



Lisbon School  
of Economics  
& Management  
Universidade de Lisboa

**MASTER**  
**MONETARY AND FINANCIAL ECONOMICS**

**MASTER'S FINAL WORK**  
**DISSERTATION**

**THE IMPACT OF BANKING CRISES ON PUBLIC DEBT: THE CASE-  
STUDY OF PORTUGAL (1970-2015)**

**NUNO DIAS DUARTE PARRAÇA PINTO**

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**SUPERVISION:**  
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## ACRONYMOUS

BoP – Bank of Portugal.

BGSC – Breusch-Godfrey Serial Correlation.

FED – Federal Reserve Board.

GMM – Generalized Method of Moments.

GD – Great Depression.

GR – Great Recession.

GDP – Gross Domestic Product.

IFI – International Financial Investments.

JEL – Journal of Economic Literature.

MFW – Master's Final Work.

NPL – Non-performing loan.

OLS – Ordinary Least Squares.

## ABSTRACT, KEYWORDS AND JEL CODES

The effect of the last major banking crisis (Subprime) was catastrophic for everyone. Several economies were affected and showed a worsening of public debt in a short period of time. Therefore, the objectives of this dissertation were to explore banking crises` literature and to quantify, using an Ordinary Least Square regression, the impact of banking crises on Portugal's public debt. For the Portuguese case, the availability of data allowed the creation of a base with a time horizon between 1970 and 2015 (annual data). The regression results show that, for the Portuguese case, in the event of a banking crisis, the public debt will increase sharply. This result is important to current literature because despite all efforts to make the financial system robust, the possibility of a new banking crisis continues to exist. In addition, these phenomena can lead to unsustainable public debt, which can cause major disruptions to the economy as a whole. It is therefore suggested that more attention be paid to the policies of the financial system, streamlining legislation that could shield the country from having one of its banking institutions trigger a crisis and/or move forward with mechanisms to absorb the impact of an external crisis.

**KEYWORDS:** Banking crises; Public debt; Portugal case; Ordinary Least Square regression.

**JEL CODES:** G21; G33; H60; C20.

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# THE IMPACT OF BANKING CRISES ON PUBLIC DEBT: THE CASE-STUDY OF PORTUGAL (1970-2015)

The objectives of this dissertation were to explore banking crises` literature and to quantify, using an Ordinary Least Square regression, the impact of banking crises on Portugal's public debt. For the Portuguese case, the availability of data allowed the creation of a base with a time horizon between 1970 and 2015. The results show that, for the Portuguese case, in the event of a banking crisis, the public debt will increase sharply. This result is important to current literature because despite all efforts to make the financial system robust, the possibility of new banking crises continues to exist.

## 1. INTRODUCTION

The choice of this theme, the impact of banking crises on public debt, was made based on different reasons. Firstly due to the importance of the banking system's role in the overall economy. It is well known that banks provide an essential service to the rest of us, namely, they create credit that allows the real economy to grow and expand. Secondly, the existence of banking crises, which persist to occur and that manifest themselves in different ways, for instance, with a significant number of bank runs, huge increases in NPL's (Non-performing loans), financial losses and/or bank closures, cause severe disruptions in the stability of the banking system, namely the interruption of the supply of credit. This ultimately may lead to losses for shareholders who can lose all their money, for depositors who can lose at least part of them but also may cause costs for taxpayers. Given the above, the aim of this dissertation was not only to explore banking crises` literature but also to quantify, using an Ordinary Least Square regression, the short-term impact of banking crises on Portugal's public debt during the period between 1970 and 2015.

We thought it would be important to have two objectives: on the one hand, to focus on the characteristics of a banking crisis, namely its definition, the causes behind these crises, the costs to the economy in general, also how economic agents, especially decision makers, react in the presence of a banking crisis and what they can do to mitigate and even try to put an end as soon as possible to such a devastating phenomenon. On the other hand, to try to quantify, using a case study, the damage that these have on one of the most important macroeconomic variables, the countries' public debt.

As Paul De Grauwe (2008) argued, “the essence of banking is to channel saving surpluses from those who want to save to those who want to spend. Banking thrives on these imbalances. Without these imbalances there would be no banking.” (Grauwe, 2008, p. 17). Although, these imbalances make the banking system particularly exposed to changes in the expectations of agents. For instance, if depositors suddenly lose their confidence in the banking system, they may start thinking that banks do not have enough money to redeem mainly their deposits. If a significant number of depositors think this way, they will most likely decide to withdraw their deposits at the same time and banks will be unable to meet these requests as their assets are illiquid and they do not keep enough reserves. Assets are said to be illiquid because banks cannot get cash from their selling at a reasonable price, because too many of them are trying to sell the assets at the same time, and so the prices will decrease, a phenomenon known as fire sales of assets. When this happens, liquidity crisis is said to erupt. This can lead to losses; it can also impact the solvency of banks and therefore trigger more liquidity problems. Even sound and solvent banks, that comply with capital requirements and preserve eligible collateral to offer, can become insolvent if a bank run occurs.

These run-on banks are just one way, maybe the easiest form of a banking crisis to reveal itself. There are others and stemming from the asset side of bank`s balance sheets as well, which are more difficult to interpret, and that we will mention later in our work. Just to reinforce what these bank runs can trigger, the following scheme (Figure 1) representing what happened in the US in the Great Depression (GD) in 1929 is presented:

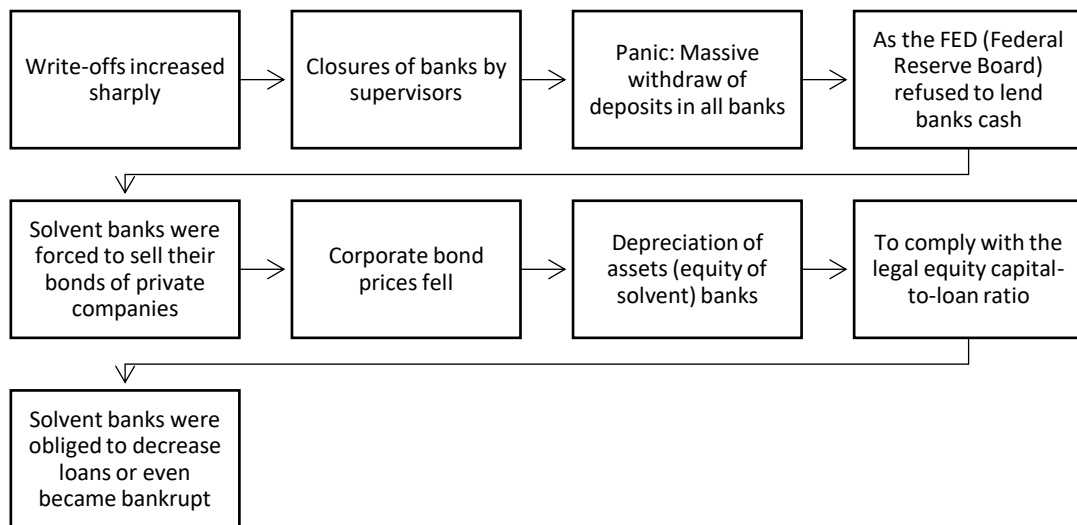


Figure 1 – Brief scheme representing what happened in the GD of 1929

The point here is to be aware of this irreversible circle, once the collective movement of distrust is established, it is very difficult to restore it and the negative consequences are plain to see. We will address some of them later in our analysis.

In addition to these negative outcomes of bank runs, and more broadly of banking crises, it is of our interest as well to focus on the impact that these have on the economy as a whole and not only on the banking system's dynamics. As Reinhart and Rogoff (2009) did, we do not intend to analyze only the fiscal costs which we will denominate from now on as bailout costs but also the costs that affect the revenue side, because, as the authors defended, nearly always banking crises lead to severe drops in tax revenues. Many past studies focused on the major impact of banking crises on the economic activity by looking through the main fiscal consequences, analyzing almost exclusively the bailout costs (e.g, Grawe, 2008; Hoggarth et al., 2002; Romer and Romer, 2017). What we will do is to give more relevance to what this past literature left unexplored, i.e., the analysis of the direct consequences on public debt.

Reinhart and Rogoff (2009) wrote "Arguably, the true legacy of banking crises is greater public indebtedness-far over and beyond the direct headline costs of big bailout packages" (p. 170). Also, in IMF (2014), there is an underlying idea that "banking crises have also been associated with increases in public debt beyond the direct costs" and this is another idea that we want to highlight throughout the dissertation, analyzing both direct and indirect fiscal costs. It is based on these total costs that we will detail the process of increasing public debt as a result of banking crises.

In short, public or government debt can be defined as the accumulation of past deficits over time. A country has a budget deficit when, during a given year, its government revenues turn out to be less than its government expenditures, which includes the interest payments on existing debt. This means that the state revenues are not enough to keep on financing the sovereign's costs. To finance this gap between revenues and spending, what the government usually does is to borrow from the capital markets by issuing government bonds. The public debt, in simple terms, is precisely what this government owes to investors.

During crises time, with special emphasis on those of the banking type, this budget deficit tends to be higher due to not only the higher costs that government must bear to rebuild the financial system, but also due to the decline in revenues caused by the weaker economic conditions. In sum, these events put a considerable pressure on public finances

via the fiscal cost associated on the one hand with crisis resolution, and on the other through their overall adverse impact on asset prices, interest rates and growth (IMF, 2014). Therefore, it is natural to expect that deficits will persist longer and, thus, one solution to cover the deficit will be to increase public debt. And once again this is what we are interested in explaining.

One important aspect that we were also concerned about, because it is closely related to the progression of countries' public debt, was the sustainability of public finances. We can gauge something about this by monitoring the path of the government debt-to-GDP ratio, which is precisely the macroeconomic indicator in focus in the dissertation.

This dissertation is organized as follows. The next section presents relevant theoretical studies related to the topic of banking crises. Then, section 3 describes the empirical methodology and the data used to examine the implications of banking crises on Portugal's debt-to-GDP ratio. Section 4 presents the results and their discussion. Finally, section 5 concludes.

## 2. LITERATURE REVIEW

### 2.1. The Role of banks

In a broad view, as Mishkin (2006) argued, the financial institutions, especially banks, have a relevant role on the economy as they promote liquidity services, risk sharing and solve information problems.

In more detail, as Amaral (2008) stated, banks can be seen as institutions oriented toward obtaining funds from the public, typically in the form of deposits, which later employ in credit operations, creating money. In doing so, they play a key role in the financing of the economy and the operation of payment systems. Banks work as a financial intermediary, performing a set of activities in order to channel funds from savers to debtors. This intermediation is necessary in the first place to mitigate the problems arising from information asymmetry. There are two risks of asymmetric information, the adverse selection, which happens before the transaction and the moral hazard, which instead occurs after the transaction. Both are better managed by banks because they have improved means of evaluation and monitoring than individuals. Then, this intermediation is also important because banks decrease the time and costs associated with financial transactions since they are specialized in this function.

In sum, banks have different and very important financial roles, namely, liquidity intermediation, as they channel savings to investment projects, risk intermediation, because they take the risk and resell it to final investors, information intermediation, they also play a huge part on transmission of monetary policy effects, on intergenerational wealth transfer, as they provide long term savings instruments and, finally, on payment system.

Despite of the important responsibilities, as specified by Amaral (2008), the stability of a credit institution is subject to different types of risk inherent to the business itself. We can list some, the most relevant ones, such as the credit risk, the liquidity risk, the interest rate risk, the currency risk, the market risk, and the operational risk. Perhaps the most important one is the credit risk because it is linked with the possibility that some

debtors will default, and consequently they would be unable to fulfill their obligations to the bank, for example, to pay their installments.

All these risks endanger the stability of a bank. As Amaral (2008) holds, if the health of a financial institution deteriorates to the point of collapse, fear can spread to several banks, creating a panic situation and dragging healthy and solvent institutions along with it, because the financial sector is based on the assumption of trust and it is extremely vulnerable to changes in agents' expectations. In more severe scenarios, this could indicate the beginning of a banking crisis.

In the next point we will discuss the financial crises that plague countries' economies.

## 2.2. What is a financial crisis? What kinds of financial crises are there? What are the main features of each type?

There are relevant questions that merit to be answered regarding this matter. The first to which we have given attention is what is a financial crisis? In a more generic sense, financial crises can be defined as major disruptions in financial markets that lead to serious breaks in the business cycle. It can be typified by failures of many firms, either financial or nonfinancial and by deep falls in asset prices.

Furthermore, as Aceña et al. (2009) have stated, it is interesting to examine whether crises are similar, or whether they are different from each other and whether they share similar characteristics or, on the contrary, are remarkably distinct.

In fact, there are many types of financial crises, namely banking crises, the main object of study in our analysis, currency crises, sovereign debt crises and stock market crashes. Then, one can further distinguish twin crises, which are the simultaneous occurrence of two of the previous types of crises, and third generation or triple crises, i.e., an unfortunate event that happens when a country suffers at the same time three of the mentioned before kinds of crises. Usually, the last is by far the most severe one, which has more negative impact on output and consequently on the economy. An example of this was the Subprime crisis, which was a major international financial crisis that started

in 2007 in the US residential mortgage market and spread all over the world, which was a combination of a currency, debt and banking crisis simultaneously.

In line with that, Reinhart and Rogoff (2009) defended that severe financial crisis hardly ever occur in isolation and that banking crises are often accompanied by other types of crises, including currency crises and debt crises. For example, in the case of a twin crisis, there are different feedback mechanisms. Let us imagine that a particular country faces a banking crisis, as we will see later, the public sector of this country must step in and implement measures to reconstruct the financial system, which causes a deterioration of its fiscal position. As a result, there will be expectations of monetization of the fiscal deficit along with a currency depreciation. This is just one illustration of how a banking crisis can lead to a currency crisis. There are more and in the reverse form as well, i.e., a currency crisis leading to a banking crisis.

Now, we are focusing in briefly defining the more relevant type of crises.

Aceña et al. (2009) defined a currency crisis as a devaluation, in fixed exchange rate regimes, or a sharp depreciation, in floating exchange rates regime, of the currency as a result of a speculative attack on the currency's exchange value. Also, the actions taken by the authorities when the countries' currency face a similar attack, either by spending large amounts of international reserves or by raising interest rates, can as well be considered an indicator of a currency crisis.

In what concerns sovereign debt crises, they are generally associated with situations characterized by an unsustainability of debt servicing, which manifests itself in the default of debts and later in difficulties in borrowing or even in the inability of the state to borrow.

For the case of financial market crashes, we did not find clear definitions in the literature. Aceña et al. (2009), for example, defined a stock market crash as an event when the stock price index declines by more than 25% from its nearer highest historical quotation. This method is similar with the one used by Patel and Sarkar (1998), who used a different percentage of decline for development markets, which was 20%, and for emerging markets, which tend to be more volatile and for that reason have a higher percentage, 35. This means that when the stock price index in these opposite countries decreases by these values, the countries are dealing with a stock market crash.



Turning our attention now to our topic of interest, we present below the definitions and other relevant information related with banking crises, according with different perspectives we found in the literature.

### 2.3. What is a banking crisis?

The time has come to define a banking crisis according to different perspective we discovered in the literature. It is worth noting that from now on when we refer to a banking crisis, we are always referring to a systemic one, i.e., financial crisis which affects almost all banks in a country.

Primarily, according to Amaral (2008), there is no consensus on definition of a banking crisis. In other words, there is no agreement on the necessary requirements for a banking system to be considered in crisis.

Starting with the thoughts of Demirgüç-Kunt and Detragiache (1997), a given country faces a systemic crisis episode if one of the following 4 conditions is fulfilled. The conditions are as follows: the ratio of non-performing assets to total assets in the system has to exceed 10%, the costs of bailout operations by the authorities have to exceed 2% of GDP, the period has to include large-scale nationalizations of institutions, and finally there has to exist a run-on deposits or measures such as freezing deposits, a deposit guarantee scheme, or even declaring a bank vacation must be implemented.

Roughly a decade later, Laeven and Valencia (2008) stated that there are two conditions that need to hold for a banking crisis to exist. The first one is large signs of financial distress, that is revealed among other things by a huge increase in non-performing loans (NPL) (over 20%), significant bank runs, financial losses in the banking system and/or bank closures (at least 20% of banking system assets). The other condition that is required to be verified has to do with a significant banking policy intervention measures to fight against these losses. The authors presented the following 6 measures of policy interventions: deposit freezes and/or bank holidays, significant guarantees put in place, substantial bank nationalizations, weighty asset purchases (at least 5% of GDP), extensive liquidity support (at least 5% of deposits) and bank restructuring costs (at least

3% of GDP). They stated that if 3 out of these 6 measures are used, it means that a banking crisis has occurred.

According to a more general definition, Aceña et al. (2009) supported that banking crises are dated based on a combination of events, such as the forced closure, mergers, or government takeover of financial institutions, runs on banks, or the existence of government assistance to one or more financial institutions.

As Amaral (2008) claimed, whether a period is considered a banking crisis depends on the opinion of the experts. What we can conclude, as Laeven and Valencia (2020) argued, is that systemic banking crises are extremely disturbing incidents that lead to prolonged decreases in economic activity, financial intermediation, and in the end in welfare. These authors identified 151 banking crises during the period between 1970 and 2017 for all countries in the world. We will look later on at the consequences this can have for the economy in general.

As stated, banking crises manifest themselves in distinct ways. One of them perhaps the easiest to identify is the run-on banks, also, because there is information available for most countries regarding data on bank deposits, as argued by Aceña et al. (2009). These authors also defended that there are other forms of crises not so easy to isolate because of the lack of relevant data for some variables, such as the share of NPL's in bank portfolios, real estate and stock prices, which tend to fluctuate widely, and the business failure indicator. According to them, this is because many banking problems are not originated on the liability side of banks' balance sheets as bank runs, but on the asset side due to a prolonged deterioration in asset quality.

These variables are not the cause of banking crises but the indicators that tend to change as a result.

#### 2.4. The causes of banking crisis

Focusing now on the causes of banking crisis, we found there are plenty of them. Kaminsky and Reinhart (1999) held that banking crisis are incidents driven by the business cycle. And the logic is as follows: economic downturns reduce the value of bank assets, which leads to a higher probability of banks not being able to meet their

commitment. Realizing this instability, the depositors withdraw their funds, which further aggravates the banks' situation and may lead to a crisis in this sector. Grauwe (2008) argued that the stability of the banking system could be undermined due to lack of regulation, hence bank balance sheets were exposed to phenomena such as bubbles and crashes. In fact, often in history, financial innovation was ahead of regulation, which can be a danger. Note what happened in the Subprime crisis, one of the main financial factors that triggered it was precisely the development of structured credit products that hid the real risk, which could perhaps have been avoided if regulation was tighter and more effective at the time. Klomp (2010) concluded, using a logit model with data from 110 countries between 1970 and 2007, that there was significant heterogeneity in the causes of banking crises and that, on average, the most important ones were a negative GDP growth, a high credit growth and a high real interest rate.

Still others argued that the main reason for the occurrence of this phenomenon is political, such as Calomiris and Haber (2014), who made a comparison between the number of banking crisis occurred in Canada and the USA since 1920. In this period, USA suffered three crises while Canada suffered none. According to the authors, the difference is explained by the construction of both banking system. Canada has a more stable banking system partly due to its structure, consisting of a small number of very large banks with nationwide branches, which allows them to transfer funds to branches in areas troubled by a hostile economic shock. Whereas in the U.S. local banks carry more weight and are therefore not only unable to spread risk across regions, but also unable to simply move funds from one location to another to address liquidity issues.

Either way, whatever causes these events, there are many consequences that they bring. As claimed Aceña et al. (2009), the crisis problem is one of the dominant macroeconomic features of our time and they continue to occur despite robust efforts to consolidate the international financial architecture and when our knowledge of nominal variables, banking structures, and financial markets has taken a huge step forward. Although, much remains to be understood about how to predict these episodes, how to prevent them, and how to properly confront and combat them.

In what follows, we will witness how costly these crises can be, especially in terms of the increase in the public debt of the countries, with all the problems that this entails.

## 2.5. The costs of banking crises

Since we have already discussed what a banking crisis is, along with its possible causes, it is now time to look at its consequences for the whole economy.

First, according to Hoggarth et al. (2002), the directly disturbed agents are the stakeholders in the collapsed bank. By stakeholders they mean the shareholders, the depositors, the bank's creditors and the borrowers. All of them can be affected for different reasons. The firsts of the list because the value of shares will decrease or disappear, the depositors due to the possibility of losing a part or even all their savings, the creditors since they may not get paid back and, finally the borrowers because they may be reliant on banks for financing and may face some troubles in finding alternative sources. However, these agents are not charged the full costs since all taxpayers may also incur direct costs as a result of public sector crisis resolution. Later on, we will see what this is and what implications it has for the economy.

In general, there are several macroeconomics variables that are ruthlessly affected following such an occurrence, namely output (e.g., Friedman and Schwartz, 1963), which normally deviates sharply from its trend, fiscal costs (e.g., Hoggarth et al., 2002) which tend to be higher the greater the countries' banking intermediation, unemployment (e.g., Reinhart and Rogoff, 2009b), which also tend to increase, among other variables. It also usually has major consequences on the financial markets (e.g., Reinhart and Rogoff, 2009b), with special impact on real estate and equity prices, and so on. However, in this research we are particularly interested in their effects on countries' public debt, one of the most relevant macroeconomic indicators that also seems to be influenced by banking crises.

Regarding output, as Friedman and Schwartz (1963) argued, banking crises can produce a sharp and unforeseen contraction in the stock of money and thus result in a recession. When the banking sector is weakened, this can lead to a reduction in bank lending, either because some banks fail or because banks under capital pressure are constrained in their ability to make new loans. This may force businesses and households to adjust their balance sheets and particularly to reduce spending. Output may decrease in the short-term. But in the long run, the economy's output may also be affected, since investment will be hampered by reduced access to bank financing and therefore capital

accumulation will be reduced, which negatively affects productive capacity and therefore output.

There are many studies that analyze the adverse impacts of banking crises on economic activity, but to our knowledge few focuses on the direct consequences of the recession on government finances, specifically assessing the increase in public debt.

We have found two, which we are going to pinpoint. One is the previously mentioned Reinhart and Rogoff (2009), which attempted to evaluate the increase in gross government debt three years after the occurrence of banking crises, using only descriptive evidence. The authors showed that this indicator rose on average by 86% throughout these years. The other study that we relied on is Furceri and Zdzienicka (2012), who pointed out criticisms to the former study of Reinhart and Rogoff since they had calculated the change in the real value of government debt. An alternative way, used by the former authors was to calculate the change in public debt but as a percentage of GDP, and they found smaller values for the increase in public debt when compared to the average value of Reinhart and Rogoff. Focusing on the debt-to-GDP ratio instead on the percent change in debt levels is important, for the authors, not only because this indicator is an improved measure to assess fiscal sustainability but also because examining the percent rise in debt levels after banking crises can lead to possible misunderstandings since it critically relies on the initial debt level before the occurrence of such an event. These authors used an unbalanced panel of 154 countries between 1980 and 2006 and they discovered that banking crises are associated with a substantial and lasting increase in the government debt-to-GDP ratio. Particularly for severe ones, banking crises are, on average, followed by a medium-term increase of about 37 percentage points in the government gross debt-to-GDP ratio.

So now that we have investigated the consequences that we have found in the literature concerned with the increase, on average, in public debt after a banking crisis, it is relevant to briefly emphasize how this process works.

## 2.6. Policy Response to Banking Crises and the resulting fiscal costs

In this regard, it is important to firstly note, as Reinhart and Rogoff supported (2009), that systemic banking crises are fought through bailout of the banking sector, which comprise measures like directed mergers of bad banks with relatively sound and healthy institutions, purchases of bad assets, outright government takeovers, or some combination of these. The implementation of these kind of measures as a way to sustain the credibility of the payment system and to avoid a vicious cycle of the country's output carries major fiscal consequences, particularly in the early stages of the crisis, as the authors have argued.

Laeven and Valencia (2020) added that in the premature phases of banking crises, and many times in combination with liquidity provision, states have also resorted to guarantees, either limited or full, on bank liabilities, to support stem the bank run and ease liquidity pressures on these entities. These measures are also referred to as financial sector intervention. They typically help buy policymakers time to create more complete solution and restructuring plans, such as using fiscal and monetary policy to reduce the economic consequences in the aftermath of banking crises.

The authors of the IMF (2014), in turn, claimed that banking crises, of the systemic type, impact government finances via direct and indirect channels. In the Table I it can be seen some of these measures broken down by each type.

TABLE I: FISCAL COSTS OF BANKING CRISES

<b>Fiscal Cost</b>	<b>Examples</b>
<b>Direct Fiscal Costs</b>	<ul style="list-style-type: none"> <li>• Bank recapitalizations</li> <li>• Asset purchases</li> <li>• Calls on government guarantees</li> <li>• Depositor payouts</li> <li>• Central bank recapitalization</li> </ul>
<b>Indirect Fiscal Costs</b>	<ul style="list-style-type: none"> <li>• Revenue effect from lower growth and the decline in asset prices</li> <li>• Expenditure effect from automatic stabilizers</li> <li>• Discretionary fiscal policy (revenue and expenditure) in response to increasing economic slack</li> <li>• Mark effects on borrowing costs</li> <li>• Effects through exchange rate changes</li> </ul>

Adapted from: IMF (2014)

According to the IMF (2014), while the direct channel concerns crisis management responses, where governments directly support the banking system, the indirect channel, on the other hand, performs through the impact of banking crises on the economy. Summing up, the direct fiscal costs can contain government guarantees on bank liabilities to ease liquidity pressures as well as a wide range of measures that aim to recapitalize banks and boost economic growth. These policies involve significant costs for sovereigns and contribute to expanding public debt. As for indirect fiscal costs, these have to do with the negative impact of banking crises on several variables such as aggregate demand, economic growth and asset values. Banking crises bring with them an increase in risk premiums and an interruption in the supply of credit to bank-dependent borrowers, which in turn causes consumption and investment to fall, thereby affecting the economy. The negative impact on interest rates, growth, asset prices, and the effects of inflation and exchange rates that also worsen, cause government revenues to fall, and this creates pressures on public finances that jeopardize fiscal sustainability.

## 2.7. How a banking crisis leads to an increase in public debt?

According to the BoP, the public debt is the contractually agreed amount by which the general government must repay creditors at maturity. In this sense, general government comprises all the administrations that make it up - central, regional and local government, as well as social security funds. It includes liabilities in deposits and deposit-like instruments made with the general government, such as savings or treasury certificates, debt securities issued, like bonds and treasury bills, and loans obtained by these entities.

In short, public or sovereign debt is how much a country owes to lenders outside of itself. These can incorporate individuals, companies, and even other governments.

Simplifying, we can say that public debt in one year is the sum of existing public debt, which was issued before this year, and the budget deficit of this year. Public debt is thus the accumulation of annual budget deficits. It is the result of years when governments spend more than they receive mainly through tax revenues. A country's deficit affects its debt and vice versa. The governments usually go to the capital markets to get the financing to cover its deficit. They issue government bonds and then they will have to pay interest and to redeem the face value of these bonds at maturity.

In times of banking crisis, as already mentioned, the weakening of economic conditions, which results, all else equal, in less revenue for the state since at such times there is a shrinking of tax bases (Kindleberger, 1989) along with increased spending associated with automatic stabilizers, to which is further added the high expenditures associated with bailout costs and demand stimulation lead to a rapid deterioration of budget balances. According to Limberg (2020), the combination of these two dynamics, revenue shortfalls and higher expenditures, places an enormous fiscal burden on governments. The author stated that the governments have, in principle, three main options to tackle this fiscal pressure, that are: increase public debt, cut expenditure, and raise revenue via taxation. As Saylor and Wheeler (2017) defended, taking on public debt may be an attractive solution in the short term. Therefore, it is expected the rise of this variable.

When the government debt-to-GDP ratio reaches an excessive value, these challenges and endanger the sustainability of public finances. It means that government



revenues are not enough to keep on financing the costs associated with the new issuance of public debt. As far as the European Union is concerned, the sustainability of public finances is a key feature of the Maastricht Treaty. Countries joining the Economic and Monetary Union need a deficit of less than 3% and a debt-to-GDP ratio of less than 60%. This is indeed a challenge for countries, even more so in times of banking crises or in their aftermath.

The authors of the IMF (2014) have also discussed the issue and argued that developments in the banking sector can impact public debt sustainability as they amplify the depth and duration of recessions, limit the pace of recovery, and exert vigorous fiscal burdens.

### 3. EMPIRICAL METHODOLOGY

In this section it will be presented all the statistical information obtained to establish this dissertation, the databases and the descriptive statistics of the data as well as a brief theoretical linkage between the additional independent variables with our dependent variable, the public debt. The econometric method selected and the tests that had to be run will also be presented. Our objective in this empirical methodology was not to quantify the increase in public debt on a global scale, but to understand the implications of the banking crisis on public debt in a particular case, that of Portugal.

Portugal was one of the countries in Southern Europe that suffered the most after the Subprime crisis. With the collapse in tax collection due to the crisis in 2009, the budget deficit went from 3.5% to 10% in 2010, and public debt increased from 68% in 2009 to 90% in December 2010. Being aware of this, we thought it would be attractive to use data from Portugal for what we were interested in explaining, namely the significant impact of banking crises on public debt.

#### 3.1. Data

The data used in this dissertation was obtained from distinct database. The current analysis collected annual data from 1970 to 2015 for Portugal. In Appendices there is the Table A.I, which summarizes mainly both the variables used in the dissertation and the database from which they were extracted, along with other relevant information. Analyzing the Table A.I, it can be stated that the variables banking crisis (*bcris*) and trade openness (*tr\_open*) limited the beginning of data series (in 1970) just as the variable *pub\_dbt* limited the end (in 2015). This limitation in relation to public debt data was found in several databases used for this dissertation, such as BoP, World Bank, *INE* and *PORDATA* and was not related to the lack of more recent data because they were in these databases and even forecasts for 2022 and 2023, but with the lack of data for older years and the database used by the IMF contained these data, for example until 1970. As is known, more horizon years in a time series analysis, the more robust the results will be, hence this approach was chosen.

In our dataset, we use the following variables:

- the public debt, (*pub\_dbt*), as our dependent variable;
- the *bcris*, as independent variable;

- the credit (lcredit), as independent variable;
- the government bonds` interest rate (gov\_bonds), as independent variable; and
- the tr\_open, as independent variable.

It is possible to observe the descriptive statistics of the variables used in this dissertation in the Table II (below). The variable statistics are presented in level and in first difference. In addition, the units of each variable are presented.

Table II: Descriptive statistics of the variables

	pub_ dbt	dpub_ dbt	lcredit	lcredit	gov_ bonds	dgov_ bonds	tr_ open	dtr_ open	bcris
Mean	56.567	2.500	30.445	0.0426	9.7867	-0.063	60.189	0.8284	0.111
Median	54.075	2.350	30.216	0.0342	8.5592	-0.0008	61.493	1.526	0.000
Maximum	130.165	15.206	31.348	0.1924	21.503	5.3650	80.491	9.6029	1.000
Minimum	13.504	-5.670	29.441	-0.1303	2.4233	-4.9925	37.715	-12.408	0.000
Std. Dev.	30.162	4.696	0.5928	0.0713	5.4531	1.8862	10.262	4.2438	0.318
Skewness	1.063	0.959	0.3017	-0.0916	0.4849	0.2202	-0.2134	-1.0083	2.475
Kurtosis	3.879	3.889	1.5833	3.005	1.9170	4.8417	2.8635	4.6750	7.125
Sum	2545.54	112.51	1370.18	1.9187	440.40	-2.8550	2708.5	37.277	5.000
Sum Sq. Dev.	40027.48	970.40	15.463	0.2236	1308.41	156.54	4633.25	792.44	4.444
Observa- tions	45	45	45	45	45	45	45	45	45
Units	% of GDP	% of GDP	Absolute number	Absolute number	Annual %	Annual %	Annual % of GDP	Annual % of GDP	1=ban- king crisis or 0=none

### 3.2. Variables

After explaining the sources and type of data, the next step is to analyze the variables used. First, as our dependent variable we have Portugal`s public debt. Then, as independent variables we have four. Besides the bcris variable, the model has lcredit, tr\_open and gov\_bond. The bcris was built by the World Bank as a dummy, that is, taking the value of 1 in the years where there was a banking crisis, in our case for Portugal, and 0 in the other cases.

The credit variable is commonly used in the literature to explain some macroeconomic issues, among which, public debt. The IMF study (2014) used this variable as a percentage of GDP and found a positive impact for the Advanced Markets and a negative impact for Emerging Markets, using a Least Square-pooled regression during the time span between 1999 and 2012. More broadly, Arcand et al. (2015) have

argued that the outcome for the economy will depend on the ratio of the credit to GDP. If this ratio reaches 100% and credit continues to grow this will have a negative impact on the economy, namely on economic growth. Kindleberger (1978) argued that more finance, meaning credit in the economy as well, corresponds to more macroeconomic volatility, with influences on indicators such as output and public debt. However, according to Calomiris et al. (2014), who distinguished countries by income level, on the one hand high-income countries, with an average credit-to-GDP ratio of 87%, and on the other hand low-income countries, with an average of 11% of this ratio, over the period between 1990 and 2010, it is also a problem when the banking system lends too little as a percentage of GDP.

Regarding the trade openness variable, it also has an impact on several macroeconomic variables. Specifically, on public debt. The IMF (2014) also used trade openness to explain the dependent variable, public debt. The authors found a negative impact of this independent variable on public debt in advanced markets and a positive impact in emerging markets. Furceri and Zdzienicka (2012), using impulse response function with an unbalanced panel of 154 countries between 1980 to 2006, also used trade openness to explain public debt. The results they got suggest that this variable was insignificant impacting public debt. In another study on the impact of trade openness this time on trade balances, Combes and Saadi-Sedik (2006) using a Generalized Method of Moments (GMM) system estimator, for 66 developing countries during 1974-98, showed that even if trade openness increases a country's exposure to external shocks and thus negatively affects its fiscal balances, an outward-looking policy strategy should lead to an overall strengthening of its fiscal balances. They concluded that this positive impact of trade openness on fiscal balance is quite clear empirically.

The interest rate on Portuguese government bonds, we introduced as an indicator of the instability of the country's public finances. The logic behind this use is that higher interest rates in this context mean that investors require a higher risk premium to invest in government bonds in Portugal or elsewhere, because they believe the bonds carry more risk, the risk of the government defaulting and becoming unable to pay, first the interest payments and then the face value of the bonds. Conversely, if interest rates are small, bonds can be seen as less risky and safer.

### 3.3. Method

In order to estimate the short-term impact of banking crises episodes on the public debt of Portugal for the established time span, 1970-2015, we opted for a time series regression, using the Ordinary Least Squares (OLS) method. This method is suitable for studies involving time series and whose focus is to verify the relationships created between variables. Therefore, we chose the OLS regression, which allows in a simple way capturing this phenomenon, revealing the impacts between variables. Next, we show the Equation 1 adapted from Asteriou & Hall (2011):

(1) Equation to the OLS regression

$$S_t = \alpha + \beta_1 X_{1t} + \beta_2 X_{2t} + \dots + \beta_n X_{nt} + m_t$$

Adapted from: Asteriou & Hall (2011)

In the equation presented above,  $S_t$  is the parameter that represented the dependent variable, in other words, the variable to be explained in the econometric model;  $\alpha$  is the regression constant;  $\beta_1$  and  $\beta_2 \dots$  are the parameters of independent variables;  $t$  is the time span of the econometric model; and  $m_t$  is the error term or residuals.

Next, we re-parameterize Equation 1 with the parameters previously presented in this dissertation. The re-parameterized equation is the econometric model to be estimated in this dissertation, we presented below (Equation 2):

(2) Regression of the dissertation

$$Dpub\_dbt_t = \alpha + \beta_1 bcris_t + \beta_2 DLcredit_t + \beta_3 Dgov\_bonds_t + \beta_4 Dtr\_open_t + m_t$$

"L" before the variables denotes natural logarithm and the letter "D" stands for first difference. Below, at Figure 2 it is shown the details of the method used in the dissertation.

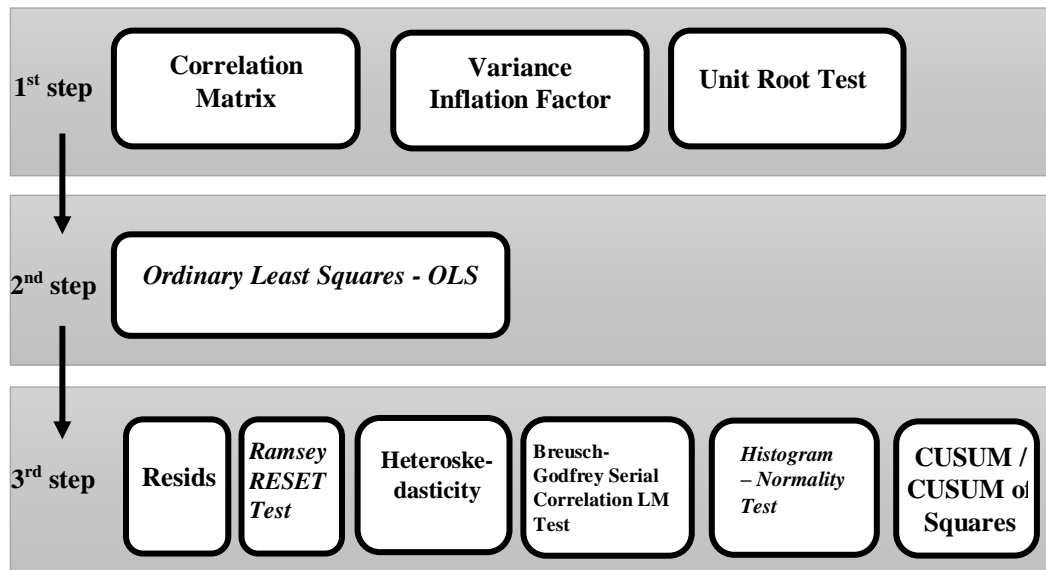


FIGURE 2 – Summary of the methodology

Adapted from: Belucio and Fuinhas (2019)

Thus, we proceeded to econometric pre-tests to ensure that the model results are robust. To do so we followed the recommendations of the manual prepared by Fuinhas et al. (2019). Details about the various tests will be presented in the following.

First, we are going to test the problem of multicollinearity. For this we have to look at the Correlation Matrix and the Variance Inflation Factor statistic.

Below is the Correlation Matrix (Table III), which shows us the degree of correlation between all variables in the equation. In short, according to Fuinhas et al. (2019), the relevant point here is to look at correlation's coefficients and to see if there is any value close to 1, which may indicate that there is multicollinearity, or at least there are high levels of this phenomenon.

Table III: Correlation Matrix

Correlation Matrix in Level					
	pub_dbt	lcredit	gov_bonds	tr_open	bcris
pub_dbt	1				
lcredit	0.7946	1			
gov_bonds	-0.226	-0.5028	1		
tr_open	0.8631	0.8099	-0.2397	1	
bcris	0.4891	0.5234	-0.1758	0.3473	1
Correlation Matrix in 1 <sup>st</sup> Difference					
	dpub_dbt	dlcredit	dgov_bonds	dtr_open	bcris
dpub_dbt	1				
dlcredit	-0.2649	1			
dgov_bonds	0.3601	0.1043	1		
dtr_open	-0.0862	0.0954	0.2143	1	
bcris	0.6893	-0.1057	0.2442	0.03307	1

Note: "D" denotes first difference and "L" denotes natural logarithm.

It seems that there is no correlation between the variables since almost none of the values is of concern. We based on the idea that absolute values are considered within normality. Only the *tr\_open* variable and *lcredit* in Table III present a higher positive value. This indicates that as one variable increases or decreases the other will have the same effects. To remove the uncertainty, we proceed to the Variance Inflation Factor (VIF) test, presented next, in Table IV. The mean of the level analysis is 2.91, and in the first differences, the average is 1.08. These values suggest that the data has no multicollinearity problems. Again, according to the authors, issues of this type would exist if centered VIF were greater than 10.

Table IV: VIF

In level				In First Difference:			
Variable	Coefficient Variance	Uncentered VIF	Centered VIF	Variable	Coefficient Variance	Uncentered VIF	Centered VIF
C	52295.92	11600.9	NA	C	0.3635	1.6160	NA
Lcredit	64.48345	13244.89	5.2256	DLcredit	46.872	1.4145	1.0356
Gov_bonds	0.2426	6.6043	1.5536	DGov_bonds	0.0730	1.1306	1.1293
Tr_open	0.1437	117.51	3.4070	DTr_open	0.0135	1.0953	1.0542
Bcris	67.872	1.6365	1.4587	Bcris	2.4677	1.2190	1.0836
Mean Centered VIF			2.9112	Mean Centered VIF			1.0757

Note: "D" denotes first difference; and "L" denotes natural logarithm.

Even without the inclusion of the *bcris* parameter (presented in Table A.II, in appendices), it is accepted that the data has no problems in what concerns multicollinearity. The mean of the VIF statistic becomes 2.96 in Level and 1.04 in First

Difference. There are, therefore, good indications that the model to be estimated meets the requirements of the first pre-tests.

Then, we moved on to another tests: the Augmented Dickey–Fuller (ADF) and Phillips Perron (PP) for unit roots; and for stationarity, the Kwiatkowski-Phillips-Schmidt-Shin (KPSS) test.

Below it is shown the Table V which incorporates the tests for unit roots and stationarity.

Table V: Unit Root Test

			Level	1st Difference
pub.dbt	ADF	Constant	-0.100730 (1) [0.9429]	-3.626317 (0) [0.0090]
		Constant and trend	-2.461085 (2) [0.3449]	-3.668905 (0) [0.0353]
		None	1.430377 (1) [0.9600]	-3.106915 (0) [0.0026]
	PP	Constant	0.820197 (3) [0.9933]	-3.634060 (2) [0.0089]
		Constant and trend	-0.877451 (4) [0.9497]	-3.709916 (2) [0.0321]
		None	2.712751 (3) [0.9980]	-3.129659 (3) [0.0025]
	KPSS	Constant	0.719753 (5) **	0.238198 (4)
		Constant and trend	0.120120 (5) *	0.123919 (3) *
	bcris	ADF	None	n.a.
Constant			n.a.	n.a.
Constant and trend			n.a.	n.a.
PP		None	-2.497377 (2) [0.1228]	-6.480741 (0) [0.0000]
		Constant	-2.653545 (1) [0.2600]	-6.414435 (0) [0.0000]
		Constant and trend	-2.354434 (2) [0.0195]	-6.557439 (0) [0.0000]
KPSS		None	0.371671 (4) *	0.055556 (0)
		Constant	0.099850 (4)	0.055816 (0)
lcredit		ADF	Constant	-1.050165 (1) [0.7268]
	Constant and trend		-2.297418 (1) [0.4265]	-3.179575 (0) [0.1018]
	None		1.212649 (1) [0.9401]	-2.98396 (0) [0.0037]
	PP	Constant	-1.436324 (4) [0.5562]	-3.21286 (1) [0.0258]
		Constant and trend	-1.881494 (4) [0.6475]	-3.201114 (1) [0.0974]
		None	2.646268 (3) [0.9976]	-2.970396 (1) [0.0039]
	KPSS	Constant	0.81406 (5) ***	0.143097 (3)
		Constant and trend	0.118933 (5)	0.107569 (4)
	gov.bonds	ADF	Constant	-1.455074 (1) [0.5467]
Constant and trend			-2.365994 (1) [0.3915]	-4.645934 (1) [0.0029]
None			-0.876448 (1) [0.3307]	-4.453527 (1) [0.0000]
PP		Constant	-0.907581 (0) [0.7768]	-4.289016 (6) [0.0014]
		Constant and trend	-1.975363 (3) [0.5986]	-4.434627 (7) [0.0051]
		None	-0.633277 (0) [0.4374]	-4.339574 (6) [0.0001]
KPSS		Constant	0.362234 (5) *	0.286462 (1)
		Constant and trend	0.142529 (5) *	0.100475 (2)
tr.open		ADF	Constant	-1.125868 (0) [0.6975]
	Constant and trend		-2.932990 (0) [0.1623]	-6.446117 (0) [0.0000]
	None		1.099152 (0) [0.9270]	-6.357519 (0) [0.0000]
	PP	Constant	-0.766043 (7) [0.8189]	-8.210041 (14) [0.0000]
		Constant and trend	-3.012210 (3) [0.1403]	-8.503508 (15) [0.0000]
		None	2.627481 (14) [0.9974]	-6.470313 (8) [0.0000]
	KPSS	Constant	0.784308 (5) ***	0.176514 (14)
		Constant and trend	0.088844 (3)	0.158421 (14) **



Notes: \*\*\*, \*\* or \* denote statistical significance at 1%, 5% or 10%; In ( ) the number of lags or bandwidth; In [ ] we show the p-value; “L” denotes natural logarithm.

After analyzing the parameters of the variables in the Table V, it is possible to state that there is a strong indication of the presence of a unit root in the level variables and the stationarity of the variables is detected after the first differences. In this way, an OLS-type regression, composed only of the first difference of the variables, fulfills the stationarity pre-requisite.

## 4. RESULTS AND DISCUSSION

Since the pre-tests did not show any problems, we were able to proceed to the estimation of the model. The specifics of the estimation results can be seen in Table VI.

Table VI: Estimation of the Regression

Method: Ordinary Least Squares		Dependent Variable: DPub_dbt				
Sample (adjusted): 1971 2015		Included observations: 45 after adjustments				
Independent Variables	Coefficient	Standard Error	t-Statistic	Probability or p-value		
Constant	2.276203	0.486913	4.674764	0.0000	1%	***
Bcris	10.83686	1.398439	7.749253	0.0000	1%	***
Dlcredit	-13.72347	5.527433	-2.482792	0.0177	5%	**
Dgov_bonds	0.571083	0.216542	2.637290	0.0121	5%	**
Dtr_open	-0.192190	0.093739	-2.050268	0.0475	5%	**
Dummy 1981	7.280946	2.584181	2.817506	0.0077	1%	***
Dummy 1992	-7.619919	2.602863	-2.927514	0.0058	1%	***
Dummy 2008	-8.638245	2.867072	-3.012915	0.0046	1%	***
R <sup>2</sup>	0.756202					
$\overline{R}^2$	0.710078					

Note: "D" denotes first difference and "L" denotes natural logarithm; \*\*\*, \*\* or \* denote statistical significance at 1%, 5% or 10% level, respectively.

The results reveal that all the variables are statistically significant. The variable bcris at 1% while the rest of the variables at 5%. In addition, three impulse dummy variables (Dummy 1981; Dummy 1992; Dummy 2008) were generated in order to correct the strongest shocks detected in the series in these 3 years. The justification for 1981 peak may have been due first to an exogenous factor such as rising world oil prices. At that time also, budget expenditures rose, being largely financed through the contraction of foreign debt, the escudo (local currency unit) appreciated in value, exporters found it more difficult, and imports rose. As a result, the current account deficit rose from five percent of GDP in 1980 to 11.5 percent in 1981 (Mateus, 1985; Macedo, 1992).

The recession of 1992-1993 occurs in a period in which we can identify changes at different levels. At a global level with the US starting an economic recovery after the recession and the end of the Gulf War. At an European level and after the fall of the Berlin wall in 1989, the process of German reunification began, which led to an increase in inflation, being combated by the German central bank with an increase in interest rates. Finally, Portugal joined the European Exchange Rate Mechanism (April 1992), which also made our monetary policy more restrictive like the German one, and at the same time Portugal oriented its budget policy to reduce the public deficit according to the Maastricht

Treaty (3% of GDP). Additionally, our European trading partners were also in recession during this period, which is also considered to be another factor that led to this recession.

The 2008`s outlier was possibly caused by the exogenous shock of the Subprime financial crisis, already mentioned in section 2. Below (Figure 3), we can see the outliers of these shocks graphically as well as the difference caused by the introduction of the dummies.

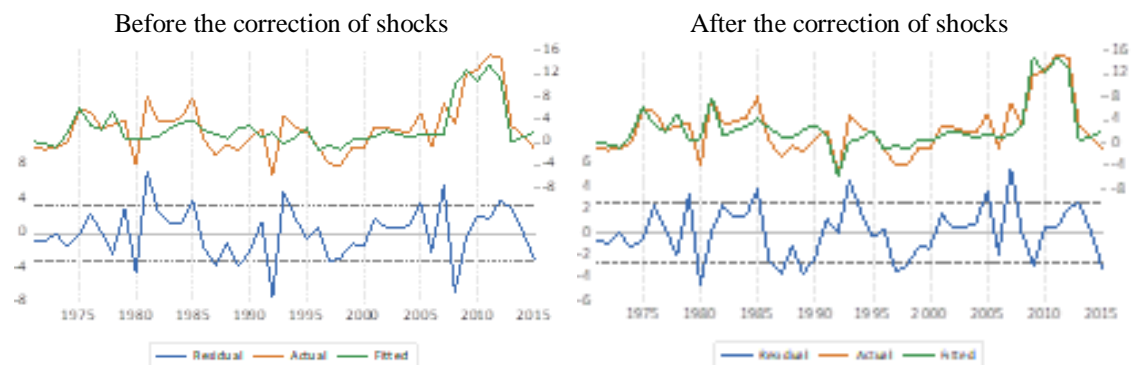


FIGURE 3 – Resids

Continuing with the estimation analysis, one can highlight the values of  $R^2$  and  $\bar{R}^2$ , that we can consider good values, being 0.76% and 0.71%, respectively.

We conclude that the estimation performed respects the econometric criteria to be considered valid. Therefore, we have statistical evidence that the variables used in the regression are relevant for the explanation of the change in public debt of Portugal.

Thus, it appears that, for Portugal and for the established time span, *ceteris paribus*, when there is a banking crisis this leads to a rise in public debt of 10.84%. Regarding credit`s variable we found a negative variable with a coefficient of 13.72, being the variable that in our model impacts the most in absolute terms public debt. Finally, smaller quantitative effects were observed for both government bond`s interest rates and trade openness to GDP, with the former positively impacting the dependent variable, as opposed to the latter, which showed a negative impact.

We thought it would be relevant to mention that we tried to test other important variables such as inflation, institutional quality, banking supervision index, tax revenues (in % of GDP) and the current account balance due to their strong connection with public debt. However, different problems were encountered from the moment of data collection,

for example, data paid only for institutional quality and banking supervision index, to the moment of results' estimation, such as the variables tax revenues and current account balance not being statistically significant, and we opted to present a parsimonious model, to the problem of data stationarity for the inflation variable, which was not even solved after the transformation by first difference.

To ensure the robustness of the results, tests were also performed after the model was estimated. The first presented below (Table VII), the Ramsey RESET test, which shows us whether the model is correctly specified.

Table VII: Ramsey RESET Test with the shock's corrections

	Value	Df	Probability
t-statistic	1.258450	36	0.2163
F-statistic	1.583697	(1, 36)	0.2163
Likelihood ratio	1.937314	1	0.1640

Null hypothesis: The non-linear combinations of the fitted values collaborate to explain the dependent variable.

In the table, especially by focusing on the probability of t-statistic, we can gauge that this value is in the acceptance zone (greater than 0.1), and we accepted the null hypothesis, meaning that our model is correctly specified. Also, in the test without shock's correction, present in Table A.III in the appendix, the model seems to be well specified, even with a higher statistical probability, of 0.4316.

Next, we proceed to the three Heteroskedasticity tests, namely the White, the ARCH and the Breusch-Pagan-Godfrey. To proper analyze it, we presented the results in the Table VIII. The null hypothesis in all tests is the presence of homoscedasticity.

Table VIII: Heteroskedasticity Tests

White			
F-statistic	0.376693	Prob. F(16,28)	0.9779
Obs*R-squared	7.970674	Prob. Chi-Square(16)	0.9497
Scaled explained SS	4.393099	Prob. Chi-Square(16)	0.9980
Arch			
F-statistic	0.619360	Prob. F(1,42)	0.4357
Obs*R-squared	0.639424	Prob. Chi-Square(1)	0.4239
Breusch-Pagan-Godfrey			
F-statistic	0.520929	Prob. F(7,37)	0.8129
Obs*R-squared	4.037067	Prob. Chi-Square(7)	0.7755
Scaled explained SS	2.225061	Prob. Chi-Square(7)	0.9463

Null hypothesis: Homoscedasticity.

We concluded that by analyzing the three different tests that the model is homoscedastic, i.e., in all the tests we do not reject the null hypothesis. Also, the model

without the correction of shocks is homoscedastic. We can observe the probabilities for the same three tests in appendices (Table A.IV).

The presence of autocorrelation was tested with the Breusch-Godfrey Serial Correlation (BGSC) LM test (Table IX) for serial correlation. The null hypothesis on this test is the no serial correlation at up to 1 lag. The problem of the serial correlation it is severe and invalidates any OLS- regression.

Table IX: Breusch-Godfrey Serial Correlation LM Test

F-statistic	0.235289	Prob. F(1,36)	0.6306
Obs*R-squared	0.292202	Prob. Chi-Square(1)	0.5888

Null hypothesis: No serial correlation at up to 1 lag.

The results of the test (the probability of the F-statistic equal to 0.6306) show the null hypothesis is not rejected. It is thus concluded that this model does not exhibit serial correlation. Once again in appendices (Table A. V, Table A.VI, and Table A.VII), it is presented the result of this test for the model without correction of shocks with 1 lag and 2 lag as well as the model with correction of shocks with 2 lags, respectively. The various possibilities were tested in order to give the greatest possible robustness to the estimated model. All of them do not reveal the presence of the problem.

Next, we show the last two tests after the regression, the Histogram and Normality test (Figure 4) and the CUSUM and CUSUM of Squares (Figure 5).

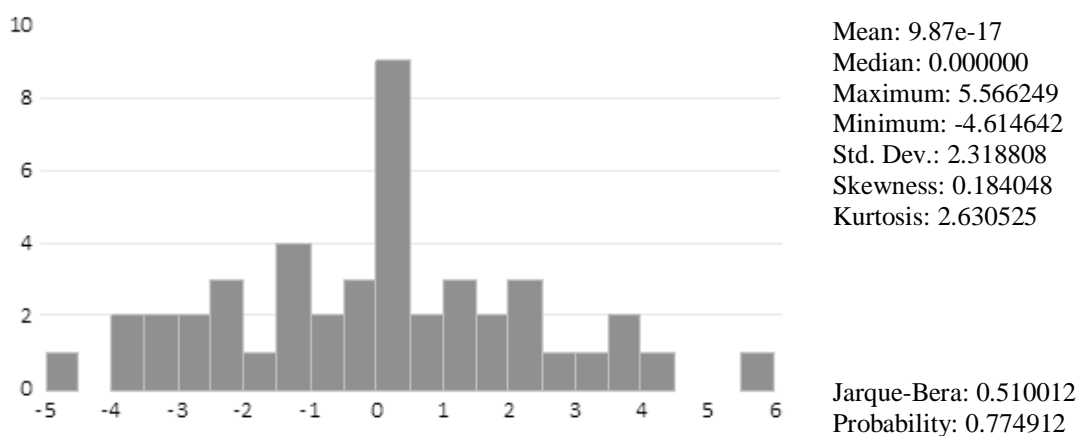


FIGURE 4: Histogram and Normality test

When analyzing the Jarque-Bera statistic, a statistically significant P-value is found. We accept the null hypothesis; this means that the errors follow a normal distribution.

Regarding the graphical analysis, the histogram suggests the strong presence of outliers in the series and that the normality of the estimation errors is respected, corroborating the results presented by the Jarque-Bera statistic. When we compare this graph with the one in Figure 6 in the appendices, we observe a change in the graph that occurs naturally once the correction for shocks is inserted.

Figure 5 below shows the CUSUM and CUSUM of Squares graphs.

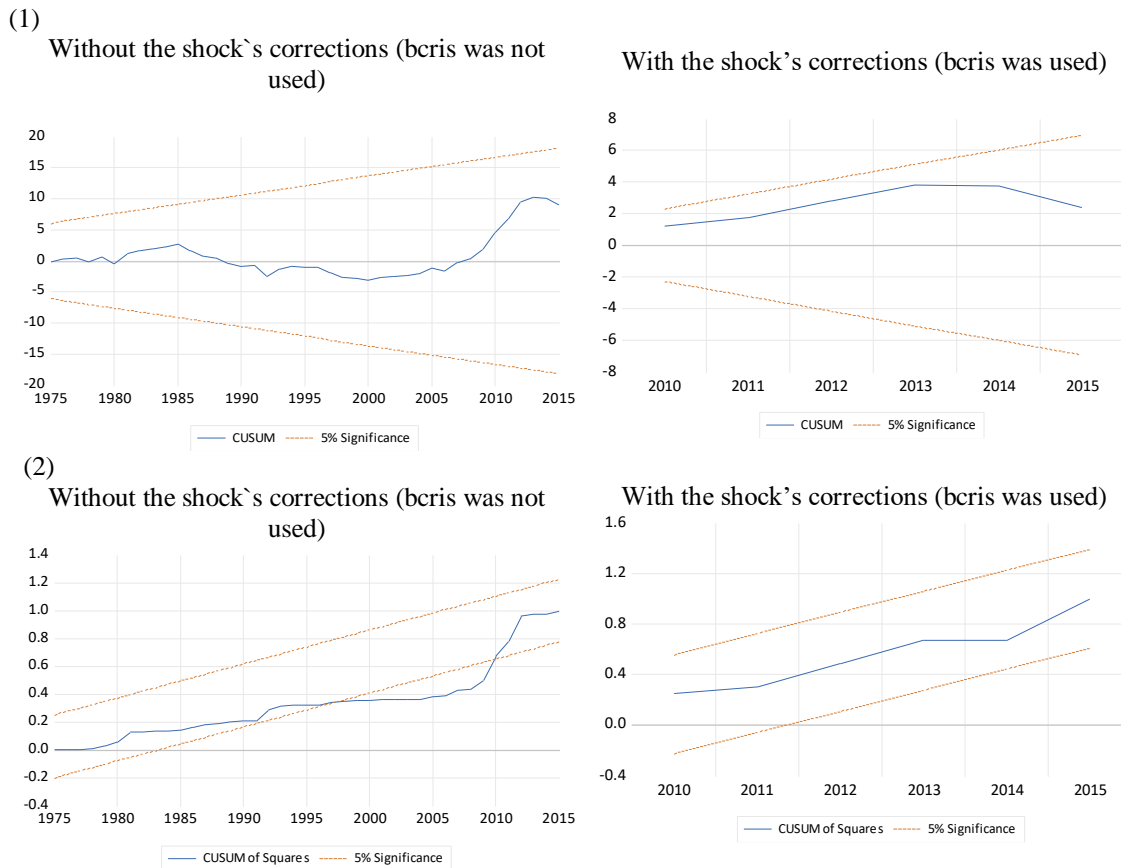


FIGURE 5 – CUSUM (1) and CUSUM of Squares (2)

The graphical analysis shows that the model is stable over time, however, the shock caused possibly by the contagion of the Subprime crisis generated the greatest exogenous impact on the model. In fact, the 2008 crisis was one of the biggest financial crises in the world. This result was expected because the residuals in the equation signaled its existence and therefore, after the correction of the shocks, it is seen that the series returns to the normality zone without transgressing the test boundary.

Furthermore, although in the applied methodology being endogenous or exogenous is not a problem, according to economic theory this issue was verified, and it was concluded that the model is not endogenous. Thus, Figure A.VIII (in the appendices) shows the result of the Exogeneity Blocks. After analyzing the figure, it can be stated that

the model is exogenous. Public debt and trade variables are the only endogenous parameters. The Exogeneity Blocks are analyzed in the "All" line, where the probability of  $\chi^2$  is presented. The null hypothesis of the test is that the variable is exogenous and, therefore, in the output presented, the variables dlcredit, bcris and dgov\_bonds will be exogenous, since H0 is not rejected for each of them (Fuinhas et al., 2019). Furthermore, it can be stated that endogeneity is always present in the models, even because the variables have correlations, as it was possible to verify previously with the results of the Correlation Matrix and the VIF tests, which indicates the presence of this phenomenon. However, not enough to call into question the models' validity.

It is possible to affirm that, according to the data, the chosen econometric model is robust and the estimation presented here meets all the statistical requirements to be considered adequate.

#### 4.1. Discussion of the results

Regarding our main result, it was already expected according to the literature (e.g., Reinhart and Rogoff, 2009; Furceri and Zdzienicka, 2012) that we would find a positive impacting result between these two variables, that is, banking crises significantly influencing the public debt of the countries affected by them. In this research, we confirmed that fact for Portugal within our time span, that is, banking crises are followed by a short-term increase in the ratio of gross government debt to GDP.

In the other studies related to this topic mentioned before, Reinhart and Rogoff (2009), who studied a panel of developed and developing economies from 1800 to 2008, found that on average real government debt increased by 86 percent during the 3 years following a banking crisis. And for this they used only a descriptive analysis. As for the study by Furceri and Zdzienicka (2012), their analyzes comprises not only the short run, i.e. one or two years later, but also the medium run which they consider to be eight years later. For this, these authors estimated impulse response functions directly from local projections. The major finding of this study was that “banking crises are associated with a significant and long-lasting increase in government debt-to-GDP ratio”. In particular for severe crises, they found that the government debt-to-GDP ratio increased by 37 percentage points in the medium-term after a banking crisis. Thus, it is highlighted that the result found for our case study corroborates with the results of these two articles (Reinhart and Rogoff, 2009; Furceri and Zdzienicka, 2012). However, any result is alarming and should especially alert decision makers to better and more effective implementation of change.

Currently, as a comparison with banking crises, we can use this pandemic crisis that has plagued us. Naturally different in terms of origin and in what they represent, but roughly speaking, the way they are fought and the serious economic consequences they have for the economy turn out to be similar. Once again governments have to intervene for the economy to recover, and the recourse is almost always the same: borrowing from the IMF or the ECB, usually through partnerships with EU institutions to get more favorable conditions. As a result, public debt increases. According to the IMF study (2014), to tackle the negative effects of banking crises, governments have to directly support the banking system by implementing measures such as bank recapitalizations, asset purchases, calls on government guarantees, payments to depositors, among others.



These measures along with the external loans contribute to a huge legacy of these crises, but as one would imagine it is a common feature of all crises. In the future, it may mean increased taxes, career freezes, and on a more macro level, decreased production, increased unemployment and augmented public debt which in more severe cases can jeopardize the government's debt service and consequently lead the country into default. To avoid this, preventive measures should be applied, such as more and better regulation and supervision of the banking system, be more attentive to the negative signs of both the economic cycle and the banks themselves, such as growing NPL's or bank runs, and when it is not possible to avoid a banking crisis, acting fast to try to mitigate the damage and prevent it from lasting for a long time, and ensure that the loans are used in a transparent and sustainable way.

It is commonly known that the effects of credit can be diverse in an Economy. The results of our estimation show that, *ceteris paribus*, public debt declines when credit rise. Our results suggest that credit was one of the economic variables that most impacted the Portuguese public debt in the period under analysis. This result does not corroborate the IMF (2014) findings for the case of Advanced Markets, where a positive relationship was found. However, according to more general studies that do not relate credit directly to debt but to the economy in general, such as Arcand et al. (2015), Kindleberger (1978) and Calomiris et al. (2014), the result is not consensual. It is contradictory, assuming that reducing public debt to GDP it is considered a positive sign for the economy, with Kindleberger (1978) who considers that more credit is a negative sign for economic variables. To some extent, when credit as a percentage of GDP is less than 100%, it is in line with what Arcand et al. (2015) argued, a positive relationship with the economy. And finally, it will be in agreement with Calomiris et al. (2014), in the sense of a positive relationship between credit and the economy, since they stated that too little credit in the economy is also problematic. In short, it is possible to infer that credit to the private sector, within controlled limits, whether to buy consumption goods and services or investment goods, leads to higher aggregate demand, which in turn leads to higher output and lower unemployment. In principle, and holding everything else constant, public debt tends to at least no increase since budget balances will be more balanced.

In what concerns the interest rate of government bonds, the results show in our case study that, *ceteris paribus*, a rise in this variable corresponds to a growth in our dependent variable, the public debt as a percentage of GDP. In a simple analysis, if the

interest rates on government bonds is how much the country, in this case Portugal, will have to pay on coupon payments to its investors, the higher the interest rate, the higher the debt the government will have to pay. Moreover, the regression results seem to be in line with what actually occurred in Portugal during the period under analysis. We are referring to the time after the Subprime crisis emerged in the country and triggered the debt crisis suffered also by other southern European governments. The process unfolded as follows, the Great Recession (GR) led to the collapse of tax revenues which in turn led to increases in deficit and debt. Realizing this, investors began to predict that Portugal would not be able to meet its obligations to them. As a result, there was a massive sell-off of these bonds, which lowered their price in the secondary market (the stock and bond market) and consequently raised interest rates on government bonds in the secondary market, leading in turn to predicted increases in interest rates in the primary market, where the government first issues its bonds. Such a situation led to predicted increases in interest payments and thus predicted increases in the budget deficit and, as a result, predicted an acceleration in the increase in government debt, which in fact occurred. This vicious spiral was called by Grauwe as the "death spiral".

In what concern our last independent variable, trade openness as a percentage of GDP is showing negative impact on public debt. This means that when this variable increases, the public debt decreases. Thus, the result for this variable is in line with the IMF (2014) result for the Advanced Market group, which in our understanding is a positive indicator to Portugal's economy. Also, this is in line with the result that Combes and Saadi-Sedik (2006) found in their analysis of the impact of trade openness on the budget balance. The authors stated that trade openness would strengthen the budget balance if the trade policies developed by the decision makers are well implemented. As one would expect, if budget balances are well adjusted, or even if there is a surplus, public debt is expected not to increase or even decrease, all else being constant. One way to achieve this would be for the European Central Bank to lower interest rates on both deposits and treasury bills and bonds. This would cause International Financial Investments (IFIs) to shift from, for example, Eurozone deposits, treasury bills and bonds to US securities. They would sell the eurozone bonds and use the euro to buy dollars, pounds or yen, so there would be an excess supply of euros, with their devaluation. In other words, export prices would fall, increasing exports, and conversely, import prices would rise and therefore imports would fall. All in all, trade openness would be better,

which would provide, higher aggregate demand, higher output and lower unemployment and, in principle, public debt.

## 5. CONCLUSION

Banking crises are devastating events which can jeopardize the normal functioning of the banking system and lead to its paralysis, depending on the degree of severity, causing serious disruptions throughout the economy. This relevance of the banking sector combined with the strong impact it has on all economic agents and on the economy led us firstly to study this topic in more detail.

The effect of the last major banking crisis, the Subprime crisis, which started in the US, has left its mark on almost the entire world. Several economies were affected and showed a worsening of public debt in a short period of time. This dissertation has two objectives, the first was to make a review of the banking crisis literature; the second was to quantify the impact of banking crises on Portuguese public debt. To do so, we revisited the subject and, developed an econometric study using an OLS regression model with a time span between 1970 to 2015 (annual data).

Given the objectives of this dissertation, it is important to draw its main conclusions. Regarding the literature review, we point out that financial institutions, especially banks, play a relevant role in the economy as they promote liquidity services, risk sharing and solve information problems (Mishkin, 2006). Because a financial institution is based on the assumption of trust and is extremely vulnerable to changes in agents' expectations, if its health deteriorates to the point of collapse, fear can spread to several banks, creating a panic situation and dragging along healthy and solvent institutions (Amaral, 2008). This can lead to systemic banking crises, which are extremely disruptive incidents that lead to prolonged reductions in economic activity, financial intermediation and, in the end, welfare (Laeven and Valencia, 2020). Therefore, they have a significant impact, especially on output (Friedman and Schwartz, 1963) and public debt (e.g., Reinhart and Rogoff, 2009; Furceri and Zdzienicka, 2012). On public debt because these events negatively impact government finances via direct and indirect channels (IMF, 2014). The combination of these dynamics, increasing expenditures and declining revenues, leads government to take on public debt, which can be an attractive alternative in the short run (Saylor and Wheeler, 2017). It is inferred that in the long term, since countries will not only have to reimburse investors, either with the coupon payments and at maturity with the face value of the bond, but also, at least for countries belonging to

the European Union, must comply with the limits of the Maastricht Treaty, this alternative can be considered very challenging and difficult to reach, impacting debt sustainability.

Focusing on the regression results, we concluded that for the time horizon established, the model variables had the following impact on the Portuguese public debt:

- Banking crises significantly impacted positively public debt as a percentage of GDP;
- Credit also had a strong impact on the independent variable, i.e., when credit increased the debt in percentage of GDP decreased;
- Government bonds` interest rates had a positive impact on public debt; and
- Trade openness negatively influenced the public debt.

In addition, we captured the presence of 3 shocks in the Portuguese economy of statistical significance (significant at 1%). We used dummies variables to control for the shocks because there was justification in the Portuguese economic literature for the existence of shocks in those periods. It should also be noted that in addition to the variables presented in the regression, we tested tax revenues as a percentage of GDP and the current account balance for Portugal. However, the results obtained were not statistically significant. The econometrics was verified with post-estimation tests that confirmed that the model is correctly specified, i.e., the model is robust in explaining the selected variables, is homoscedastic, shows no serial correlation, respects normality and the regression data follow a normal distribution.

As main proposals to combat the impact caused by banking crises, which was our focus in this research, we highlight measures that allow a more effective regulation at the level of the banking sector and that give warnings when some indicators such as the excessive growth of NPL's, bank runs or credit growth in an uncontrolled way, happen. In addition, it is inferred that it is important to act quickly to try to mitigate the damage and prevent it from lasting for a long time, and to ensure that the mechanisms that allow for the rehabilitation of the banking system, such as loans, are used in the most sustainable way possible, because they leave a heavy legacy in terms of public finances.

Like all research, this one also had its limitations, among them, the time horizon of the econometric study. In time series analysis, the longer the period, the more robust are the results, so extending the time horizon into the future is an important task. Another point as a suggestion for future research is that it would be interesting to study the effects of banking crises in the medium and long term as well. Also, propose to include the

variables we tested, tax revenues as a percentage of GDP and the current account balance, since they can have significant impacts on public debt. Finally, it is suggested to analyze the effects of the Subprime crisis in other southern European countries and compare the intensity of the results of these countries with the ones found for Portugal.

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## APPENDICES

Table A.I: Descriptions and Sources

Variables	Database	Site	Units	Time span	Definitions
pub_dbt	IMF	<a href="https://data.imf.org/">https://data.imf.org/</a>	annual %. Percent of GDP	1960-2015	The general government sector consists of all government units and all nonmarket nonprofit institutions that are controlled and mainly financed by government units, comprising the central, state, and local governments. The general government sector does not include public corporations or quasi-corporations.
gov_bonds	IMF	<a href="https://data.imf.org/regular.aspx?key=62808837">https://data.imf.org/regular.aspx?key=62808837</a>	annual %	1960-2017	Interest rate of Government Bonds.
Bcris	World Bank	<a href="https://databank.worldbank.org/">https://databank.worldbank.org/</a>	absolute number	1970-2017	1=banking crisis, 0=none
tr_open	World Bank	<a href="https://databank.worldbank.org/">https://databank.worldbank.org/</a>	annual %; Percent of GDP	1970-2020	Trade is the sum of exports and imports of goods and services measured as a share of gross domestic product.
credit	BIS	<a href="https://www.bis.org/statistics/totcredit.htm?m=6%7C380%7C669">https://www.bis.org/statistics/totcredit.htm?m=6%7C380%7C669</a>	Percent of GDP	1960-2020	Credit from All sectors to Private non-financial sector

Note: Due to the lack of data for 1975 regarding gov\_bonds, the average was calculated with the 1974 figures and 1976.

Table A.II: VIF without the inclusion of the bcris parameter

In level				In First Difference:			
Variable	Coefficient	Uncentered	Centered	Variable	Coefficient	Uncentered	Centered
	Variance	VIF	VIF		Variance	VIF	VIF
Constant	43097.04	9019.98	NA	Constant	0.5582	1.4023	NA
Lcredit	53.839	10433.58	4.116	DLcredit	81.445	1.3887	1.017
Gov_bonds	0.2486	6.3866	1.502	Dgov_bonds	0.1208	1.057	1.056
Tr_open	0.1459	112.546	3.263	Dtr_open	0.0238	1.095	1.054
	Mean Centered VIF		2.961		Mean Centered VIF		1.042

Note: "D" denotes first difference and "L" denotes natural logarithm.

Table A.III: Ramsey RESET Test without the shock's corrections

	Value	Df	Probability
t-statistic	0.794713	39	0.4316
F-statistic	0.631569	(1, 39)	0.4316
Likelihood ratio	0.722896	1	0.3952

Null hypothesis: The non-linear combinations of the fitted values collaborate to explain the dependent. variable.

Table A.IV: Heteroskedasticity Test without the shock’s corrections

White			
F-statistic	0.708153	Prob. F(13,31)	0.7413
Obs*R-squared	10.30367	Prob. Chi-Square(13)	0.6689
Scaled explained SS	8.838725	Prob. Chi-Square(13)	0.7850
Arch			
F-statistic	2.075306	Prob. F(1,42)	0.1571
Obs*R-squared	2.071760	Prob. Chi-Square(1)	0.1500
Breusch-Pagan-Godfrey:			
F-statistic	0.352867	Prob. F(4,40)	0.8405
Obs*R-squared	1.533781	Prob. Chi-Square(4)	0.8206
Scaled explained SS	1.315712	Prob. Chi-Square(4)	0.8587

Null hypothesis: Homoscedasticity.

Table A.V: BGSC LM Test without shocks correction (up to 1 lag)

F-statistic	1.567905	Prob. F(1,39)	0.2180
Obs*R-squared	1.739201	Prob. Chi-Square(1)	0.1872

Null hypothesis: No serial correlation at up to 1 lag.

Table A.VI: BGSC LM Test without shocks correction (up to 2 lag)

F-statistic	1.054149	Prob. F(2,38)	0.3585
Obs*R-squared	2.365432	Prob. Chi-Square(2)	0.3064

Null hypothesis: No serial correlation at up to 2 lag.

Table A.VII: BGSC LM Test with shocks correction (up to 2 lag)

F-statistic	0.123550	Prob. F(2,35)	0.8842
Obs*R-squared	0.315472	Prob. Chi-Square(2)	0.8541

Null hypothesis: No serial correlation at up to 2 lag.

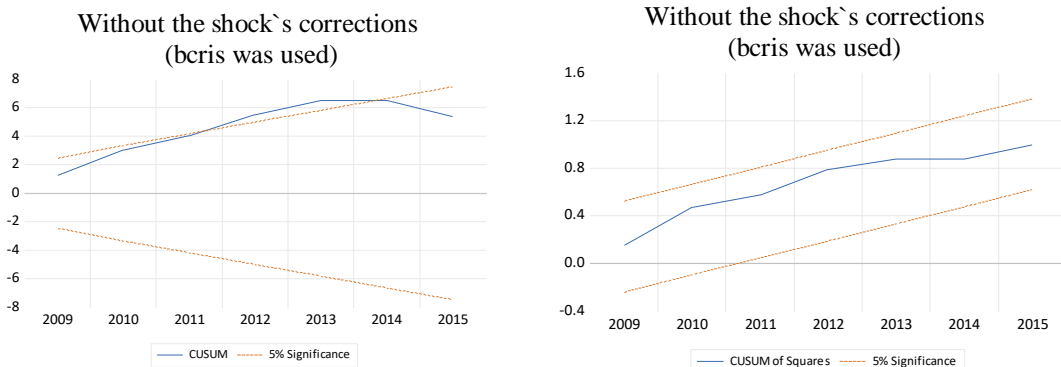


FIGURE 6 – CUSUM and CUSUM of Squares

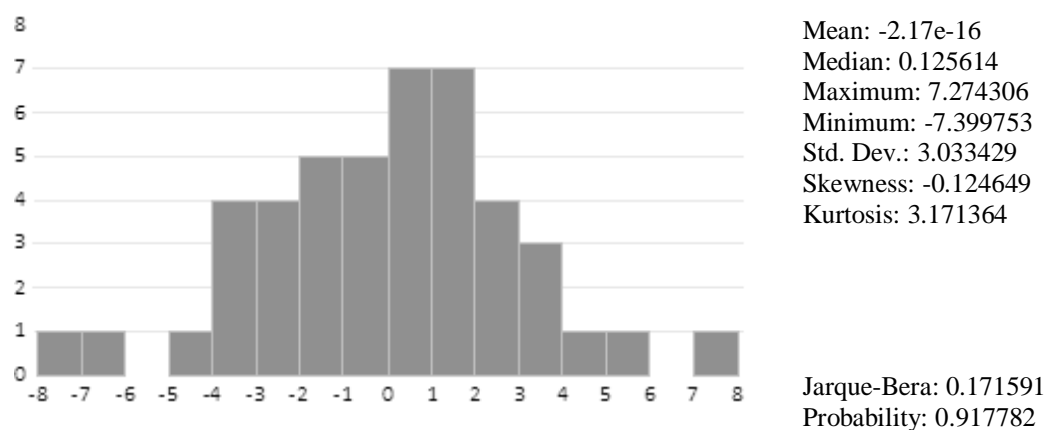


FIGURE 7 - Histogram - Normality Test without shock`s correction

Table A.VIII – VAR Granger Causality/Block Exogeneity Wald Tests

Dependent variable: DLCREDIT			
Excluded	Chi-sq	df	Prob.
DPUB_DBT	3.548124	2	0.1696
DGOV_BONDS	0.860794	2	0.6503
BCRIS	1.024497	2	0.5991
DTR_OPEN	1.193322	2	0.5506
All	7.840839	8	0.4492
Dependent variable BCRIS			
Excluded	Chi-sq	df	Prob.
DLCREDIT	0.168011	2	0.9194
DPUB_DBT	1.759227	2	0.4149
DGOV_BONDS	2.028618	2	0.3627
DTR_OPEN	0.080508	2	0.9605
All	4.173165	8	0.8412
Dependent variable: DGOV_BONDS			
Excluded	Chi-sq	df	Prob.
DLCREDIT	1.811427	2	0.4043
DPUB_DBT	0.498665	2	0.7793
BCRIS	0.079488	2	0.9610
DTR_OPEN	3.830456	2	0.1473
All	6.234502	8	0.6210
Dependent variable: DPUB_DBT			
Excluded	Chi-sq	df	Prob.
DLCREDIT	4.584441	2	0.1010
DGOV_BONDS	11.46087	2	0.0032
BCRIS	11.57972	2	0.0031
DTR_OPEN	0.437689	2	0.8034
All	35.22008	8	0.0000

Dependent variable: DTR\_OPEN

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Excluded	Chi-sq	df	Prob.
DLCREDIT	7.298281	2	0.0260
DPUB_DBT	0.692128	2	0.7075
DGOV_BONDS	1.648871	2	0.4385
BCRIS	6.780667	2	0.0337
All	15.23006	8	0.0548

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