



**The performance of the Spanish bank system in the
crisis of 2007 - 2008**

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Biographic note

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Abstract

This dissertation addresses the response of the Spanish banking sector to the economic and financial crisis of the period 2007-2009. This is done, mainly, by testing the stability of some key financial ratios. The study will apply the econometric Chow model on the Spanish banking sector in order to establish the impact of the 2007 financial crisis. The use of the Chow model implies the calculations of thirteen financial ratios for the Spanish banking system, to verify the existence of structural breaks or some changes in trend. Ratios belong to the fourth following categories: profitability, liquidity, credit quality and capitalization. Also, this study compares between two models. On the one hand the 133 Spanish banks, and on the other hand the study which has taken and applied the leading 390 U.S. banks in terms of assets as benchmark.

We find a strong evidence of a change in trend of all ratios under study during the period from 2008 to 2009. Furthermore, our results suggest that the level of similarity between the data ratios obtained for the Spanish financial system and the financial system of the United States is very high, although, the Spanish ratios have been affected of much greater severity, in all the cases. Nevertheless, we can actually conclude that there are obvious indications of a trend change in the ratios of the Spanish banking system, as a result of the financial crisis of 2007.

The study is really relevant as it demonstrates how the crisis did affect definitely on the financial situation in Spain, as this is demonstrated by the structural breaks found in the ratios. The similarities found with U.S. shows us how important globalization is nowadays, and the easy access of the population to global information.

Keywords: Chow test, Spanish Banks, U.S. Banks, Structural breaks, Financial crisis.

JEL classification: C12, C22; C32.

Resumo

Esta dissertação aborda a resposta do sector bancário espanhol à crise económica e financeira observada no período 2007-2009. Tal é maioritariamente efetuado, testando a solidez de rácios financeiros chave. Este estudo aplica o modelo econométrico de Chow no sector bancário espanhol de forma a determinar o impacto da referida crise. A utilização do modelo de Chow implica o cálculo de trinta rácios financeiros do sistema bancário espanhol e a verificação da existência de quebras estruturais ou alteração de tendências. Os rácios pertencem a uma das seguintes quatro categorias: rentabilidade, liquidez, qualidade de crédito e capitalização. Logicamente, este estudo faz a comparação entre duas realidades: por um lado, 133 bancos espanhóis e, por outro, um estudo que foi feito aos 390 principais bancos norte-americanos em termos de ativos, que servirá como referência.

Foi encontrada uma forte evidência da alteração das tendências de todos os rácios sob análise durante o período de 2008 a 2009. Além disto, os nossos resultados sugerem que o nível de semelhança entre os rácios obtidos entre o sector financeiro espanhol e o sistema norte-americano são muito elevados, embora o impacto tenha sido bastante mais severo no caso espanhol. Não obstante, há uma clara evidência de alteração de tendências nos rácios do sistema bancário espanhol, como resultado da crise financeira de 2007.

Este estudo revela ser de enorme importância uma vez que comprova que a crise afetou a situação financeira em Espanha, tal como é demonstrado pelas quebras estruturais observadas nos rácios. As semelhanças encontradas com os E.U.A. evidenciam a relevância da globalização nos dias de hoje e a forma como os cidadãos têm facilmente acesso a informação global.

Palavras-chave: Teste de Chow, Bancos espanhóis, Bancos norte-americanos, Quebras estruturais, Crise financeira.

Códigos JEL: C12, C22, C32.

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List of abbreviations

BBVA	Banco Bilbao Vizcaya Argentaria
C_I	Cost to Income
E_L	Total Equity to Total Liabilities
E_TA	Total Equity to Total Assets
ECB	European Central Bank
EU	European Union
FSB	Financial Stability Board
GDP	Gross Domestic Product
IL_E	Impaired Loans to Equity
IL_GL	Impaired Loans to Gross Loans
IMF	International Monetary Found
LA_TDB	Liquid Assets to Total Deposits and Borrowing
LLR_GL	Loan Loss Reserves to Gross Loans
MFI	Monetary Financial Institution
NIM	Net Interest Margin
NL_TA	Net Loans to Total Assets
NL_TDB	Net Loans to Total Deposits and Borrowing
ROA	Return on Assets
ROAA	Return on Average Assets
ROAE	Return on Average Equity
U.S.	United States

1. Introduction

Spanish economy has been suffering a severe crisis since the end of 2008. The increase of the sale of new and used homes in the United States was the beginning of the subprime crisis. Banks began to lend money in large quantities and to look for customers to provide them with higher interest rate than the established. This means, riskier customers which were called: “subprime” customers. The famous "subprime" mortgages are nothing more than mortgages with a high risk of default. This mortgages were considered by the bank as having an above-average probability of not being returned to them.

Even so, in the peak of the real estate boom, banks had the mentality that as prices were rising, a possible sale of the house could settle those mortgages that families had contracted with the banks previously. This situation created an environment of widespread mistrust throughout the whole global financial system. The situation was aggravated by the fall of Lehman Brothers and other U.S. financial institutions. These institutions, at the same time, dragged other German, Dutch or British entities, among others, shortly.

Spanish economy was also greatly affected by all these facts, but the situation that we found in Spain was even worse. As Reinhart and Rogoff (2009) state, bank or financial crises are not a rare element and have become more frequent in recent decades. Spain had developed series of excesses and imbalances that had been accumulating in the boom phase and that caused the crisis to be particularly vulnerable to changes, when talking about macroeconomic conditions.

Events were happening over the years. The international financial crisis hastened the correction of the real estate excesses and the indebtedness of the private sector that characterized the high growth stage that preceded the recession. The deterioration of the economic situation and employment, the latter one in a unique way, had a very negative impact on public finances and on the situation of financial institutions whose are exposed to real estate risk. Spain went into recession in the second quarter of 2008 and remained in that situation until the first quarter of 2010. That year began a modest recovery that stopped at the second half of 2011. Just before the intensification of the sovereign debt crisis and its generalization towards an increasing number of countries.

The aim of this dissertation is to examine how the crisis that began in Spain in 2008 affected the performance of its banking system. To do this we will use thirteen financial ratios included in four different groups, such as: profitability, liquidity, credit quality and capitalization ratios. The purpose of the study of these ratios is to know if it would be a structural break and trend change between the pre-crisis and post-crisis years. To know this, we will use an econometric model called Chow test, which will show us the existence or not of these breakpoints. At the same time, we will also study the situation of the U.S. with the aim of knowing if the crisis affected both countries equally and if it did it in the same period of time.

With this purpose, in the second chapter we analyse some of the literature review in order to find a relation between the crises in some of the European countries. On the third chapter we present the econometric model used for our study, as well as, it is going to be explained how the data have been obtained for this study. The results obtained and the conclusion are going to be presented on fourth and fifth chapter and this will be the completion of our relevant studies.

2. Literature review

2.1. Spanish Crises

The Spanish crisis is not a new topic to research about. Just googling “Spanish crisis” we can obtain a lot of different studies, articles, thesis and some other type of literature. This factor make our study easier and more complicated at the same time. Easy because we have a lot of information to make reference to, but complicated because it is not easy to try to contribute with new different ideas. We are going to see a brief resume about some papers which have been founded interesting at some point.

Thus, the crisis, challenges us to make a revision of past crisis through the History, specially a look back to the last important crisis that crack the world during 1930s – and perhaps also the institutional incentives and unexamined assumptions that drive them – so that accounting research can contribute to a broader social and political analysis of the financial crisis (Arnold P., 2009).

While first approaching to the impact of the crisis on the Spanish economy we have appealed to a number of different researchers which have the Spanish and world crisis as point of study.

As we have said before, it is not a secret that the economic and financial crises of the Spanish economy have been a subject of study for many years. Harrison (1985) studies the Spanish economy in the twentieth century. He speaks of the role that Spain had during the two world wars and how it all affected to the Spanish economy. Later on, Simpson (1986) returned to analyse the Spanish economy but this time he prolonged its study until 1986, year in which Spain was admitted into the European Community. Another prominent author in the study of the Spanish economy is Lieberman. Lieberman (1982) made an analysis of the Spanish economy throughout the years 1940 to 1982 and afterwards extended this study until the year 1993 (Lieberman, 1995).

This last crisis that has suffered Spain is in a new context. Spain on this occasion depends not only on its decisions because the country is inside the European Union and inside the European monetary economic system: the Euro. That is why the decisions that Spain should take, cannot be taken by Spain itself. Because of that, this situation makes difficult to respond quickly to the Spanish economic problems.

Likewise, after the pass of the years, we have been able to observe the following: how

the crisis itself is much more damaging to the Spanish economy than to its European partners. This makes us think that the bases on which our economy were based were much weaker than those of some of the rest of the countries of the European Union.

As Estrada et al. (2009) say, the unemployment rate went from 9.6% in 2008 to 17.9% in Spain in just one year¹. This fact proves the idea that it was not a crisis either. It shows us that it affected much more in countries that already had basic structural problems.

A recent study by Gentier (2012) evaluates the consequences of the Spanish housing crisis on the banking system. In their paper “Spanish Banks and the Housing Crisis: Worse than the Subprime Crisis?” the authors initial idea explains to us nothing new: the Spanish crisis was motivated through the housing bubble as it makes it also Estrada et al. (2009). But throughout the text Estrada (2009) analyses all the factors which, according to the author, influenced the crisis, such as: institutional factors and external factors. Then, the author shows us the difficulties that have had all the Spanish banking systems as a result of their house loans. To conclude the study, the author talks about how deep the crisis was in relation to the banks' equity capital.

In the same vein as the previous ones, Elcano (2016) report tells us that in the years before the boom of the crisis the branches of banks and boxes were multiplied increasing their credits. A big part of these loans were destined to the purchase of real estate assets, without any control. The easy access to loans and the boom of the real estate sector caused that the price of the houses went to almost the double between the years 1997 and 2007. Álvarez (2008) adds to this idea about the lack of liquidity in the market due to the credit in the construction, and the uncertainty to the markets that this has associated to it.

Royo (2013) shows in this article how the reaction of the Spanish banking system during the period between 2008 and 2010 was positive. The reasons that the author finds for that affirmation are the following ones: the institutional, the political, and the cultural factors. He also analyses the factors that caused that after that period of time and with the explosion of the Spanish mortgage system in the real estate, the banks culminated falling. To conclude the study, the author explains how the country ended up being intervened and what measures were applied to solve it.

Carballo-Cruz (2011) also shows us the idea of how the excess in credits in construction made the exposure of banks to this sector to be so high, with the final that

¹ Data from the Survey of Active Population (EPA) & from the National Institute of Statistics (INE)

everybody knows. It also tells us about the factors that have caused the recovery in Spain to be delayed. These concepts in Carballo-Cruz's (2011) opinion would be: the high level of debt, especially private debt, and the high unemployment rate. He also points out the tough situation of the private sector, which along with the situation of instability found in the rest of the world what makes the Spanish situation even more complicated. Fernández and Ohanian (2010) also include these reasons (house and credits) in their study, and the study incorporates concepts such as oil and the speed with which the crisis was managed.

Cuadras (2009) coincides, with other authors, in that the crisis is preceded by an uncontrolled growth in the construction of new housing and all the loans and mortgages associated with all of them. This concentration of credit in this sector favoured the shaking of the Spanish financial system. Cuadras (2009) also considers other factors such as the type of financial strategy carried out by Spanish banks unlike its European neighbours.

2.2. General studies about banking

We can find very different studies throughout the economic literature that focus on the banking systems. Among them, we can find several studies in which their authors seek to discover the relationship between economic growth, stock markets and banks.

King and Levine (1993) and Rajan and Zingales (2001) provide empirical evidence that countries with highly developed financial markets grow faster. That financial development is particularly helpful in enhancing the growth of industries that, for technological reasons, rely heavily on external funds to enable their investment.

Levine and Zervos (1998) in their study, they show us how the relationship between the stock market liquidity and the banking development, both positively, predict growth, capital accumulation, and productivity improvements, when entered together in regressions. The results of the study show that financial markets are important for growth. In the same way, Beck and Levine (2004) speak of the positive relation that the stock markets and banks have in the economic growth. It evaluates the independence that can have both, stock market development and bank development, on economic growth. In the same way Ndako (2010) examined the casual relationship between stock markets, banks and economic growth in South Africa. Moreover, the study shows that there is evidence that the financial sector plays a critical role in the South Africa's economy. However,

different results can be found in Rioja and Valev (2014). These findings show that, in low income countries, banks have a positive effect on capital accumulation. The paper finds out that stock markets, however, have not contributed to capital accumulation or productivity growth in these countries.

2.3. Studies about banking performance

We can find a wide range of authors who write in relation to the bank performance. Among all these studies, there are many variables under study and many situations which are being analysed. For instance, Demirgüç-Kunt and Detragiache (1998) study, during the period from 1980 to 1994, the appearance of banking crises in very diverse countries. They use a multivariate logit econometric model. The study concludes that this scenario of banking crisis is more propitious in situations of macroeconomic weakness, when growth is low and inflation is high. With a similar method, Von Hagen and Ho (2007) show us that in order to be able to act on the crises of the banking systems, the first and most difficult thing is to identify them. We usually identify them with some type of event that happens in our environment. Therefore, this is, the focus of this study. The authors use conditional logit models to study the latest financial crisis by obtaining data from forty-seven different countries. They use different variables such as: macroeconomic, financial, and institutional variables. The study also concludes that many of the variables under study such as: slowdown of real GDP, lower real interest rates or extremely high inflation usually, precede a crisis of the banking system. In this same line, Čihák (2007) tells us about the importance that stress tests are taking in order to have greater control over all these events discussed above and that often trigger banking crises. It also tells us about the relationship between these stress tests with other analysis tools.

Garcia Herrero and Del Rio (2003) perform a study for which they use data from 79 different countries for the period from 1970 to 1999. The authors empirically show us the factors on which financial stability is based and in the elections that the central banks do to get it. We find that if banks focus on price stability then the likelihood of crisis is reduced. The authors also find a relationship between the degree of freedom of the central bank in each country and the possibility of a crisis in the banking system. In the same line De Nicolò et al. (2004) analyse the relationship between all types of banking factors and

the performance of banking systems. In order to do this, they focus on analysing whether financial firm risk and systemic risk potential in banking are related to consolidation and conglomeration. They close their study without being able to verify if that consolidation and conglomeration are synonyms of security.

According to Englund (1999), Kaminsky and Reinhart (1999) the majority of banking crises follows a common pattern of causes and consequences. The authors give us a series of guidelines to understand the course of a banking crisis. Banking crises are, normally, initiated by deregulatory measures. This creates a great expansion, as in the case of construction, which causes prices to rise which causes that loans are stopped, and so we have a banking crisis. The prices fall, the credits are not paid and all the damage is suffered by the financial sector. The financial sector is the one that has lent the money or even in many cases, the one that has invested in it. This explanation fits perfectly with the crisis suffered in Spain in 2008. The IMF (1998), for instance, documented 54 banking crises between 1975 and 1997. Whilst the World Bank listed as many as 117 systemic banking crises in 93 countries since the late 1970s till 1999 (Caprio and Klingebiel, 2003).

The crisis of 2008 has made us remember other events in history. Many of these crises have many similarities. Reinhart and Rogoff (2008a) show us a series of financial crises and talk about the relationships that could exist between them. In the case of Spain, they speak of the crisis of 1977 where we can observe that prices fell by 35% over the 5-year duration of this crisis. In other texts such as Bordo (2008) we find different crises over time and how these were addressed. Also Bordo (2008) explains how the determinants of the emerging market crises evolves in relation to the balance sheet approach. Gorton (2008) tells us that in order to understand crises we must know the design of financial assets. Specifically, he talks about securities, derivatives, and other vehicles. However, as pointed out by Allen and Gale (2009) the empirical literature on bank fragility has focused on documenting empirical regularities. The definition and measurement of the object of study about -what a banking crisis is, when it occurs, and how long it lasts- has been, at best, derived loosely from theory. As a result, this literature offers many-often contrasting-findings, which vary considerably in terms of samples used, banking crisis definitions and relevant dating.

Knaup and Wagner (2009) make a different and point to a new method for measuring the quality of banks' credit portfolios. As Knaup and Wagner (2009, p.1) state:

“a different use on the information impounded in bank share prices by exploiting differences in their sensitivity to credit default swap spreads of borrowers of varying quality”.

This study suggests that the market was aware of their (average) exposure to high risk credit.

Reinhart and Rogoff (2008a, 2008b and 2009) analyse the historical causes and consequences of the financial crises, paying special attention to the major crises in developed countries after the Second World War. The analysis is based on several standard indicators, such as: the level of inflation, the increasing leverage, the large deficits sustained by current accounts and the path of the economic growth.

We also find some studies with data on the starting dates and characteristics of systemic banking crises over the period 1970-2009. Laeven and Valencia (2010) carry out a study that goes on since 1970-2009. In this study they show us new and comprehensive data on the starting dates and characteristics of systemic banking crises over the period 1970-2009, building on earlier work by Caprio et al. (2005) where the author shows us different aspects such as: problems identified by political theorists and responsibilities. Laeven is also based on Reinhart and Rogoff (2009) who did an improvement on the study with the new U.S. data. Mortgage crisis of 2007 on the previous studio of Laeven and Valencia (2008) database on systemic banking crises to include the recent episodes following the U.S. mortgage crisis of 2007. This last update includes: an improved definition of systemic banking crisis, the inclusion of crisis ending dates, and a broader coverage of crisis management policies.

More recently, other papers as Arjani and Paulin (2013) show something that we have already tried to show before. The idea that not all financial systems were affected in the same way by the crisis of 2007-2009. In this case, the authors talk about the performance of the Canadian banking system during this period which was relatively strong.

Rioja and Valev (2014) study how the stock markets, the banks and other sources of the economy act for economic growth in low and high income countries. The study focuses on how these components affect the productivity and the capital accumulation. The results show the evident differences that we have been talking about between both low and high income countries.

The paper written by Claessens and Van Horen (2014) shows that when banks are

attacked by a crisis, they tend to reduce their presence abroad, only having in some case some small investment. However, the evidence to which this study reaches is that global banking is not becoming more fragmented but is undergoing major structural transformations.

2.4. Banking performance studies in other countries during the crisis period

As everybody knows we are living in an increasingly and globalized world. News travel across the planet with great rapidity. When something is news in a country, it spreads very quickly in all over the planet. Armada et al. (2008) have shown that crises should not be studied as an individual phenomenon, but rather that these crises have connections between them and that they can be transmitted very quickly between countries.

In this crisis this fact could be seen with total clarity. The crisis that began in the United States soon spread into the whole planet. That is why many banks saw how their equity was lost throughout 2008.

We found many different studies between the years before and after the crisis of 2007. Some of the studies that we have discussed are focused on the analysis of certain concrete parameters. For example, one of the most used parameters is of profitability. Studies like Dietrich and Wanzenried (2011) analyse the profitability of 453 commercial banks in Switzerland over the period from 1999 to 2008. The study is done in a very similar way to the one we have performed, not because the method used, but by all the ratios that we have chosen in its analysis. The study divides the period under study into two in order to analyse the impact of the crisis on these parameters.

In similar manner, Tomuleasa and Cocris (2014) performs a study that covers the period between 2004 and 2012. Their study shows us the determining factors of profitability in the European banking sector. This study concludes that all bank-specific determinants have their impact on bank profitability. However, against what one might think, it does this not always in the way that was anticipated and profitability is considered pro-cyclical. For their part, Pagano et al. (2014) talk about how the European banking system has grown over the last 20 years in Europe. In their study they show how Europe

has grown much more than other regions of the world. It also shows the contribution of the European banking system within the global framework.

In this same line Trujillo-Ponce (2013) performs an analysis of the factors that may influence on the profitability of Spanish banks for the period of 1999-2009. This study also shows a comparison of the performance of commercial and savings banks. For example, the study by Shukla (2014) shows that the financial crisis reached all corners of the world. To reach these conclusions, this study shows a negative variation of the Banks' Return on Assets (ROA) during the period 2007 - 2010, the year in which it began to recover. De Bonis et al. (2011) study the situation of the Italian banking system after the crisis and compare it with some of the most important European banks. To do that they use a series of parameters such as size, profitability and balance sheets among others.

We also find some studies that revolve around the influence of the composition of the boards between the different financial firms. Thus, Erkens et al. (2012) show that during the years 2007-2008 the firms with more independent boards and higher institutional ownership experienced worse returns during the crisis period. The explanation given by the authors is that a higher institutional ownership was adopted to a high risk situation before the crisis and with this more independent board was raised more equity capital during the crisis, which led to a wealth transfer from existing shareholders to debtholders. In the same line we find the study carried out by Noeth and Sengupta (2012). Depending on the structure of the bank, we could maintain different structures of equity, but in European banks we find a great increase of leverage during the period from 1997 to 2009. All of this was too risky for many of these banks that could not cope in the crisis years. Another of the studies that we find in relation to this subject is the one of Beltratti and Stulz (2012). The study analyses the factors that could lead to a poor performance of banks during the credit crisis. The study shows the fragility of banks financed by short-term capital and also shows that banks that had boards in which members were not financial professionals or belonged to other sectors which were not economic. This had a much worse performance during the crisis than boards formed by financial professionals.

Other studies were not based on financial ratios like the previous ones. They were based on very diverse concepts such as the size of the bank, as it can affect macroeconomic or microeconomic values in the performance of the banks. For instance, we find studies like Laeven et al. (2016) where the authors make a study during the 2007

crisis of the risks that can occur in a bank depending on its size and with what factors may be related. Iannotta et al. (2007) also discuss the positive relationship between the size of the bank and its performance, as well as Schoenmaker and Werkhoven (2012), who try to analyse the situation after the crisis when they compare the performance of banks in relation to their size and the presence of multinational companies. Outside the European borders we can find multiple studies. For instance, we find the study by Forughi and De Zoysa (2012) which is the first one made for the Australian banking system evaluating the effect of the crisis. This study also served to evaluate and comment on the effectiveness of recent mergers and acquisitions of Australian banks.

One of the most active authors in the US banking system study is Robert A. Weigand. Weigand (2015) shows us a study of several parameters to perform a comparison of the twenty most important banks of U.S. and Europe from 2001 to 2013. In this study it emphasizes the performance of the post-crisis years, where it can be observed that U.S. Banks obtained a systematic and considerable better result in all the parameters under study in relation to the European banks. A year later Weigand (2016) extends his study to data from 2015 and this time includes Japan in the study. This time notes that benefits had fallen an average of 20% in each case. After the crisis, the study continues to show that given the volatility that the U.S. banks establish in the market they continue performing better than European and Japanese banks.

Arjani and Paulin (2013) show that the performance of Canadian banks during the period 2007-2009 was really strong and put a stress into the importance of learning from the mistakes of the past. For this reason, they comment on the importance of liquidity for banks.

Xu (2011) conducts a study of the four major state banks in China during the period 1990-2008. The study shows that banks had a positive result during this time period and that too much protection by the Chinese government which led to a lack of motivation to develop new products and services. Allen et al. (2012) conducted an exhaustive analysis of the Chinese financial system and proposed a series of keys for China to prevent a crisis such as the one that shook the world in 2007.

Finally, Nagarkar (2015) conducts a study of the poorest banks of India after the crisis and for that purpose Nagarkar analyses its most important financial parameters. All of them conclude that banks, in general, they have a better performance if the deposits that

were made outweigh the money which has been borrowed. They also tell us about how the government tries to make mergers of the largest banks with the smaller ones, something that we have been able to see on multiple occasions, especially after the crisis.

2.5. Portugal

The crisis completely affected Portugal in 2008. The economy of the country was shaken hard as it came from a situation of instability where we could find many problems of macroeconomic imbalances, a large foreign debt and budget deficit. All this triggered social instability.

According to the studies we found in Portugal, Crosignani et al. (2015), they show us the situation of the country's sovereign debt, which are making a broad analysis. Throughout the study we are showed how the country is leveraging during the years before and after the crisis. The study focuses on the evolution of balance sheets of monetary financial institutions (MFI) in Portugal. All this hindered the integration of the Portuguese financial sector into the international countries.

On the same line appears the study of Pereira and Filipe (2016), this study focuses on the years after the crisis of 2007. This study makes a comparison between the trends of monetary financial institutions (MFIs) in Portugal compared to the Euro Area. As in the studies that we have seen for other countries, in this one we also find data from Portuguese banks that refer to ratios, board dimension, executive compensation and board members' qualifications. In all those studies women's presence is incidental. They also show us the reduction of human resources and branch offices.

Gurnani (2015) on his part shows all the economic adjustments suffered by Portugal after the bailout and all the financial reforms and austerity measures taken by the government. He makes an exhaustive analysis of the beginning of the crisis and how all this affect in Portuguese society and on the finances.

To conclude, Eichenbaum et al. (2016) show how Portugal remains after the crisis and the bailout program. They tell us about how the IMF program has made easier for the country to regain access to international markets and thus, to be able to finance itself again, which had remained in recent years in the hands of the private sector borrowing.

3. Methods and Data

3.1. Method

The chosen model to be applied to the Spanish and U.S. banking sector is the econometric “Chow test”. Perhaps because this test is one of the oldest tests in the econometric literature is also one of the most used and analysed.

However, this is not a test without fail or that works perfectly. It also has critical points and because of them we are going to highlight their limitations and their virtues.

Chow (1960) considers a test for a simple structural change. In this test is imposed that the change is known previously and that it uses a classic statistic. The fact of considering a known point of change for this test implies that the researcher has only two options: (i) to choose an arbitrary change point; or (ii) to choose a point of change based on the knowledge of the time series.

Consequently, the results can be highly sensitive to such arbitrary choices, and therefore researchers can easily draw different conclusions. When the point of change is unknown a priori, the problem is getting complicated in the sense that the point of change is a noisy parameter that is present in the series and affects the stability tests; under these conditions, the Chow test is not maintained.

Therefore, to carry out our study, we will develop the so-called Chow test, a parametric test on residuals of alternative which estimates whose application needs the following requirements:

1. The Chow test does not "look for" structural changes in the sample but rather confirms or denies a prior suspicion of structural change by the modeller. Thus, the point or points of change of structure must be known. In practice we suspect, a priori, from the appearance of a point of rupture, either by the existence of theoretical reasons that support conceptually that change, or by observing, in the results obtained, some of the usual symptoms in the presence of a structural change (change or rupture in the dynamics of errors, systematically wide confidence intervals for selected exogenous variables...).

In our case we assume that we can find a trend change or structural change in the financial ratios in the proximity to the years in which we consider that the crisis occurred. Therefore, the Chow test, as the author points out earlier, will not seek a structural change in the sample of our ratios, nor will it indicate the year in which the crisis took place. Otherwise, we will have to introduce the year in that we think that clear symptoms of the crisis appeared. This will be done based on the different studies that we find around the subject and with which we can assume that we are introducing the correct value in the Chow test. The result of this test will show us if we find a structural change in our financial ratios or, on the other hand, that there is no evidence that leads us to this conclusion.

The year we will introduce as a breaking point could vary between different samples. The reason is that we can consider as true that the crisis did not act at the same time and equally in the different countries. That is why we will have to analyse and seek the different opinions of different authors, to find the year that best fits into our different cases.

2. It is appropriate that the "suspicious" change point (for example, the year in which we suspect that the structure began to change) is not very close to the beginning or end of the sample. That is, the ideal is that this breaking point divides the total sample into two sufficiently large "pieces" (subsamples). The reason for this requirement is that, as it will be seen later, to implement the Chow test we will estimate our model, separately, in each of the two subsamples (different structures). So, in each one of them, we need a sufficient number of data to estimate.

Once given these starting conditions the way of operating to perform the contrast is simple. For the case of a single point of structural change:

1. The total sample of size " n " is divided into the two subsamples that determines the cut-off point of sizes " n_1 " and " n_2 " respectively.
2. In addition to the initially estimated model (the one originally estimated for the total sample), two more models are now estimated: one in each of the two subsamples identified. From each of these two new partial estimates we will

obtain a set of different parameters as well as different estimation errors.

3. Using the errors of the original estimation and the two partial estimates, the following contrast, is computed which a null hypothesis will be that the two sets of parameters (the derivatives of the sub-models of the different sub-samples) are equal:

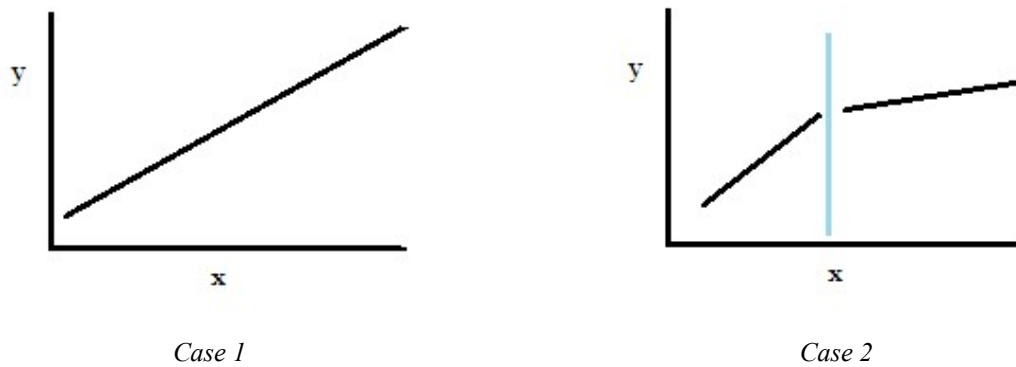
Equation 1. Chow test equation

$$Chow = \frac{(RSS - RSS_1 - RSS_2)/k}{(RSS_1 + RSS_2)/(n_1 + n_2 - 2k)} \sim F_{k, n_1 + n_2 - 2k}$$

Where RSS is the residual sum of squares for the estimated global model with "n" data, RSS_1 is the residual sum of squares for the estimated model in the first subsample of size " n_1 " and RSS_2 is the residual sum of squares for the estimated model in the second subsample of size " n_2 ".

The contrast proposed by Chow is extremely simple to understand. If it is observed carefully, it is verified that the numerator of equation 1 compares the residuals obtained in the unique RSS model against the residuals obtained in the two partial estimates RSS_1 and RSS_2 . That is to say that two different strategies of estimating the model are being compared: a strategy in which the sample is used in full. Because it is understood that there is no structural change (case 1) with another strategy in which instead of a single model estimates two models. Because it is understood that there are two different structures in the sample (case 2), as it could be observed on the following figure 1.

Figure 1. Chow test



This model enables us to determine if the Spanish banks' tested ratios were continuous over time, presenting no structural break at the time of the crisis; or if on the contrary, these ratios were affected by the global crisis and therefore reveal the occurrence of a structural break at the time the crisis hit or slightly afterwards. The hypotheses to be tested using the Chow test are as follows:

- H_0 : Parameters are stable; so there is no significant difference between the pre-crisis and the post-crisis ratios of the selected sample banks.
- H_1 : Parameters are not stable; so there is a significant difference between the pre-crisis and the post-crisis ratios of the selected sample banks.

This means that once the Chow test is performed, if it does not find a significant change between the trend of the data prior to the year of the crisis and the data of the years after the crisis in the ratios under study then we will say that there is no breakpoint in the trend of the ratio and therefore H_0 will be confirmed, as it does not find any type of significant change in the trend of these ratios. If, on the other hand, the Chow test shows a significant change in the trend of the ratios data in the years prior to the crisis and in the years that followed. We could say that there is a change in one breakpoint as a result of the crisis and therefore H_1 will be confirmed. This would mean that the ratios under study undergo a change in their trend as a result of the crisis.

The test tries to express if the single estimate generates more errors than a split estimate. If it were so, if the errors obtained with a single estimate were clearly superior to those obtained when two models are chosen, it must be understood that there is a structural change. Conversely, if the errors which have been made using the single model are similar to the sum of the errors made with two partial models there would be no reason to think that the sample contains a structural change.

It can be observed in the expression that once the error difference is computed it is expressed in percentage terms in order to eliminate the effect of the size of the measurement units. And is corrected, as in all contrast, numerator and denominator, by the degrees of freedom used in each expression².

² The degrees of freedom of the numerator "k" are derived from the combination of the degrees of freedom used to calculate the residual sums of squares expressed in the equation: (nk) for the total model, (n1-k) for the estimated model in the first subsample and (n2-k) for the model estimated in the second subsample.

Obviously, from a mathematical point of view, even if there is no structural change, the error committed with a single estimation will always be greater than the sum of the partial errors³. What the test tries to determine is whether that gain is large enough to suspect that there is a relevant structural change.

It can be verified that this test is distributed as an "F" ratio so that its use for the contrast of the null hypothesis is simple: when the value of this calculated statistic exceeds the value of tables of a distribution "F" it must be considered that it exists (namely, when this ratio takes a very large value, higher than that of tables, in our calculations, this means that the error committed with a single model is much greater than the sum of errors committed with two partial estimates which confirms the existence of a structural change point).

However in this model we find some limitations. The limitations of this contrast are obvious:

- Only detects abrupt structure changes, which may in fact be associated with "break points" in the sample. In the case of a less sudden, progressive alteration, which is generated, for example, over several years in a temporal model, the test clearly has clear power problems (tends to accept the absence of structural change)⁴
- For its application, we must know the breakpoint previously. This is to say, it is not a contrast with the ability to "detect" a change of structure, but to "confirm" the suspicion of its existence at a certain point.
- The contrast loses power as the cut-off point approaches to the extremes since one of the two structures will be under-represented by the sample. It will be difficult to observe the change in the quality of the estimation (and it is so in the squares errors)
- It is sensitive to the presence of heteroscedasticity. Indeed, the presence of heteroscedasticity (which may not be caused by various problems) is manifested in a non-constant evolution of estimation errors (errors tend to grow or decrease

Thus, $(n-k) - ((n1-k) - (n2-k)) = k$.

³ Structures always change, even very slightly. So splitting the estimate of a model in pieces will always generate less total errors. (Other thing is the less reliability of the results obtained with smaller samples).

⁴ Faced with the suspicion of a gradual change of this nature, a suggestion of general utility could be to apply the Chow test by comparing the overall estimate with the sum of the two estimates made at the beginning and at the end of the sample, eliminating data referring to the period Between the two structures.

as we move through the sample). So that evolution in the errors may lead to a significant result of the Chow test (which ultimately also compares the errors by subperiods) and to a false conclusion about the existence of a structural change.

We are going to analyse how our particular case could be affected by these particularities:

- We are really looking for that sudden change of break. We are not looking for a smooth change of trend that the Chow test could not possibly detect, since we want to know if the crisis has affected all those financial ratios.
- In our case, the break point is given by the year in which we determine that the crisis occurs in the countries of our sample: in this case the United States and Spain. So we are through the information gathered from different studies. These studies determine this possible breakpoint.
- If we approximately know the area where the breakpoint should be and that will be given by the year of the crisis, we will not be at the ends of the sample at any time.

3.2. Data

Different studies such as Bessis (2002); European Central Bank [ECB] (2010); Greuning and Bratanovic (2009), show that some ratios such as return on average assets (ROAA) do not give us enough information to check the performance of a bank (Eken & Kale, 2013).

Therefore, we choose a wide variety of ratios to be tested, which will allow us to get an overview of the situation of the banking system under study.

As we well know, we can find multiple financial ratios giving us a wide and very varied information about the different indicators that we can find when measuring the operation of a bank. For them we will group these financial ratios, which we will see below, to know what aspects of the Spanish and U.S. banking systems were the most affected by the crisis and which one the less.

The ratios chosen were broken up into four main categories (Hempel and Simonson, 1999):

1. **Profitability Ratios** which focus on the net income and enable us to measure how efficiently a bank is using its assets and managing its operations.
2. **Liquidity Ratios** that provide information about the capacity of a bank to meet its obligations if funding is interrupted and about the risk of illiquidity.
3. **Credit Quality Ratios** help in evaluating the risk of the bank's loans and particularly, their ability to be collected prior to or upon maturity.
4. **Capitalization Ratios** to measure the solvency of the bank while analysing its financial structure as well as its generation and use of capital through a combination of earning retention and debt.

In the following table 1 we can observe the different groups previously commented and all the ratios that include each one of these groups:

Table 1. Chosen Ratios

Profitability Ratios		
Ratio Name	Symbol	Equation
Return on Average Assets	ROAA	ROAA = Net Income / Total Assets
Return on Average Equity	ROAE	ROAE = Net Income / Total Equity
Cost to Income	C_I	Cost to Income Ratio = Overheads / (Net Interest Revenue + Other Operating Income)
Net Interest Margin	NIM	Net Interest Margin = Net Interest Revenue / Average Earning Assets
Net Profit Margin	NI_REV	Net Profit Margin = Net income / Net interest Revenue
Liquidity Ratios		
Ratio Name	Symbol	Equation
Liquid Assets to Total Deposits and Borrowing	LA_TDB	Liquid Assets to Total Deposits and Borrowing = Liquid Assets / Total Deposits and Borrowing
Net Loans to Total Assets	NL_TA	Net Loans to Total Assets = Net Loans / Total Assets
Net Loans to Total Deposits and Borrowing	NL_TDB	Net Loans to Total Deposits and Borrowing = Net Loans / Total Deposits and Borrowing
Credit Quality Ratios		
Ratio Name	Symbol	Equation
Loan Loss Reserves to Gross Loans	LLR_GL	Loan Loss Reserves to Gross Loans = Loan Loss Reserves / (Net Loans + Loan Loss Reserves)
Impaired Loans to Gross Loans	IL_GL	Impaired Loans to Gross Loans = Impaired Loans / (Net Loans + Loan Loss Reserves)
Impaired Loans to Equity	IL_E	Impaired Loans to Equity = Impaired Loans / Total Equity
Capitalization Ratios		
Ratio Name	Symbol	Equation
Total Equity to Total Assets	E_TA	Total Equity to Total Assets = Total Equity / Total Assets
Total Equity to Total Liabilities	E_L	Total Equity to Total Liabilities = Total Equity (Total Liabilities and Equity - Total Equity - Hybrid Capital - Total Subordinated Debt)

The use of the above ratios extends from 2005 to 2013, since we know that it is between these years when we find a greater effect of the crisis. We will make the same study in the case of both banks systems: the U.S. banks and the Spanish banks.

The reason for selecting this period is that we know that the approximate year of study is 2007. This year should be the beginning of the crisis and as discussed above, the Chow test divides the sample into two sub-samples that must be of a similar size. This is why we are not longer to extend our study.

3.2.1. Data collection

As for obtaining the data, as well as Naimy and Karen (2016) the ratios are sourced from the old Bankscope, now called Orbis Bank Focus. As they explain on their website "is a comprehensive global database of banks' intelligence, ratings and financial statements. So we have a new database of banks worldwide. The information is sourced by Bureau van Dijk from a combination of annual reports, information providers and regulatory sources.

This has not been the case for Spanish banks. For Spanish banks, as Orbis points out on its website, we have only been able to obtain the information for the last five years, which is insufficient for the range of data we are looking for as we would need information from the last eleven years since the last data correspond to 2016.

Therefore, in order to obtain the information of the Spanish banking system we have had certain difficulties. But finally, Banco Bilbao Vizcaya Argentaria (BBVA) offers us on its website an application where we can see all the parameters of the Spanish banking system as a whole. This useful application for our study is called "Principal monitoring indicators for the Spanish banking system"⁵.

This application does not offer us all the ratios, just like Orbis does. However, with all the information we have, we do not find it difficult to calculate these ratios through their formulas.

On the other hand, because the data distribution is unknown, we chose Slovin's formula sampling technique.

⁵ <https://www.bbvaresearch.com/en/spanish-banking-data/>

Equation 2. Slovin's Formula

$$n = \frac{N}{(1 + N \times e^2)}$$

Where:

n = Sample size

N = Total population; which is in our case the total number of banks provided by Orbis Bank Focus for the U.S. and Spain.

e = Error tolerance; we chose a 5% error margin.

This sampling technique was applied for both to U.S. and Spanish system banking since the population provided by Orbis Bank Focus was very large. Therefore in case of the U.S. system banking (with $N_{us} = 15,358$ banks):

$$n_{us} = \frac{N_{us}}{(1 + N_{us} \times e^2)} = \frac{15,358}{(1 + 15,358 \times 0.05^2)} = 390 \text{ banks};$$

We chose the top 390 U.S. banks in terms of total assets since these banks represent the largest share of the U.S. banking sector's total assets. Thus, they have the biggest impact on its overall performance.

In the case of Spanish banks, after comparing the data offered by Orbis for the last 5 years with those contributed by the application of BBVA and verifying that the results are practically the same. We have chosen to take all the values from the same source. In this way we have obtained all the information of the BBVA application. The ratios that already came as such and those that were not specified, we have calculated them with the information that the application provides us.

In the Spanish case, Orbis provides the data of 215 banks, of which we can only take the information of 200 of them. Although the sample in the case of the Spanish banking system is not as broad as in the case of the banking system U.S. We will calculate the same number of banks to include in our study. Therefore, using the sampling technique

for the Spanish banking system, we obtain the following result (with $N_{spa} = 200$ banks):

$$n_{spa} = \frac{N_{us}}{(1 + N_{us} \times e^2)} = \frac{200}{(1 + 200 \times 0.05^2)} = 133 \text{ banks};$$

All bank data for each ratio are averaged. The weighted-average method applied is based on the total assets of each bank since banks belonging to the same economy differ in size; consequently, banks which represent the biggest share of the banking sector's total assets have the biggest impact on its overall performance. While banks with lower total assets have a lower impact. The weighted average for each ratio is as follows:

Equation 3. *Weighted average equation*

$$\text{Weighted Average of Ratio } A_{year \times} = \frac{\sum_{i=1} (TA_i \times \text{Ratio } A_i)}{\sum_{i=1} TA_i}$$

Where:

N = number of banks presenting a value for Ratio A

TA_i = total assets of bank i

$\sum_{i=1}^n TA_i$ = sum of total assets of all banks presenting a value for Ratio A

The yearly weighted averages for each ratio for both U.S. and Spanish Banks are presented in tables 2 and 3 respectively.

Table 2. Weighted averages for each ratio for U.S system banking

EEUU													
YEAR	PROFITABILITY RATIOS					LIQUIDITY RATIOS			CREDIT QUALITY RATIOS			CAPITALIZATION RATIOS	
	ROAA	ROAE	C_I	NIM	NI_REV	LA_TDB	NL_TA	NL_TDB	LLR_GL	IL_GL	IL_E	E_TA	E_L
2005	1,33	14,51	58,41	3,29	-49,74	21,30	54,69	64,81	1,30	0,86	5,25	9,67	11,09
2006	1,41	14,99	57,18	3,26	-39,79	21,77	55,04	65,80	1,16	0,90	5,43	9,78	11,35
2007	0,99	10,41	61,62	3,23	-1,02	22,42	54,79	65,06	1,39	1,31	8,53	9,42	10,84
2008	0,19	1,88	63,18	3,27	-0,40	21,48	52,38	61,77	2,44	2,97	18,30	9,20	10,53
2009	0,25	3,03	57,48	3,48	0,04	21,76	49,31	58,88	3,56	6,05	30,99	10,28	11,89
2010	0,70	6,95	58,70	3,65	0,57	21,93	49,42	59,26	3,39	5,31	26,10	10,71	12,41
2011	0,84	8,11	64,01	3,36	0,25	22,14	49,66	59,60	2,81	4,50	21,74	10,84	12,51
2012	0,92	8,64	65,30	3,19	-0,07	23,41	49,54	59,13	2,28	4,00	18,47	10,92	12,53
2013	0,98	9,15	63,81	3,05	-0,39	24,54	49,81	59,17	1,81	2,94	13,48	11,03	12,65

Table 3. Weighted averages for each ratio for Spanish system banking

SPAIN													
YEAR	PROFITABILITY RATIOS					LIQUIDITY RATIOS			CREDIT QUALITY RATIOS			CAPITALIZATION RATIOS	
	ROAA	ROAE	C_I	NIM	NI_REV	LA_TDB	NL_TA	NL_TDB	LLR_GL	IL_GL	IL_E	E_TA	E_L
2005	0,83	11,10	53,20	1,27	54,98	28,84	65,02	102,33	0,30	0,79	1,36	5,77	6,14
2006	1,02	13,70	47,50	1,16	70,76	23,37	69,61	110,05	0,34	0,70	1,37	6,04	6,42
2007	1,07	15,50	43,10	1,18	78,13	24,58	69,58	111,47	0,39	0,90	1,08	6,25	6,64
2008	0,66	10,40	44,50	1,14	52,39	24,74	67,02	107,34	0,70	2,81	286,00	5,33	5,65
2009	0,44	7,00	43,50	1,33	30,11	29,73	65,42	105,13	0,91	4,12	204,00	5,68	6,04
2010	0,30	5,20	46,50	1,06	28,21	27,77	65,69	105,18	0,78	4,67	166,00	5,54	5,86
2011	-0,52	-7,40	49,80	0,89	-49,78	33,92	61,27	107,72	1,08	6,01	158,00	7,38	7,89
2012	-2,55	-35,50	45,30	0,96	-225,13	44,41	54,59	108,32	4,23	7,48	117,00	7,54	7,99
2013	0,13	4,10	48,20	0,83	32,78	45,90	55,99	100,61	1,27	9,38	118,00	9,25	10,03

Note: All the results of the ratios are bank average for each country. ROAA - Return on Average Assets ROAE - Return on Average Equity C_I - Cost to Income NIM - Net Interest Margin LA_TDB - Liquid Assets to Total Deposits and Borrowing NL_TA - Net Loans to Total Assets NL_TDB - Net Loans to Total Deposits and Borrowing LLR_GL - Loan Loss Reserves to Gross Loans IL_GL - Impaired Loans to Gross Loans IL_E - Impaired Loans to Equity E_TA - Total Equity to Total Assets E_L - Total Equity to Total Liabilities

3.3. Choice of breaking point

When working with the Chow test, one of the most important parameters is to know the breakpoint for which we are going to carry out the study. This breakpoint will be the point at which we think there is a significant change or break in the trend of each ratio under study. It is therefore very important to specify exactly what this point will be.

This point may be different for the two cases we are going to study: U.S. And Spain. The reason for this is given by the fact that the crisis initiated in U.S. It spreads through the rest of the world and does not arrive with the same speed everywhere. Therefore, we will look for information in previous studies to be able to verify what will be that point that best fits in each one of the cases.

So we know, the sharp crisis in the housing market that began in the second half of 2007 completely affected credit institutions in the Spanish financial system. The balance sheets of banks and savings banks in Spain were affected by the excess of funding provided to the real estate sub-sector with resources taken in the capital markets. We will have a look at each case carefully.

3.3.1. The breakpoint in the U.S.

The particular case of U.S. banking system is quite obvious and all the studies agree in which it was the year 2007 that produced the greatest signs of the crisis in the banks.

Multiple studies such as Dymski (2010), Dooley and Hutchison (2009) or Horta et al. (2008) show that the U.S. mortgage bubble became more notable throughout the year 2007. These studies tell us about how the bubble that was created giving all that large amount of loans to people who could not afford them exploded in 2007. As Ruesga Benito states (2012), one part of the explanation perhaps rather the trigger for the crisis that occurred in 2007, lies in the ups and downs of the financial crackdown in the United States. The corollary of the subprime crisis and the generalized distrust reactions across the global financial system following the hecatomb of Lehman Brothers and other U.S. financial institutions dragged in a short time other Germans, Dutch or British, among other.

Torrero (2010) coincides in pointing to low quality mortgages. This means that to those granted to borrowers with dubious guarantees for an amount that sometimes

exceeded the cost of housing. Such as the trigger that started the financial disaster in the US. The growth of these mortgage loans (subprime) was based on the idea of rising real estate prices that provided increasing guarantee (housing was increasing more and more). This greater value of the house allowed to obtain additional financing that was often used to buy a better house, or simply for consumption. In fact, in the years preceding the outbreak of the crisis (2007) part of the household consumption in the United States was financed through this mechanism.

Therefore, to carry out the study, we clearly find 2007 as the year in which the financial crisis took part in the US economy.

3.3.2. The breakpoint in Spain

On the other hand, to analyse when the crisis began in Spain, we can intuit with the analysis of events, which was sometime between the second half of 2008 and the first quarter of 2009. In order to certify this data, we have navigated among the various studies about the Spanish financial crisis and we will go on to expose the information we have considered more interesting to be able to close the date. This information is as follows:

1. According to the International Monetary Fund (2010), after an average growth of 2.9% between 2004 and 2007, the developed economies as a whole grew by only 0.5% in 2008 and their GDP fell by one 3.2% in 2009. With regard to unemployment rates, it is expected that after reaching 5.4% in 2007 for all developed economies, it will reach 9.3% in 2010. This is, as a result, the worst performance of the world economy since the inter-war period.
2. After a long period of economic expansion, which began in the mid-nineties, in 2006 the Spanish economy began to show the firsts signs of exhaustion. The international economic crisis, which began in 2007 and deepened in 2008, hastened the end of the expansive cycle and triggered a severe adjustment of the imbalances accumulated during the previous decade. Its correction continues to these days, four years later, pending its completion.

The rapid deterioration of the international macroeconomic context highlighted the structural weaknesses of the Spanish economy, especially after 2008. (Carballo-Cruz, 2011)

3. The year 2009 was undoubtedly a go down in history as the year of the great recession because of the intensity, duration and nature of it. But with the relief of having avoided that the year 2009 was the year of the Great Depression⁶.
4. Since the end of 2008, we have witnessed an accelerated growth in nonperforming loan, a reduction in rates of return, a deterioration in liquidity ratios and a rapid reduction in the so-called "buffer" of provisions accumulated in the recent past.

For all this we will choose 2007 being set as the breakpoint, for the U.S. financial system, due to the year when the first signs of the crisis began to appear.

On the other hand, with all the information obtained from the different papers, we observed that the date of the beginning of the crisis in Spain should be included sometime between the second half of 2008 and the first quarter of 2009 as we have discussed before. Therefore, we have thought that for the Spanish financial system we will carry out two simulations. A first for the year 2008 and another for the year 2009. In this way we will be able to verify that ratios varied first and which later, if there had been some variation.

⁶ The Spanish economy in the global crisis. Program: "Economía de la crisis y la reactivación" /Caja de Ahorros de la Inmaculada de Aragón. José Luis Malo de Molina. General Manager of the Research Service. Bank of Spain

4. Results of the Empirical Study

We have analysed each of the financial ratios for the periods between 2005 and 2013, both for the Spanish banking system and for the U.S. banking system. For both of these financial systems the Chow formula was carried out after splitting the data into two subperiods at the designated breakpoint year: 2007 for the U.S. banking system; and some point between 2008 and 2009 for the Spanish banking system. Then, the regression for the two sub-periods was estimated separately.

As we have discussed before, we will show how the Chow test works in the mathematical form. We will do it with the example of US, which would be the case where the breakpoint is the year 2007. An event such as the year 2007, the crisis might disturb the relationship the financial ratios: 2005-2007 and 2008-2013, the pre- and post-2007 crisis periods.

Tables 4 and 5 show the results of the Chow test per ratio for the U.S. and Spain respectively.

Table 4. Chow test results for the selected U.S. banks

RATIO NAME	ACRONYM	U.S. 2007		
		F-VALUE	P-VALUE	DECISION
Return on Average Assets	ROAA	2,982032	0,1149	Accept H_0
Return on Average Equity	ROAE	5,835510	0,0363	Reject H_0
Cost to Income	C_I	4,922946	0,0508	Reject H_0
Net Interest Margin	NIM	0,082046	0,7804	Accept H_0
Net Profit Margin	NI_Rev	4,614559	0,0572	Reject H_0
Liquid Assets to Total Deposits and Borrowing	LA_TDB	2,674784	0,1330	Accept H_0
Net Loans to Total Assets	NL_TA	10,457790	0,0090	Reject H_0
Net Loans to Total Deposits and Borrowing	NL_TDB	12,149540	0,0059	Reject H_0
Loan Loss Reserves to Gross Loans	LLR_GL	4,054500	0,0717	Reject H_0
Impaired Loans to Gross Loans	IL_GL	6,419015	0,0297	Reject H_0
Impaired Loans to Equity	IL_E	5,550612	0,0402	Reject H_0
Total Equity to Total Assets	E_TA	2,912427	0,1187	Accept H_0
Total Equity to Total Liabilities	E_L	2,712998	0,1306	Accept H_0

Table 5. Chow test results for the selected Spanish banks (2008)

RATIO NAME	ACRONYM	SPAIN 2008		
		F-VALUE	P-VALUE	DECISION
Return on Average Assets	ROAA	2,707034	0,1309	Accept H_0
Return on Average Equity	ROAE	2,603646	0,1377	Accept H_0
Cost to Income	C_I	0,008792	0,9271	Accept H_0
Net Interest Margin	NIM	3,491861	0,0912	Reject H_0
Net Profit Margin	NI_Rev	2,825292	0,1237	Accept H_0
Liquid Assets to Total Deposits and Borrowing	LA_TDB	7,040075	0,0242	Reject H_0
Net Loans to Total Assets	NL_TA	6,252284	0,0314	Reject H_0
Net Loans to Total Deposits and Borrowing	NL_TDB	2,422195	0,1507	Accept H_0
Loan Loss Reserves to Gross Loans	LLR_GL	5,201712	0,0457	Reject H_0
Impaired Loans to Gross Loans	IL_GL	26,226570	0,0004	Reject H_0
Impaired Loans to Equity	IL_E	40,063500	0,0001	Reject H_0
Total Equity to Total Assets	E_TA	3,627737	0,0860	Reject H_0
Total Equity to Total Liabilities	E_L	3,666157	0,0845	Reject H_0

Table 6. Chow test results for the selected Spanish banks (2009)

RATIO NAME	ACRONYM	SPAIN 2009		
		F-VALUE	P-VALUE	DECISION
Return on Average Assets	ROAA	4,381708	0,0628	Reject H_0
Return on Average Equity	ROAE	4,334443	0,0640	Reject H_0
Cost to Income	C_I	0,204715	0,6606	Accept H_0
Net Interest Margin	NIM	4,582772	0,0580	Reject H_0
Net Profit Margin	NI_Rev	4,506447	0,0597	Reject H_0
Liquid Assets to Total Deposits and Borrowing	LA_TDB	15,669630	0,0027	Reject H_0
Net Loans to Total Assets	NL_TA	11,548780	0,0068	Reject H_0
Net Loans to Total Deposits and Borrowing	NL_TDB	3,622025	0,0862	Reject H_0
Loan Loss Reserves to Gross Loans	LLR_GL	5,317430	0,0438	Reject H_0
Impaired Loans to Gross Loans	IL_GL	8,218168	0,0168	Reject H_0
Impaired Loans to Equity	IL_E	1,179967	0,3029	Accept H_0
Total Equity to Total Assets	E_TA	8,493285	0,0154	Reject H_0
Total Equity to Total Liabilities	E_L	8,451112	0,0156	Reject H_0

To verify the suitability of our study, we have mapped the results of the p-values obtained after the Chow test. And that fulfill our confidence level of 90%. The intention in creating the map is to visualize at first sight in what year a change in the financial ratios takes place with more notoriety. In this way what we try to do is to check if we have made a good choice when choosing our breakpoints.

Table 7. Map for U.S. Chow test Results

	2007	2008	2009	2010	2011	2012
ROAA	-	-	-	-	-	-
ROAE	0,0363	0,0372	0,0733	-	-	-
C_I	0,0508	-	-	-	-	-
NIM	-	-	-	0,0001	0,0146	0,0014
NI_REV	0,0572	-	-	-	-	-
LA_TDB	-	-	0,0393	0,0098	0,0015	-
NL_TA	0,0090	0,0000	0,0000	-	-	-
NL_TDB	0,0059	0,0000	0,0000	-	-	-
LLR_GL	0,0717	0,0265	-	-	-	-
IL_GL	0,0297	0,0098	0,0982	-	-	-
IL_E	0,0402	0,0230	-	-	-	-
E_TA	-	0,0144	0,0000	0,0000	-	-
E_L	-	0,0164	0,0000	-	-	-

Table 8. Map for U.S. Chow test Results

	2007	2008	2009	2010	2011	2012
ROAA	-	-	0,0628	0,0316	0,0173	-
ROAE	-	-	0,0640	0,0301	0,0145	-
C_I	-	-	-	-	-	-
NIM	-	-	0,0580	0,0001	0,0000	-
NI_REV	-	0,0912	0,0597	0,0324	0,0163	-
LA_TDB	-	0,0242	0,0027	0,0010	-	-
NL_TA	-	0,0314	0,0068	0,0015	-	-
NL_TDB	-	-	0,0862	0,0820	0,0672	0,0153
LLR_GL	-	0,0457	0,0438	0,0441	-	-
IL_GL	0,0108	0,0004	0,0168	-	-	-
IL_E	0,0065	0,0001	-	-	-	-
E_TA	-	0,0860	0,0154	-	-	-
E_L	-	0,0845	0,0156	-	-	-

As we interpret through the opinion of different experts, 2007 was the year when we see a greater change from the financial ratios to U.S. and at some point between 2008 and 2009 for the Spanish case. That is why we reaffirm ourselves in all the information previously collected.

Going back to the result tables in most financial ratios we find a structural change in the trend as if we would find break points in most of them. Now we will analyse each of the particular groups. However, we can observe how in the case of U.S. Banking system only those that refer to capitalization ratios are what seem to have greater resistance to the crisis. We also found some resistance, although much less, in the profitability ratios.

On the other hand, in the Spanish case, in 2008 we observed that the profitability ratios are those what keep their trend and present a greater opposition to the crisis. Otherwise, the rest of financial ratios are affected for the most part. In 2009, we can already see how almost all financial ratios have already been affected by the crisis.

Now, we are going to proceed to carry out a more exhaustive analysis of all the financial ratios by groups.

4.1. Profitability ratios

This ratio category for Spanish banks experienced important breaks. Analysing the breakpoint, we find for the Spanish financial system that it clearly shows that the crisis caused a tremendous gap in profitability. In 2008, almost none of the ratios included in this category had undergone significant changes. It was already in 2009 when all of them, except Cost to Income, C_I, suffered significant variations in their behaviour reaching negative values most of them. When we look at ROAA and ROAE we see that they have a very similar behaviour for Spanish banking. They start with a stable trend until 2008 where they have a negative slope, which is increasing until reaching their worst moment of profitability in 2012. Specifically, we observe ROAE, which goes from 15.50% in 2007 to -35.50% in 2012. This is why it is badly damaged as a consequence of the crisis. When compared to U.S. data, we can clearly observe that although these two ratios were also affected by the crisis, the damage was never as great as in the case of the Spanish banking system.

As we have already mentioned, only Cost to Income, C_I remained stable during this

period and we do not find any breakpoint for the years under study. If it is true that after years in which the C_I came with a negative slope, in the years of the crisis makes a turning point to start a trend of change in the slope, which translates into a higher cost. On the other hand, we also find Net Profit Margin, NI_REV, which shows us a huge trend change. It goes from 78.13% in 2007 to -225.13% in 2012. This behaviour is totally opposite to the one observed for the case of U.S. This figure is easy to read since it was in 2012 when the European Union rescued the Spanish financial system. It is easy therefore to understand that this year will be massively affected by the Net Profit Margin data⁷. Finally, we find Net Interest Margin, NIM where we find a breakpoint but to our surprise, it is a positive correction. In the years of crisis, we find a positive rebound in this ratio.

In the case of the U.S. banking system we find trend changes in ROAE, C_I and NI_REV. NI_REV came from a few years from negative values in 2005 from -49.74% to reach values of 0.04% positive in 2009 and already stabilize in very close values in the following years. ROAE, does find a structural change around the year 2006 that makes it move from values close to 15% to values close to the unity for the year 2008. As we can observe, there is no such sudden change in their trends.

What is notorious is that the changes for Profitability Ratios are much more pronounced for the Spanish banking system than for the U.S. banking system, which makes us to determine that for this category of ratios, the crisis struck much more forcefully in the U.S. banking system.

4.2. Liquidity ratios

With these indicators we can analyse the exposure of the Spanish banking system to the risk of systemic liquidity. This risk is understood as the propensity of the entities to underestimate the possibility of not being able to obtain financing in the markets or to liquidate a sufficient volume of liquid assets at a reasonable price.

Between 2008 and 2009 we find a structural break in all ratios of this category for the Spanish banking system. But not all with the same tendency. We can observe that Spanish

⁷ On July 20, 2012, the Memorandum of Understanding on financial sector policy conditions, known as MoU was presented. It is the document the one that reflects the conditions of the agreement between Spain and its European partners for the rescue of the bank.

banks are starting to take much more caution. This is clearly reflected in the three liquidity ratios under study. For instance, the first of them *Liquid Assets to Total Deposits and Borrowing*, LA_TDB, we found a breakpoint in 2008, but unlike the previous ratios, this time trend from this year is upward, which shows that banks tend to have a greater number of liquid assets in their accounts in relation to the money of deposits and borrowing.

The other two ratios, Net Loans to Total Assets, NL_TA, and Net Loans to Total Deposits and Borrowing, NL_TDB also find their breakpoint between these 2 years, but unlike LA_TDB, the trend change that occurs is downward. What we could translate is that the situation previous to the crisis, the banks were more flexible, but this scenario changed totally after the blast of the crisis. During the hardest years of the crisis which was suffering the country, the banks were harder and stricter when granting loans. This propitiated less consumption of both companies and the public sector, as the access to the money was increasingly much more complicated for everybody.

This sharp decline in credit as of 2008 was determined by both demand and supply. Thus, the decline in domestic spending, the loss of confidence of the agents and the revaluation of their financial situation significantly limited the requests for new financing by companies and families. At the same time, the upward revision of perceived risks, in the context of a deep global crisis and falling asset prices, and the deterioration of the financing conditions of the lenders themselves, contributed to tightening the supply of new credits.

All this results from the tightening of the requirements related to liquidity management. Two short-term and long-term liquidity requirements are introduced. They are called respectively: the liquidity coverage ratio and the net stable funding ratio. The first one requires the entity to have high quality liquid assets that allow the net outflows of short-term funds (to a month). On the other hand, the second one, seeks to ensure an adequate financing structure, so that the longer-term assets are financed from long-term sources⁸.

On the part of the US banking system, we find that for two of the ratios under study we found a breakpoint in 2007, which makes us think that the crisis did affect directly in the liquidity of the U.S. banks. What is more, what we notice again is that the trend changes are much milder than in the cases of Spanish banks. That makes us think again

⁸ Annual Report of the Bank of Spain 2015.

that the crisis even hit both countries equally the consequences were not the same. This event makes us think that the US financial system was much more prepared than the Spaniard.

Looking in particular at each one of these ratios, *Liquid Assets to Total Deposits and Borrowing*, LA_TDB has in U.S. a similar response to the crisis as the Spanish case. However, this time we did not find breakpoint for the U.S. As we have previously interpreted, the U.S. banks increased these ratios in order to be able to have more liquidity and keep the money in cash that would allow them to face all their obligations on a daily basis. But this trend of greater liquidity we see that it is already prior to the crisis, for that reason does not meet a breakpoint for this ratio. For the ratios of Net Loans to Total Assets, NL_TA, and Net Loans to Total Deposits and Borrowing, NL_TDB, the situation is again similar to that found for Spanish ratios. It follows from the study that we find a clear breakpoint in 2007 for these two ratios. What we can interpret from these data is that access to loans was also reduced in the case of U.S. and that from mid-2007 to mid-2009 the granting of loans declined by almost 10% the values of these ratios.

Therefore, we can conclude that the liquidity ratios for U.S. were affected by the crisis and this changed the trend that was developing.

4.3. Credit quality ratios

Regarding the Spanish banking system, the three credit quality ratios undergo into a breakpoint sometime in the period between 2008 and 2009. If we analyse the trend of each of them, we will see the reason for this rupture and its change of trend.

The first ratios are Loan Loss Reserves to Gross Loans, LLR_GL, the Chow test finds structural break in 2008. This ratio had a very stable trend in the years prior to the crisis, but in 2007 when the subprime crisis began in the US, we observed that the trend of the ratio started a positive slope which reached its maximum in mid-2012 where we find its maximum value, which is more than 10 times higher than it had in 2006.

As for the impaired loans to gross loans, IL_GL, and the impaired loans to equity, IL_E, both find a structural break in the vicinity of 2008. The slope in IL_E is much more abrupt in the vicinity of 2008 than for IL_GL for these accounting terms (affecting how problem lending is reported in financial statements)

When observing IL_E we see that, evidently, a breakpoint is produced in 2007. This was the year in which the default of loans in our country began. It began with stable Equity levels at that time, so this ratio soared before the beginning of the crisis. The change in the Spanish case is very high, going from 1.08% in 2007 to 286% in 2008, values that were unsustainable for Spanish firms. In contrast, IL_GL, with a slope much less abrupt than in the previous case, shows us how since 2008 the impaired loans are gaining weight in relation to the total of the same, passing to reach 9.38% of 2013 from values close to 0.70% of 2006. The total of impaired loans was very high, as we have seen in the previous ratio, but Loan Loss Reserves also grew a lot. Due to this reason we found that the slope is much lower in this ratio.

Reading articles from newspapers and searching in the newspaper library we can see that during 2012 there was a substantial change in the Spanish banking system. That system that had been sold to us as model and that had passed all tests of resistance, turned out not to be so solvent and had to be finally rescued. Much of this problem came as a result of non-payment of loans. Thousands and thousands of loans had been conceived to buy real estate, and this led to a chain of defaults that made the sustainability of many Spanish banks difficult.

On the other hand, the same ratios for the U.S. banking system follow a trend very similar to the Spanish one but much earlier than this one and without being abrupt. For all the three ratios, we found a breakpoint in 2007. This deterioration took on the global character as you report that exposure to the U.S. subprime mortgage sector not only affected American but also European entities, although in the beginning it was believed that the problem was only specific to the United States.

The first ratio is Loan Loss Reserves to Gross Loans, LLR_GL, where we find a breakpoint for this ratio just as we did for the Spanish case. These ratios had values close to 1.25% in the years prior to the crisis and increased during the crisis to values of 3.5%. It is observed that the tendency, like in Spain, is to increase reserves to prevent the default on loans. Next ratio we find is the Impaired Loans to Equity, IL_E where we observe that we came from a stable trend of the ratio in the previous years of the crisis and that in 2007 starts a rise that leads from values of 5% in 2006 to values close to 32% in 2009. Other again, we observe a reaction totally similar to that of the Spanish financial system, but if Spain reached values up to around 280%, U.S. ones were only 32%. Finally, we compare

impaired loans to gross loans, IL_GL, where this time the trend is not as similar as in previous ratios. In the case of U.S., we found a breakpoint in 2007, much more abrupt in this case than in the Spanish ratio. But after moving from values close to 1% and quickly reaching values of 6% in 2009, the ratio quickly searches for the values it had in the years before the crisis. Values which the Spanish system is far from even in the past year, 2016, (when observing the graphs)

In general terms, the period 2007-2011 was characterized by a strong increase in doubtful loans, especially in loans to the construction and real estate sector, which led to increasing ratios of arrears. It also increased the distance between banks and savings banks, in terms of default rates and coverage ratios, a logical consequence of the greater relative exposure of savings banks to real estate financing.

In 2008 there was the largest increase in the volume of doubtful loans, in both absolute and relative terms (with a year-on-year growth rate of more than 200%). Especially in loans to the construction and real estate sector. Representing more than 45% of the total volume of doubtful loans, compared to less than 20% in previous years. Doubtful credit continued to rise and rebounded again in 2011, especially in the case of savings banks, with an annual growth above 44%.

This increase led to an increase in arrears ratios in households and non-financial corporations, especially in the case of loans to the construction sector and real estate activities. In this sector, the Nonperforming Ratio, NPL ratio, was above 20% in December 2011, while in the rest of the non-financial sectors and non-home loans to households remained at around 6.5% (The NPL ratio for home purchase was less than 3%). In addition, the savings banks had, in general, higher nonperforming loan ratios than banks, except for loans to households for purposes other than housing.

The financial entities were exposed to this type of asset via securitization and creation of special vehicles, which invested in these assets. This allowed the transfer of the risk from the balance sheets of financial institutions to other investors. The volume of mortgage lending led to higher risk or lower guarantee of payment, linked to greater restrictions on accessibility to the purchase of housing.

Consequently, in mid-2007 nonperforming loan began to have negative effects on many of these special products that were created in order to acquire and sell this type of asset. Many of them were declared bankrupt, which generate the domino effect.

The NPL is explained by the transfer model risk. When approximately 70% of the mortgage balance was securitized, the entities had a very small incentive to take care of the client's survival, because the relationship with the client ended when the mortgage disappeared from the balance sheet.

4.4. Capitalization ratios

In the case of the Spanish banking system, we discover a trend change in both ratios belonging to this group. That is why when doing the Chow test we find breakpoint for both of them.

When analysing Total Equity to Total Assets, E_TA and we found a breakpoint in 2008, this means that there is a trend change after the crisis. We see that after a decline in the trend at the beginning of the crisis and its subsequent stability during the years of this crisis a positive recovery starts in the middle of 2010. Which causes the ratio to pass from values of 6% in 2005 to values of more of 10% in 2013, which will mean a positive behaviour for shareholders as it reports much more benefits to their investments. For the case of Total Equity to Total Liabilities, E_L , we see that it behaves almost identical to the previous ratio. It starts with a positive trend before the crisis, which causes it to fall close to 1% during these years and in 2010 begins a recovery slope that leads to values close to 9%. This recovery shows that the shareholders are taking better results within the banking system, which will allow them to face the day to day with better risk.

For the U.S. Banking sector, the Chow test does not show any breakpoint in its trend, for any of the two ratios included in this group Total Equity to Total Assets, E_TA , and Total Equity to Total Liabilities, E_L . But when looking at the graph and as is well demonstrated on the map found in Table 7, this breakpoint is made in the following year, in 2008, where the trend changes totally and returns to a positive path that makes it pass values around 9% in 2008 for the case of E_TA to values of 11.5% by the year 2015. On the other hand, the E_L goes from values around 10.5% in 2008 to reach 13.2% in 2015. Analysing the causes of this small valley, we find in the annual report of the FED, information which tells us about the causes.

This decrease is due to the loss of equity of the U.S. banks in this period of time, but after this decrease from 2009 this period values begin to recover reaching the 10.03% due

to some equity injections by the U.S. treasury.

Following the subprime mortgage crisis, it is part of a series of initiatives promoted by the Financial Stability Board (FSB) and the G-20, to strengthen the financial system after the subprime mortgage crisis. This is the first revision of Basel II (CRD II), called Basel III. It was developed throughout 2009, coming into operation as of December 31, 2010. "Basel III" is a comprehensive set of reforms developed by the Basel Committee on Banking Supervision to strengthen regulation, supervision and risk management of the banking sector. The Basel III reform includes the following elements:

- Increase in the quality of capital.
- Improvement of the capture of the risks of certain exposures.
- Increase in the level of capital requirements.
- Constitution of capital mattresses.
- Introduction of a leverage ratio.
- Improved risk management, supervisory process and market discipline.
- Introduction of a liquidity standard.

The new measures of capital and liquidity harden significantly the banking regulation. Therefore, it has been agreed to establish a transitional broad period in which the measures will be implemented gradually. This period covers from January 1, 2013 to January 1, 2019, when the new regulatory framework must be fully implemented.

5. Conclusion

This study examines the impact of the 2007 financial crisis on the Spanish financial system. To do this, we have investigated the occurrence of breakpoints in each of the ratios under study and thus be able to conclude whether there is a relationship between the trend of these ratios and the financial crisis of 2007. In order to carry out these studies, we have obtained the financial data of the 390 banks determined from U.S. and the 133 banks from Spain, for the period from 2005 to 2013. The financial ratios computed from the financial data were included as follows: Profitability, Liquidity, Credit Quality and Capitalization. Then, we computed the Chow test, developed by Chow (1960) for the ratios obtained previously in order to verify if there are the mentioned breakpoints in the trend of the ratios.

This paper provides evidence on the occurrence of breakpoints in twelve of the thirteen financial ratios chosen for the study, in the case of the Spanish financial system. This leads us to certify that the financial crisis of 2007 meant a change in the trend of financial parameters.

To begin with the consequences of our study, we will say beforehand that we have found many differences between the data obtained in our study and the previous document on which our analysis is based. Naimy and Karen (2016) performed the same analysis than us, but in their case for the banking system of Lebanon. To do this, they also took the U.S. financial system as a benchmark, obtaining totally different values to ours. In particular, the first difference, and the most important, we do find it in the data collection. The financial data that have been obtained for the ratios are totally different between them, which makes a similarity between calculations totally impossible. That is why in Naimy and Karen (2016) only in five of the ratios we find structural breaks, whereas they are eight in our study, coinciding in only three of them. The reason for that mistake we think is a poor data collection in the case of Naimy and Karen (2016), since the values for our financial ratios obtained with the average for the 390 U.S. banks almost match perfectly with the data provided by the Federal Reserve System on their website. That is why we can fully rely on our data.

To apply the Chow test, we need to know the year in which we think the breakpoints exist. For this we rely on various studies of which we can obtain information that suggests the beginning of the crisis for both Spain and U.S. After knowing with this series of

documents the year where presumably the crisis impact in both nations, we have made a map of results of the Chow test to check if we were right. And so it is, the map indicates as the following: the years of highest incidence are 2007 for U.S and between the end of 2008 and the beginning of 2009 for Spain.

Afterwards, a fact that has been repeated throughout our study is demonstrated. While conducting the analysis after the realization of the Chow test, we have observed the similarity between the data obtained for the U.S. Banks and the Spanish Banks.

Graphs of all ratios are very similar between the two countries, not in time or size, but in trends. However, there is a difference in all the ratios between countries: the intensity with which the crisis has hit each one of them. For all ratios of the U.S. financial system the trends change much more smoothly and the changes and spikes that we find are not as abrupt as in the case of Spanish banks. This fact makes us think that although the crisis hit with the same events in both countries, the initial situation of welfare and stability was not the same in both. When the crisis shook Spain, the Spanish financial system was no longer in the best position possible. This impact took place after the rapid deterioration of the international financial markets, and the emergence, in a recessive environment, of the imbalances accumulated in Spain in the period of previous expansion, which certifies the first stress tests performed at the beginning of 2007. This analysis agrees with Weigand (2015) who also argued that. As could be observed, U.S. Banks obtained a systematic and considerable better result in all the parameters under study in relation to the Spanish banks.

Our results are in line with what we expected to find. The crisis affected both the U.S. banks selected ratios as the Spanish ratios. It caused in most of them a structural break. In this way the study contributes to the financial literature by providing a real analysis of how the crisis affected the Spanish financial system. The study provides the possible consequences and evidence of the structural changes that were produced in all the ratios. Therefore, this study helps to understand the effects of the crisis after 2007, among which is the extensive reduction of banking entities. It could be said that we find sufficient evidence in the ratios of Spanish banking system to be able to assume that the impact of the crisis on the Spanish banking system was very deep, which determines the existence of breakpoints in almost all their ratios under study.

We have a number of ideas for future researches. The first one is about making

possible scenarios prior to the 2007 crisis for the Spanish banking system and trying to find out what the previous situation should have been so that the crisis would not have changed the trend of the ratios under study. Another type of more theoretical study would be to try to find countries where the impact of the crisis was not as serious as in the Spanish case and present the differences in financial policy that we find among them.

Finally, a demonstration of whether the crisis suffered in Spain was only by a contagion of information from the crises of the United States. For doing this, we should try to make a comparison between what would have happened in a less globalized world and without so much access and transmission of information, in which indeed we are today. Would we have had the same reaction? Had the crisis would be occurred?

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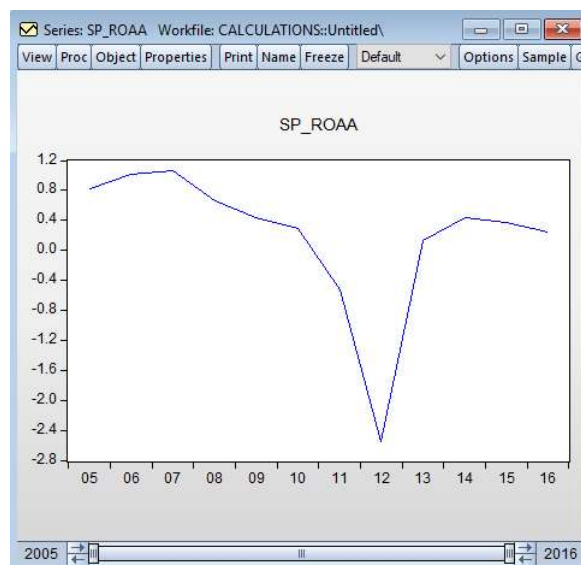
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Appendices

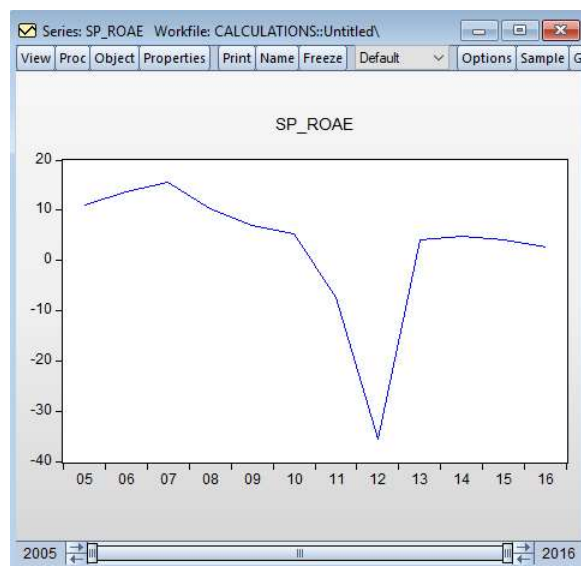
Appendix A – Graphs of Spanish financial ratios

a) Profitability Ratios

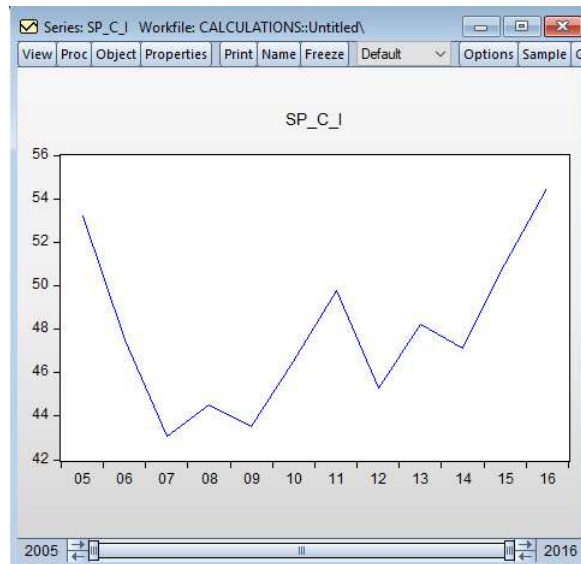
1. Return on Average Assets, ROAA



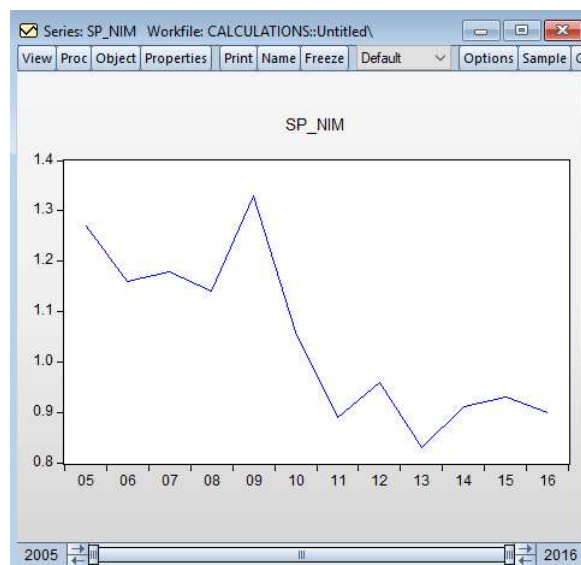
2. Return on Average Equity, ROAE



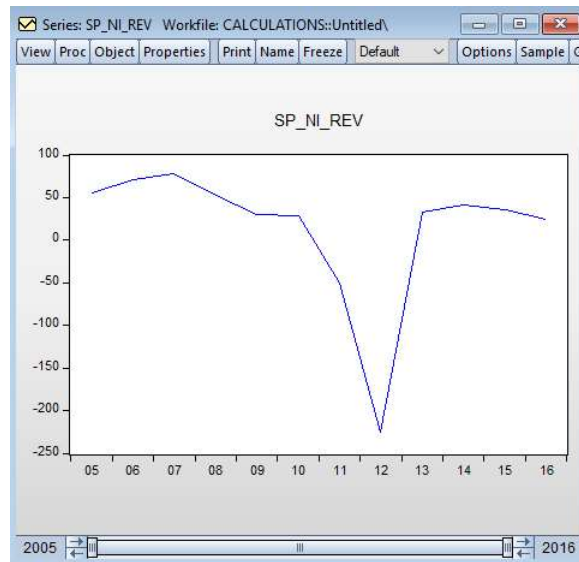
3. Cost to Income, C_I



4. Net Interest Margin, NIM

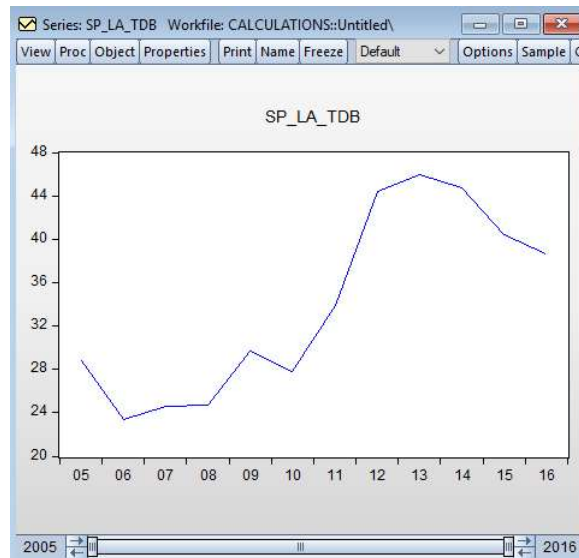


5. Net Profit Margin, NI_REV

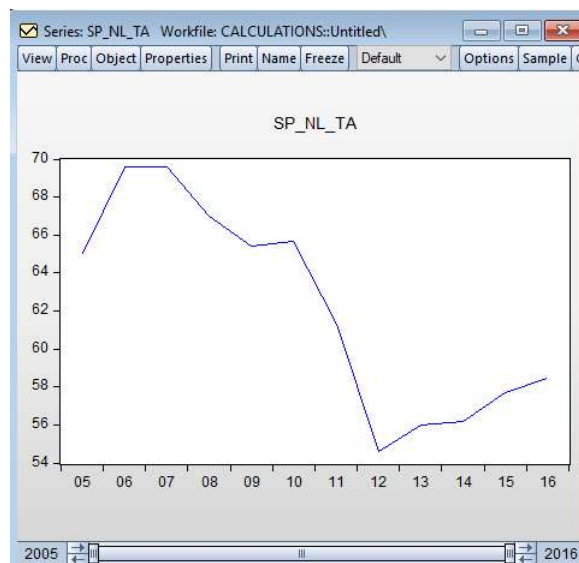


b) Liquidity Ratios

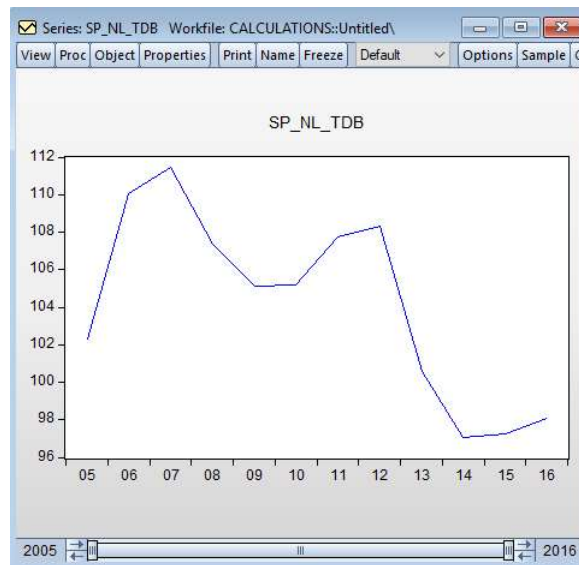
1. Liquid Assets to Total, LA_TDB



2. Net Loans to Total Assets, NL_TA

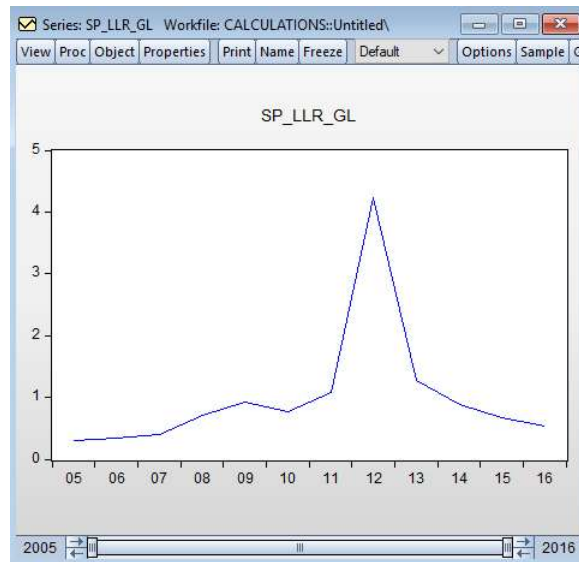


3. Net Loans to Total Deposits and Borrowing, NL_TDB

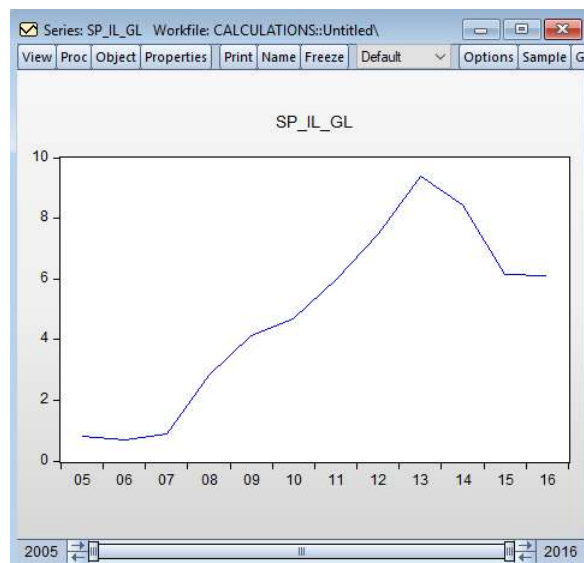


c) Credit Quality Ratios

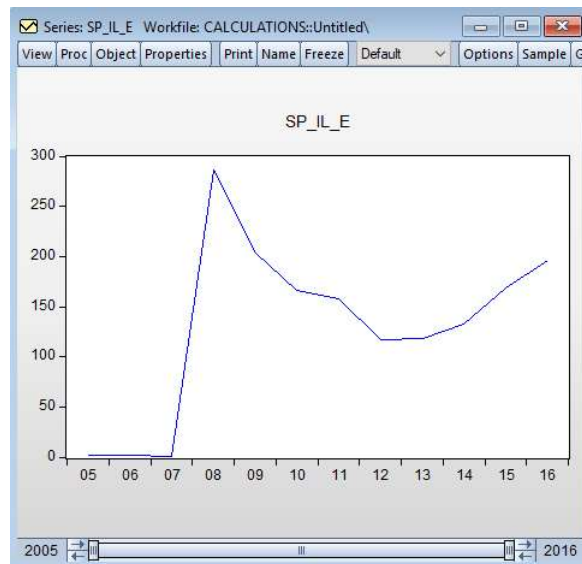
1. Loan Loss Reserves to Gross Loans, LLR_GL



2. Impaired Loans to Gross Loans, IL_GL

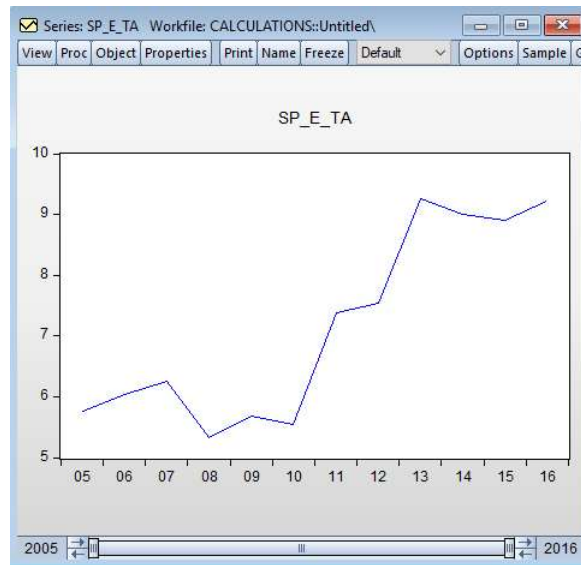


3. Impaired Loans to Equity, IL_E

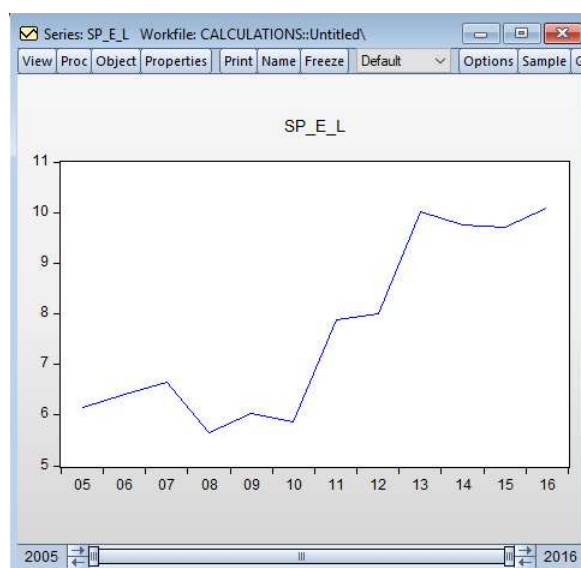


d) Capitalization Ratios

1. Total Equity to Total Assets, E_{TA}



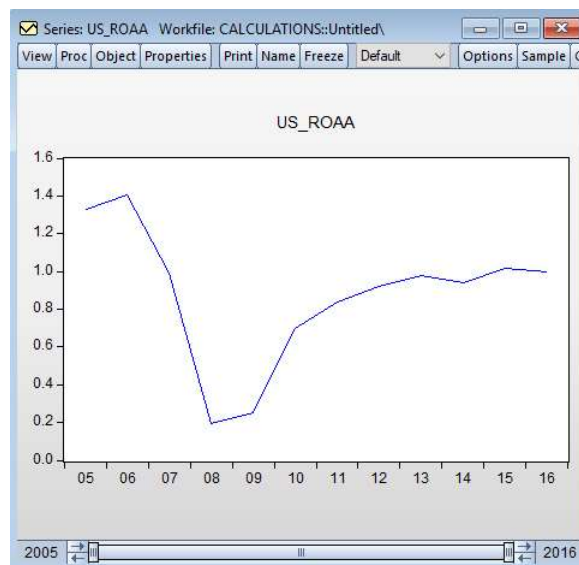
2. Total Equity to Total Liabilities, E_L



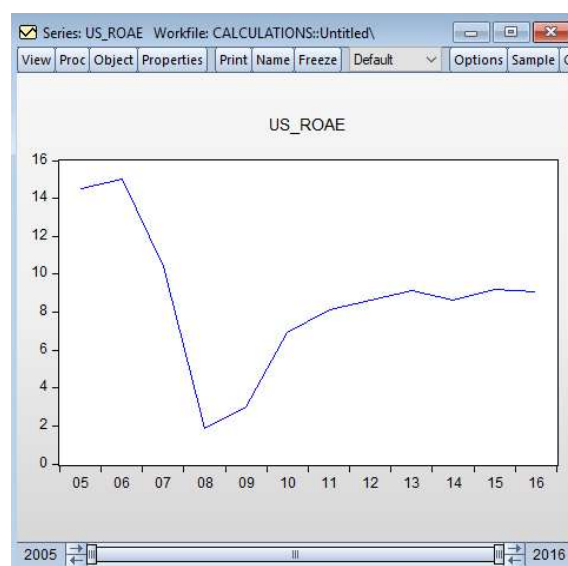
Appendix B – Graphs of U.S. financial ratios

a) Profitability Ratios

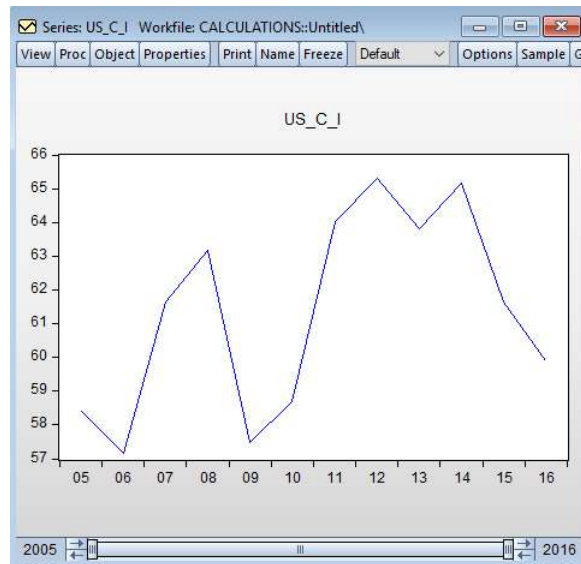
1. Return on Average Assets, ROAA



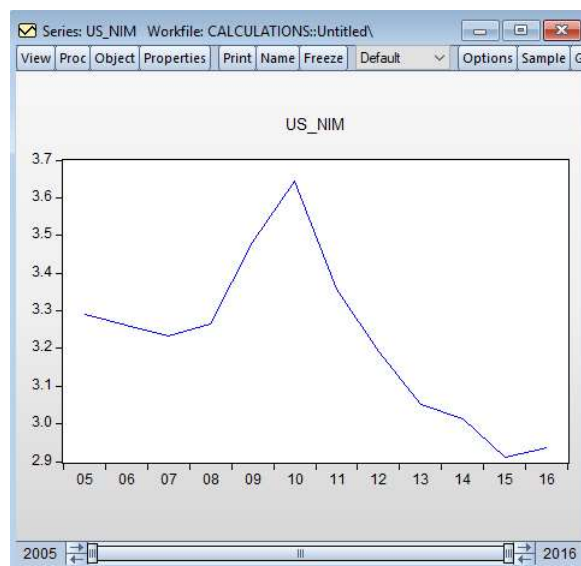
2. Return on Average Equity, ROAE



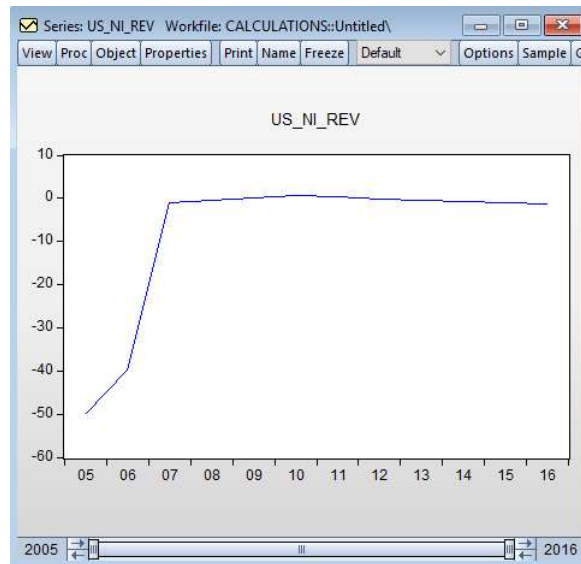
3. Cost to Income, C_I



4. Net Interest Margin, NIM

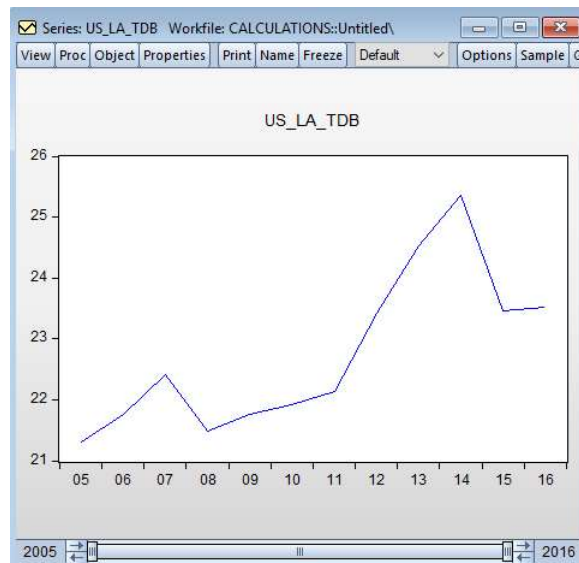


5. Net Profit Margin, NI_REV

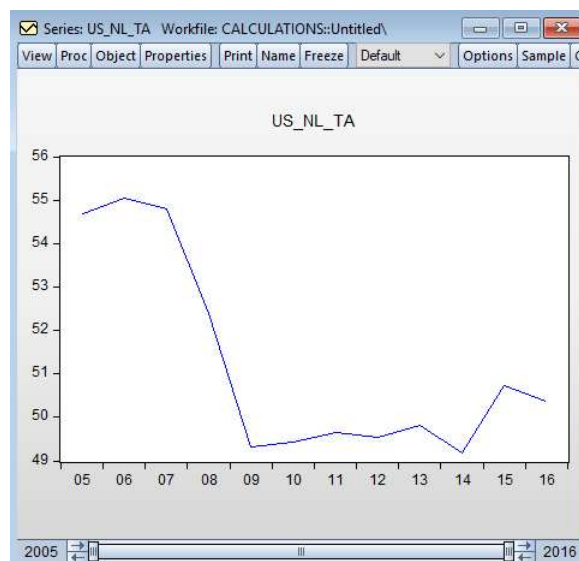


b) Liquidity Ratios

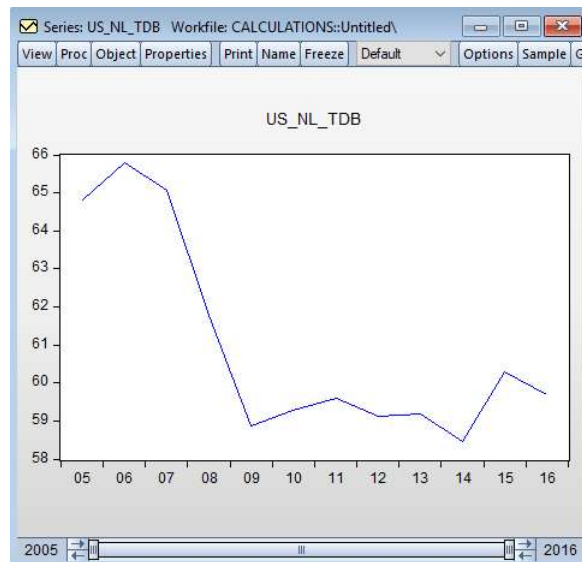
1. Liquid Assets to Total Deposits and Borrowing, LA_TDB



2. Net Loans to Total Assets, NL_TA

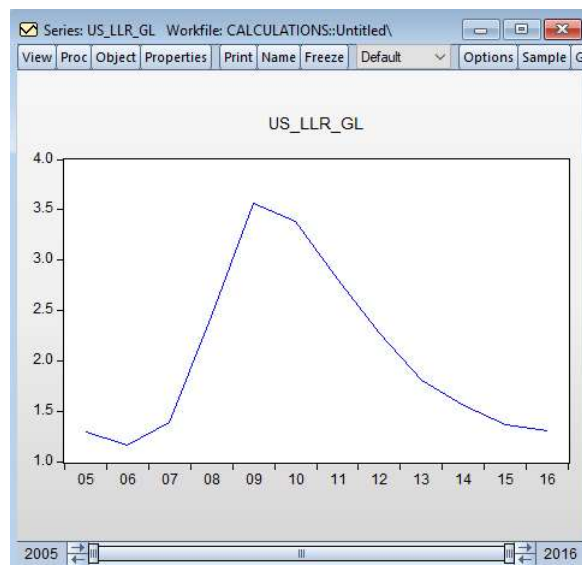


3. Net Loans to Total Deposits and Borrowing, NL_TDB

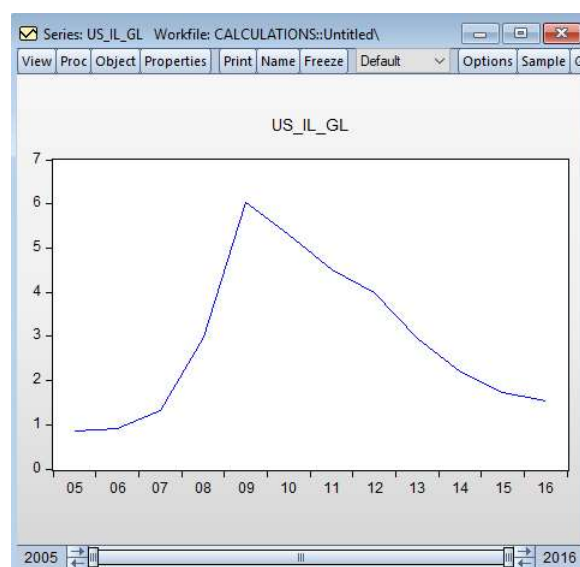


c) Credit Quality Ratios

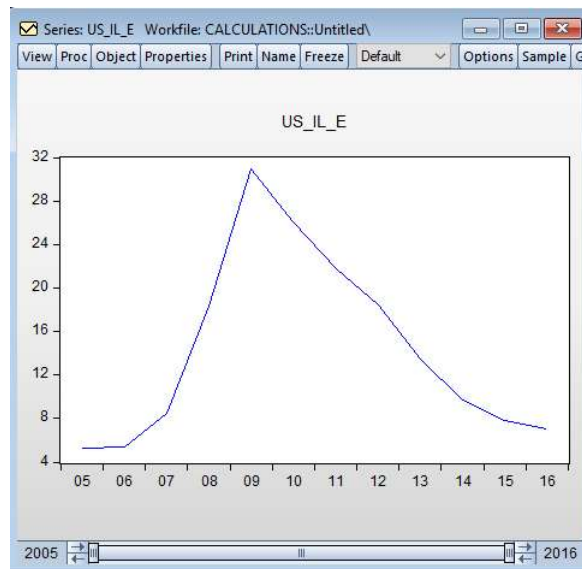
1. Loans Loss Reserves to Gross Loans, LLR_GL



2. Impaired Loans to Gross Loans, IL_GL

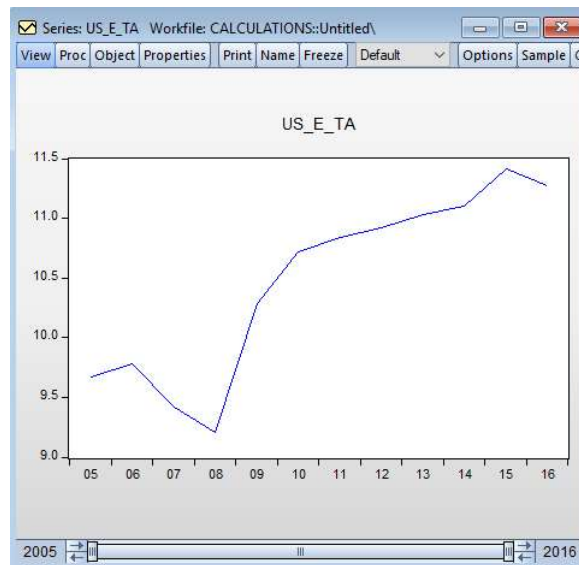


3. Impaired Loans to Equity, IL_E



d) Capitalization Ratios

1. Total Equity to Total Assets, E_TA



2. Total Equity to Total Liabilities, E_L

