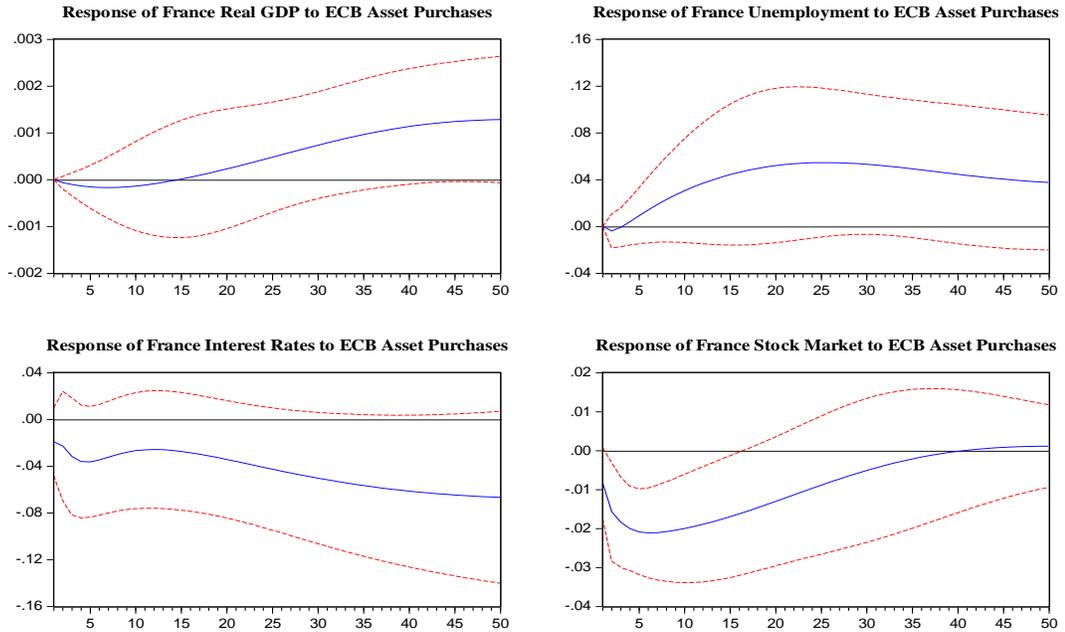
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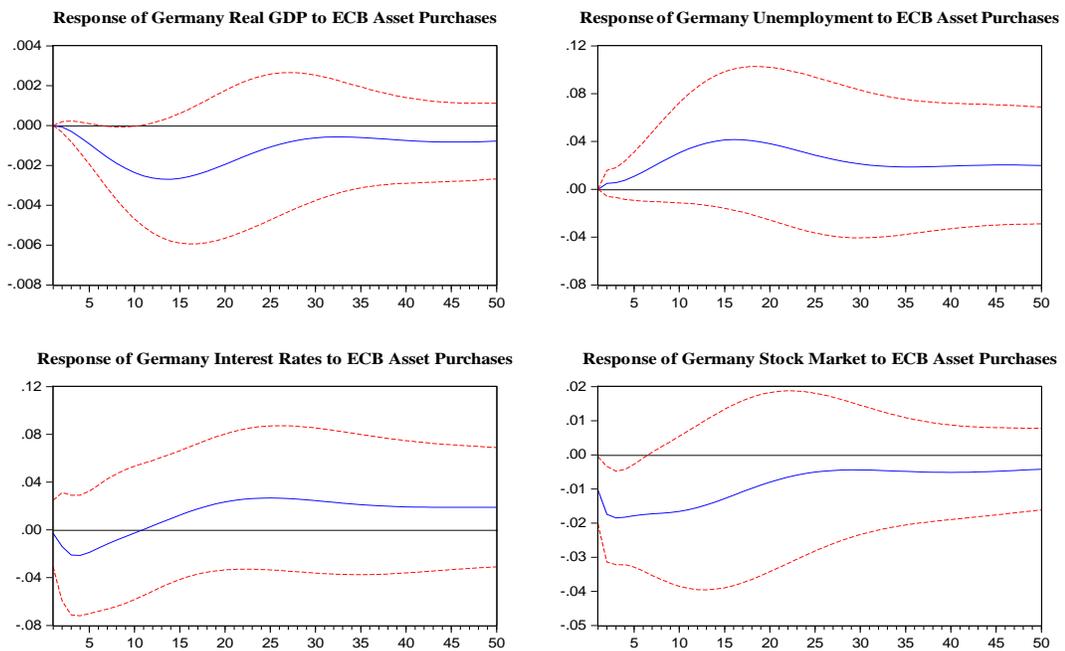
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# APPENDIX

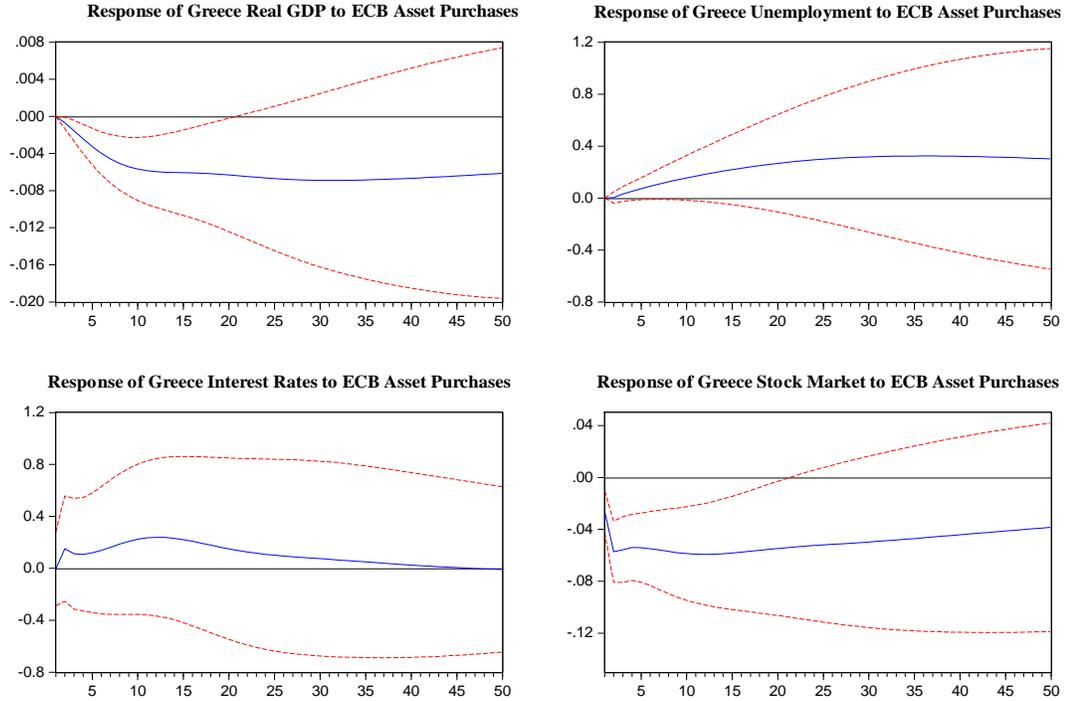
## Appendix 1: Response of France to ECB Policies



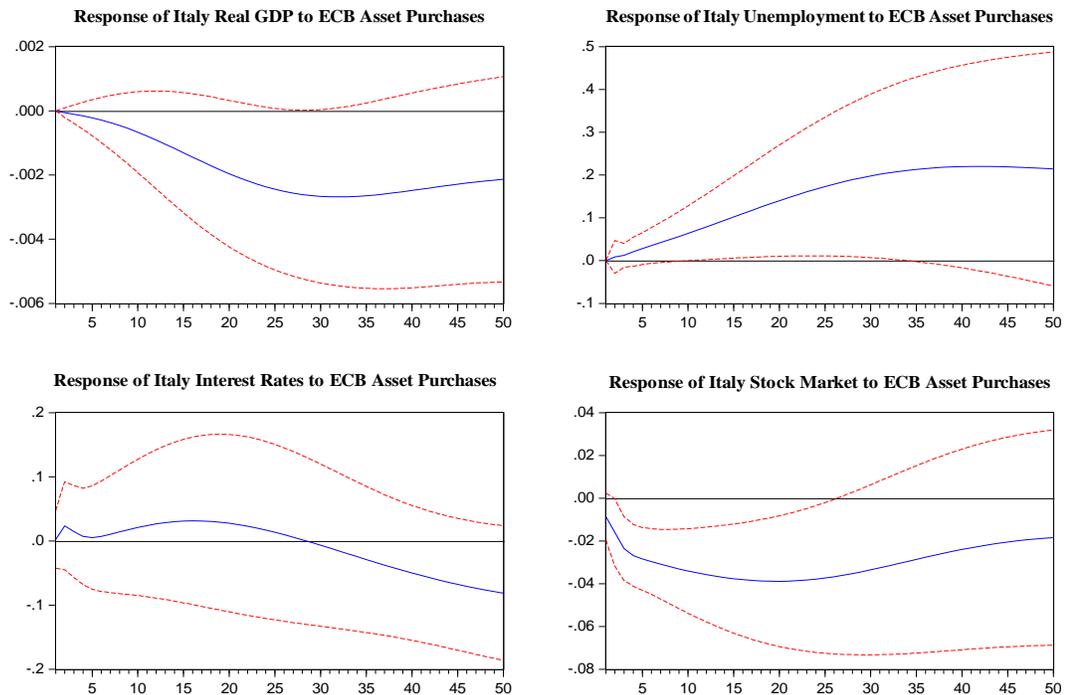
## Appendix 2: Response of Germany to ECB Policies



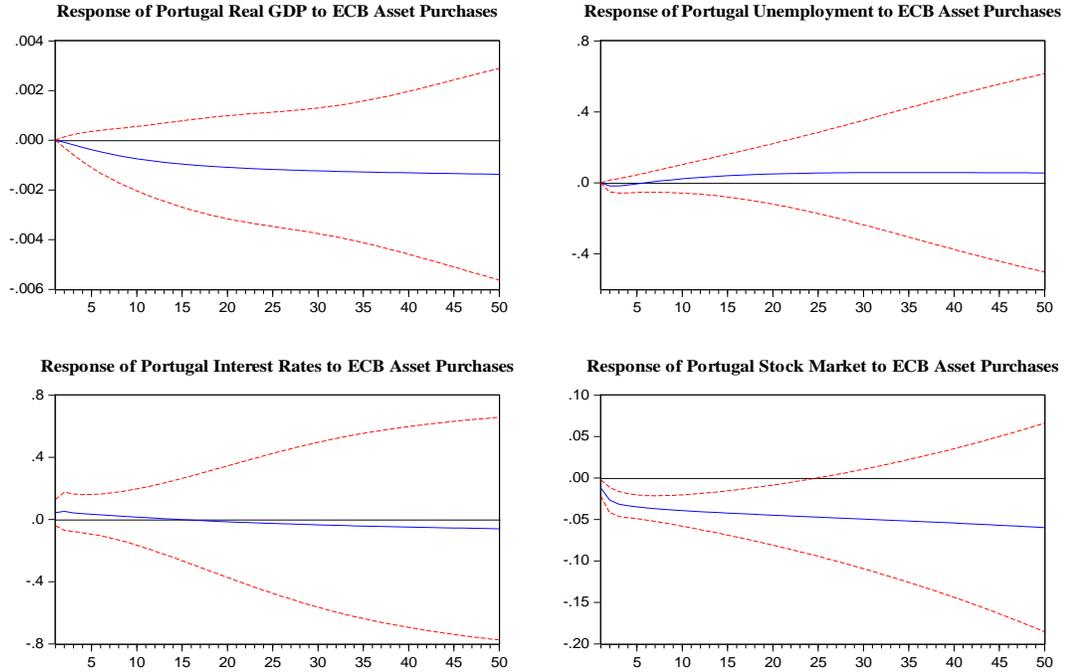
### Appendix 3: Response of Greece to ECB Policies



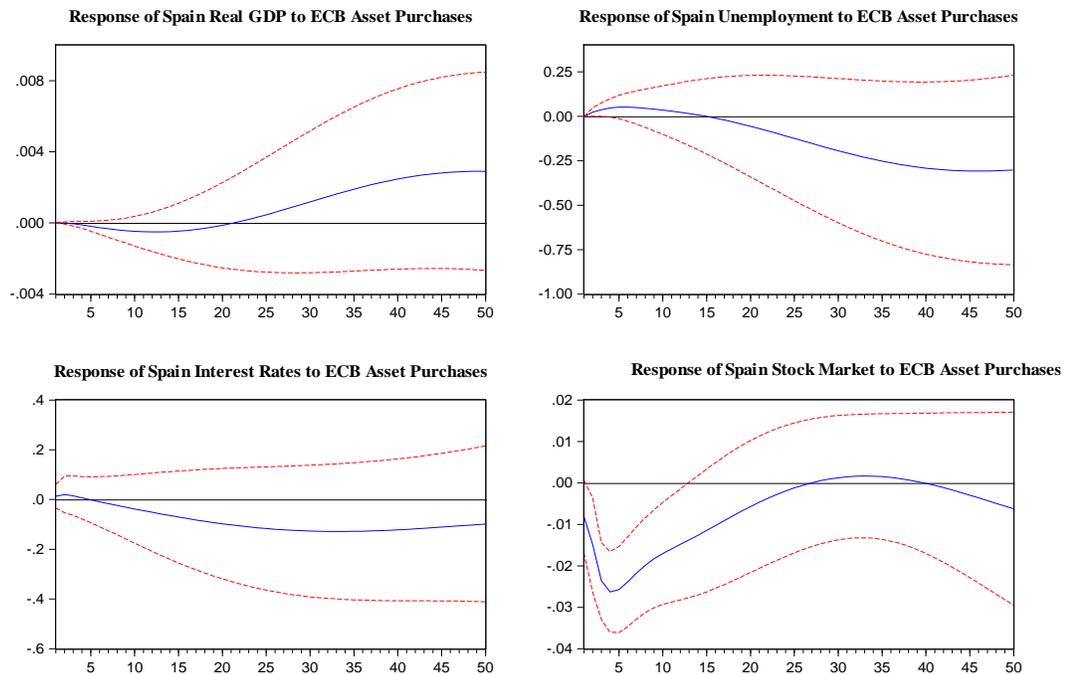
### Appendix 4: Response of Italy to ECB Policies



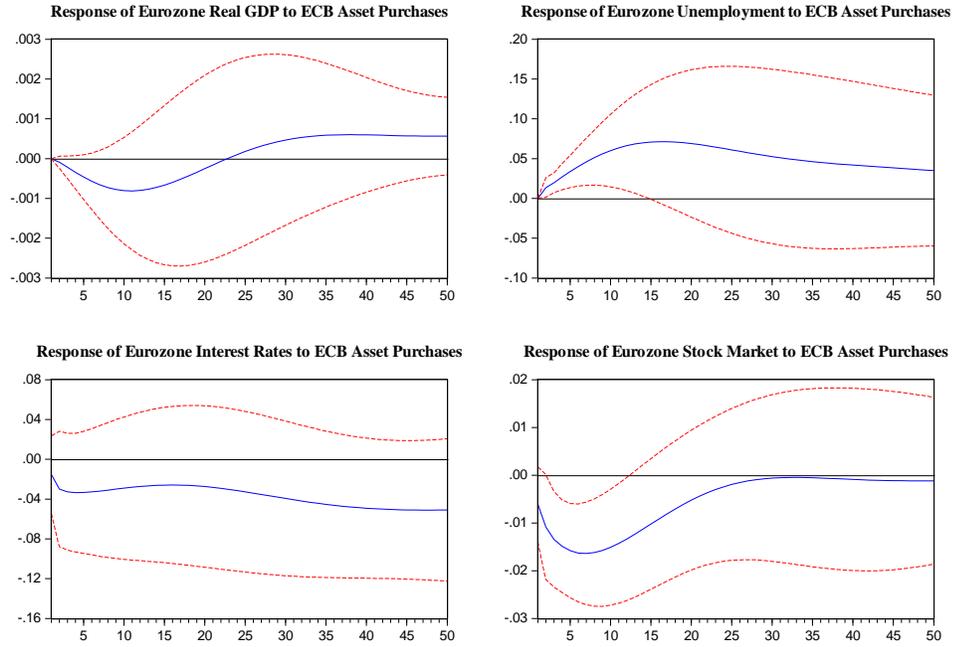
## Appendix 5: Response of Portugal to ECB Policies



## Appendix 6: Response of Spain to ECB Policies



## Appendix 7: Response of Eurozone to ECB Policies



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- Beyza Oktay, Hakan Öztunç, Z. Vildan Serin (2016). Determinants of Gold Reserves An Empirical Analysis for G-7 Countries. *Procedia Economics and Finance*, Volume 38, p.8-16.

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- Zehra Vildan Serin, Beyza Oktay (2013). An Empirical Analysis of International Reserves in G-20. *Statin Crises, Sase Annual Conference*, 25, Milan-Italy.
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#### **Published International Books or Book Chapters**

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- Beyza Oktay, Vildan Serin (2017). Gold Reserves Held by Central Banks: A Comparison of Advanced and Emerging Economies. **Global Political Economy after the Crisis: Theoretical Perspectives and Country Experiences** (Edited by Sadık Unay, Nova Science Publishers, p. 259-278.

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